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Inventor(s)	Tang; Xiaobin et al.

Guidance on safety inspection operations of functional component of elevator system

Abstract

An apparatus for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system includes: a wireless signal component connected with the elevator controller of the elevator system and establishing a wireless communication connection with the mobile terminal carried by the maintenance individual to enter the elevator hoistway for maintenance operation by broadcasting wireless signal; the apparatus configured to perform information interaction about the functional component by a wireless communication module of the mobile terminal and the elevator controller, and to provide safety checking guidance information for guiding the maintenance individual to complete the safety checking operation by a safety checking guidance module of the mobile terminal.

Inventors: **Tang; Xiaobin (Tianjin, CN), Xing; Weiwei (Shanghai, CN)**

Applicant: **Otis Elevator Company** (Farmington, CT)

Family ID: **1000008765558**

Assignee: **OTIS ELEVATOR COMPANY (Farmington, CT)**

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Primary Examiner: Carrasquillo; Jorge L

Attorney, Agent or Firm: CANTOR COLBURN LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims priority from Chinese patent application No.202010066623.4, filed on Jan. 20, 2020, the entirety of which is hereby incorporated by reference herein and forms a part of the specification.

FIELD OF THE INVENTION

(2) The invention belongs to the technical field of Elevator and relates to the maintenance of elevators, in particular to an apparatus and method for guiding maintenance individuals to perform safety checking operation on functional components of an elevator system, an elevator system comprising the apparatus, and a computer readable storage medium and a mobile terminal capable of realizing the method.

BACKGROUND OF THE INVENTION

(3) The installation and application of elevator are increasingly widespread in various buildings, and elevator maintenance work is very important for safe operation of elevators and, therefore, there is a corresponding industry standard to specify maintenance operation procedure for various elevators.

(4) Elevator maintenance operations include maintenance operations that require maintenance individual to enter an elevator hoistway, e.g. maintenance operations performed by a maintenance individual on the car roof or at a pit of an elevator hoistway, which are relatively very dangerous. To ensure the safety of the maintenance individual, corresponding safety checking operation procedures (e.g., WWWJSS) are established corresponding to the maintenance operation in the elevator hoistway, maintenance individuals are required to strictly perform the safety checking operation regulated by the safety checking operation procedures manually before performing maintenance operations in the elevator hoistway.

(5) However, manual execution of these safety checking operations relies heavily on operation standardization of maintenance individuals, manual operating levels, etc., which subject to many random factors, being time-consuming and laborious.

SUMMARY OF THE INVENTION

(6) According to a first aspect of the present disclosure, there is provided an apparatus for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising: a wireless signal component connected with an elevator controller of the elevator system and establishing a wireless communication connection with a mobile terminal carried by the maintenance individual to enter an elevator hoistway for maintenance operation by broadcasting a wireless signal: wherein the apparatus is configured to perform an information interaction about the functional component by a wireless communication module of the mobile terminal and the elevator controller, and to provide safety checking guidance information for guiding the maintenance individual to complete the safety checking operation by a safety checking guidance module of the mobile terminal.

(7) The apparatus according to one embodiment of the present disclosure, further comprising: the elevator controller comprising: an information acquisition module for acquiring, in response to a state switching operation on the functional component, first information for determining whether the functional component passes a corresponding safety checking operation in real time; the apparatus is further configured to perform the following actions by the safety checking guidance module of the mobile terminal: generating first safety checking guidance information for guiding the maintenance individual to perform the state switching operation on the functional component, and generating, based on the first information, second safety checking guidance information indicating whether the functional component passes the safety checking operation; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information, the information interaction including an interaction of the first information.

(8) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising: the elevator controller comprising: an information acquisition module for acquiring, in response to a state switching operation on the functional component, first information for determining whether the functional component passes a corresponding safety checking operation in real time; a second safety checking guiding information generation module for generating, based on the first information, second safety checking guiding information indicating whether the functional component passes the safety checking operation; the apparatus is further configured to generate, by a safety checking guidance module of the mobile terminal, first safety checking guidance information for guiding the maintenance individual to perform the state switching operation on the functional component; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information, the information interaction including an interaction of the second safety checking guidance information.

(9) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the elevator controller is configured to, in response to a first instruction transmitted from the mobile terminal, control a car to move to a position suitable for the maintenance individual to enter a pit of the elevator hoistway or to enter a car roof of the car.

(10) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the elevator controller is configured to operate in a hoistway maintenance control mode in response to a second instruction transmitted from the mobile terminal: wherein the elevator controller at least does not respond to a passenger's calling instruction in the hoistway maintenance control mode and can acquire the first information in real time.

(11) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the apparatus is configured to present the safety checking guidance information to the maintenance individual in the form of a sound and/or a user interface by an information presentation module of the mobile terminal.

(12) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising: a safety checking determination sub-module disposed in the elevator controller or the mobile terminal for determining, based on the first information, whether a corresponding functional component passes the safety checking operation, wherein the first information includes a current state of the functional component and position change information corresponding to a car in the current state.

(13) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the apparatus is further configured to: with determining that currently the functional component passes the safety checking operation, further provide safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component using a safety checking guidance module of the mobile terminal based on a predefined safety checking operation procedure, if it is determined.

(14) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the maintenance operation comprises a maintenance operation performed on a car roof of the car, the functional components requiring the safety checking operation correspondingly include a door lock switch, a car roof e-stop switch, and/or a car roof inspection switch; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the car roof e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the car roof inspection switch.

(15) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the maintenance operation comprises a maintenance operation

performed in the pit of the elevator hoistway, the functional components requiring the safety checking operation correspondingly include a door lock switch, an upper e-stop switch disposed at the pit, and/or a lower e-stop switch disposed at the pit; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the upper e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the lower e-stop switch.

(16) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the wireless signal component is a Bluetooth module or a Bluetooth Low Energy module.

(17) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the apparatus is further configured to comprise: an electronic safety control module that automatically completes the state switching operation on the functional component currently under a safety checking in response to the first safety checking guidance information.

(18) The apparatus according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the apparatus further comprises: a wireless communication module of the mobile terminal for establishing the wireless communication connection with the wireless signal component, and performing the information interaction about the function component with the elevator controller; a safety checking guiding module of the mobile terminal for providing safety checking guiding information for guiding the maintenance individual to complete the safety checking operation.

(19) According to a second aspect of the present disclosure, there is provided an elevator system comprising a car and an elevator controller for controlling the car to move in an elevator hoistway, further comprising: an apparatus for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system according to any of the apparatus described above.

(20) According to a third aspect of the present disclosure, there is provided A method for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising the steps of: establishing, by an elevator controller, a communication connection with a mobile terminal carried by the maintenance individual to enter an elevator hoistway for a maintenance operation by means of a wireless signal component in the elevator system; performing an information interaction about the functional component between the mobile terminal and the elevator controller; and providing, by means of the mobile terminal, safety checking guidance information for guiding the maintenance individual to complete the safety checking operation.

(21) The method according to one embodiment of the present disclosure, further comprising the steps of: acquiring, by the elevator controller in real time, first information for determining whether the functional component passes a corresponding safety checking operation in response to a state switching operation on the functional component; the step of providing safety checking guidance information includes the steps of: generating, by means of the mobile terminal, first safety checking guiding information for guiding the maintenance individual to perform the state switching operation on the functional component; and generating, by means of the mobile terminal based on the first information, second safety checking guidance information for determining whether the functional component passes the safety checking operation; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information, the information interaction including an interaction of the first information.

(22) The method according to yet another embodiment or any of the above embodiments of the

present disclosure, further comprising the steps of: acquiring, by the elevator controller in real time, first information for determining whether the functional component passes a corresponding safety checking operation in response to a state switching operation on the functional component; and generating, by the elevator controller based on the first information, second safety checking guidance information indicating whether the functional component passes the safety checking operation; the step of providing safety checking guidance information includes the steps of: generating, by means of the mobile terminal, first safety checking guiding information for guiding the maintenance individual to perform the state switching operation on the functional component; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information, the information interaction including an interaction of the second safety checking guidance information.

(23) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: controlling the car to move to a position suitable for the maintaining individual to enter a pit of the elevator hoistway or to enter a car roof of the car in response to the first instruction transmitted from the mobile terminal.

(24) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising: with determining that currently the functional component passes the safety checking operation, further providing safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component by means of the mobile terminal based on a predefined safety checking operation procedure. The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: automatically completing, by an electronic safety control module, a state switching operation on the functional component currently under a safety checking in response to the first safety checking guidance information.

(25) According to a fourth aspect of the present disclosure, there is provided A method for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising the steps of: establishing a wireless communication connection with a wireless signal component connected with an elevator controller of the elevator system, and performing an information interaction about the functional component with the elevator controller; and providing safety checking guidance information for guiding the maintenance individual to complete the safety checking operation.

(26) The method according to one embodiment of the present disclosure, wherein the step of providing the safety checking guidance information comprises: generating first safety checking guiding information for guiding the maintenance individual to perform the state switching operation on the functional component.

(27) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: receiving first information from the elevator controller for determining whether the functional component passes a corresponding safety checking operation; the step of providing the safety checking guidance information further comprises the steps of: generating, based on the first information, second safety checking guidance information indicating whether the functional component passes the safety checking operation; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information.

(28) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: transmitting a first instruction to the elevator controller, wherein the first instruction is used for triggering the elevator controller to control the car to move to a position suitable for the maintenance individual to enter a pit of the elevator hoistway or to enter a car roof of the car.

(29) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: presenting the safety checking guidance

information in the form of a sound and/or a user interface.
(30) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: transmitting, to the elevator controller, a second instruction to trigger the elevator controller to enter or exit a hoistway maintenance control mode in response to an input of the maintenance individual; wherein the elevator controller at least does not respond to the passenger's calling instruction in a hoistway maintenance control mode and can acquire first information for determining whether the functional component passes a checking of a corresponding safety check in real time.
(31) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: determining whether a corresponding functional component passes a safety checking operation based on the first information, wherein the first information includes a current state of the functional component and position change information corresponding to a car in the current state.
(32) The method according to yet another embodiment or any of the above embodiments of the present disclosure, further comprising the steps of: with determining that the functional component passes the safety checking operation, further providing, based on a predefined safety checking operation procedure, safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component.
(33) The method according to yet another embodiment or any of the above embodiments of the present disclosure, wherein a maintenance operation of the maintenance individual comprises the maintenance operation performed on a car roof of the car, the functional components requiring the safety checking operation correspondingly include a door lock switch, a car roof e-stop switch, and/or a car roof inspection switch; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the car roof e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the car roof inspection switch.
(34) The method according to yet another embodiment or any of the above embodiments of the present disclosure, wherein a maintenance operation of the maintenance individual comprises the maintenance operation performed in a pit of an elevator hoistway, the functional components requiring the safety checking operation correspondingly include a door lock switch, an upper e-stop switch disposed at the pit, and/or a lower e-stop switch disposed at the pit; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the upper e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the lower e-stop switch.
(35) The method according to yet another embodiment or any of the above embodiments of the present disclosure, wherein the established wireless communication connection is a Bluetooth connection or a Bluetooth Low Energy connection.
(36) According to a fifth aspect of the present disclosure, there is provided a computer readable storage medium having stored thereon a computer program, wherein the program is executed by a processor to implement the steps of any of the methods described above for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system.
(37) According to a sixth aspect of the present disclosure, there is provided a mobile terminal for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising a memory, a processor, and a computer program stored on the memory and executable on the processor, wherein when the program is executed by the processor, the steps of any of the methods described above for guiding a maintenance

individual to perform a safety checking operation on a functional component of an elevator system are implemented.
(38) The above features and operations of the present invention will become more apparent from the following description and the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The above and other objects and advantages of the present invention will become more complete and clear from the following detailed description taken in conjunction with the drawings, wherein like or similar elements are designated by like numerals.
(2) FIG. **1** is a schematic diagram of an elevator system according to an embodiment of the present invention.
(3) FIG. **2** is a structural schematic diagram of an apparatus for guiding a maintenance individual to perform a safety checking operation on the functional components of an elevator system according to an embodiment of the present invention.
(4) FIG. **3** is a structural schematic diagram of an apparatus for guiding a maintenance individual to perform a safety checking operation on the functional components of an elevator system according to yet another embodiment of the present disclosure.
(5) FIG. **4** is a schematic diagram of an elevator system according to an embodiment of the present invention.
(6) FIG. **5** is a flowchart of a method for guiding a maintenance individual to perform a safety checking operation on functional components of an elevator system according to an embodiment of the present invention.
(7) FIG. **6** is a flowchart of a method for guiding a maintenance individual to perform a safety checking operation on functional components of an elevator system according to yet another embodiment of the present disclosure.
DETAILED DESCRIPTION OF THE EMBODIMENT(S) OF THE INVENTION
(8) 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. This invention may, however, be implemented in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will become thorough and complete, and the concept of the present invention will be fully conveyed to those skilled in the art.
(9) Some block diagrams shown in the figures are functional entities and do not necessarily have to correspond to physically or logically independent entities. These functional entities may be implemented in the form of software or in one or more hardware modules or integrated circuits, or these functional entities may be implemented in different processing apparatus and/or microcontroller apparatus.
(10) In the following, maintenance operations on an elevator system may include the maintenance operations such as the corresponding inspection, the specific contents and/or items of maintenance operations are not limiting, which may vary depending on the specific operation objects. The primary purpose of the corresponding safety checking operation of entering the elevator hoistway to perform maintenance operation is to ensure the safety of maintenance individuals to enter the elevator hoistway, the object of the check operation, i.e., the corresponding functional components, may vary according to changes in the maintenance operation, which may be determined according to the corresponding safety checking operation procedure. The maintenance individual may be the corresponding maintenance operation body, which may be a person, even a robot, or the like.
(11) FIG. **1** shows a schematic diagram of an elevator system according to an embodiment of the

present invention: FIG. **2** shows a structural schematic diagram of an apparatus for guiding a maintenance individual to perform a safety checking operation on the functional components of an elevator system according to an embodiment of the present invention, wherein a module structure schematic diagram of a mobile terminal of an embodiment and an elevator controller of an embodiment of the present invention is shown: FIG. **3** shows a structural schematic diagram of an apparatus for guiding a maintenance individual to perform a safety checking operation on the functional components of an elevator system according to yet another embodiment of the present disclosure, wherein a module structure schematic diagram of a mobile terminal of yet another embodiment and an elevator controller of yet another embodiment of the present invention is shown.

(12) As shown in FIG. **1**, an elevator system **10** of an embodiment of the present invention may be installed in various buildings, the elevator system **10** comprises a plurality of one or more cars **130** traveling up and down in an elevator hoistway **120** of a building, one of which is schematically illustrated in FIG. **1**: each car **130** is under control (e.g., scheduling control, travelling control, etc.) of an elevator controller **110** in the elevator system **10**, traveling in the elevator hoistway **120** or to stop at a landing of a corresponding floor (e.g., floor n, where n is an integer greater than or equal to 2). In general, the elevator controller **110** may receive a call request command from the landing of each floor, performing operation control (e.g., scheduling control of each car **130**) of the elevator based on the command. It will be understood that the specific control manner or control principle of the one or more cars **130** by the elevator controller **110** is not limiting.

(13) The elevator system **10** may also comprise (landing) door lock switches **160** disposed at the landings of each floor, e.g. a door lock switch **160***n*−1 corresponding to floor (n−1), a door lock switch **160***n* corresponding to floor n, a door lock switch **160***n*+1 corresponding to floor (n+1); in the normal operating state, where the landing door is manually opened by a landing door lock key handling the door lock switch **160**, the elevator controller **110** may determine the current state of the door lock switch **160** and control the car **130** to move in the elevator hoistway **120** not in response to the call request of the landing.

(14) The elevator system **10** may also comprise a wireless signal component **150**, which may be a plurality of, specifically, Bluetooth modules that may be capable of broadcasting Bluetooth signals, and may even be modules of Bluetooth Low Energy (BLE); the wireless signal component **150** may be connected to the elevator controller **110** in a wired or wireless manner, thereby the wireless signals broadcast therethrough may establish a wireless communication connection with the mobile terminal **200**, the elevator controller **110** in turn may also establish a connection with the mobile terminal **200**, information interaction between the elevator controller **110** and the mobile terminal **200** (the specific content of which will be illustrated in examples below) may be realized.

(15) It will be understood that the specific type of the wireless signal component **150** is not limited to the above embodiments, but may also include other wireless beacons that may be used to enable near field wireless communication between the wireless signal component **150** and the mobile terminal **200**.

(16) The wireless signal component **150** may be specifically a BLE installed in a car **130**, in this embodiment, a passenger carrying a personal mobile terminal in the car **130** may establish a wireless communication connection with that wireless signal component **150** and automatically issue a command of registering the destination floor; of course, in this embodiment, the wireless signal component **150** may also be installed in the landing area of each floor (not shown), and a passenger carrying the personal mobile terminal in the landing area may establish a wireless communication connection with that wireless signal component **150** and automatically issue a call request command. In other embodiments, the wireless signal component **150** may also be, for example, a BLE arranged in the elevator hoistway **120** for forming a Bluetooth MESH network. It will be understood that the wireless signal component **150** is in the elevator system **10** and is limited to establishing a wireless communication connection with and interacting with the mobile

terminal **200** of an embodiment of the present invention, the wireless signal component **150** may also have other functions, e.g. for implementing an automatic call function.

(17) The elevator system **10** of the embodiment shown in FIG. **1** may use an apparatus (hereinafter simply referred to as a "guiding apparatus") **20** or **30** for guiding a maintenance individual to perform a safety checking operation on the functional components of the elevator system, as shown in the embodiments of FIG. **2** or FIG. **3**, thereby the safety checking operation is relatively easy to perform, moreover, it is easy to ensure that the maintenance individual **90** completes the safety checking operation accurately, improving the safety checking operation experience of the individual **90** while ensuring the safety of the maintenance individual **90** entering the elevator hoistway to perform the maintenance operation, avoiding the occurrence of casualty accidents. Partial function of the guiding apparatus **20** or **30** may be implemented by means of the mobile terminal **200** carried by the maintenance individual **90**, which in one embodiment may serve as one component of the guiding apparatus **20** or **30**, even as one component of the elevator system **10**.

(18) The guiding apparatus **20**, the mobile terminal **200**, and the elevator controller **110** of one embodiment of the present invention are illustrated in example below in conjunction with FIGS. **1** and **2**.

(19) Wherein, the mobile terminal **200** may specifically be various smart terminals having, for example, Bluetooth connection function, and is convenient for the maintenance individual **90** to carry, for example, the mobile terminal **200** may be a smart phone, a wearable smart device (e.g., smart bracelet, etc.), personal digital assistant (PAD), and the like, on which corresponding application components (e.g., APP components) may be installed to implement the corresponding functions described in the embodiments of the present invention. The mobile terminal **200** may be carried by a maintenance individual **90** to enter the elevator hoistway to perform a maintenance operation and is used for guiding the maintenance individual **90** to complete the safety checking operation on the corresponding functional components of the elevator system **10**, and the mobile terminal **200** may guide the maintenance individual **90** step by step to sequentially complete the safety checking operation on the plurality of functional components when the number of the functional components requiring safety checking is more than one.

(20) As shown in FIG. **2**, the mobile terminal **200** may specifically be provided with a wireless communication module **210** (e.g. a BLE) that establishes a wireless communication connection with the wireless signal component **150**, specifically, that establishes a near field communication connection based on a corresponding communication procedure, e.g., after sensing a wireless signal broadcast by the wireless signal component **150**, such that the mobile terminal **200** may establish a connection with the elevator controller **110** and perform information interaction about the functional components under the safety checking.

(21) In an embodiment, a car movement control module **220** may also be provided in the mobile terminal **200** for transmitting a first instruction to the elevator controller **110** via the wireless communication module **150**, which is used to trigger the elevator controller **110** to control the car to move to a position suitable for a maintenance individual to entering the pit of the elevator hoistway **120** or the car roof of the car **130**; when the elevator controller **110** receives that first instruction, it may control the corresponding hoisting apparatus to drive car **130** to move to that position. When, for example, a maintenance operation is to be performed on car roof of the car **130**, the position may be a position where the car roof of the car **130** is substantially flush with the floor of a landing (e.g., the landing of the floor n as shown in FIG. **1**) at which the maintenance individual **90** is currently located. It will be understood that this position may be preset or predefined in the elevator controller **110** that controls the car **130** to travel to that position in response to the first instruction. In this way, the car **130** can accurately travel to a proper position; and the introduction of the car movement control module **220** may make the operation simple and convenient compared to the existing condition in which a complex manual operation of the maintenance individual **90** to control the car **130** to travel to the proper position is required.

(22) In an embodiment, the mobile terminal **200** may also be provided with a hoistway maintenance control mode trigger module **230** for transmitting a second instruction to the elevator controller **110** for triggering the elevator controller **110** to enter or exit the hoistway maintenance control mode in response to an input of the maintenance individual **90** (e.g., selecting to enter the "hoistway maintenance control mode" in an APP component of the mobile terminal **200**).
(23) The elevator controller **110** may also be predefined with a "hoistway maintenance control mode": the elevator controller **110**, upon receiving the second instruction, may be triggered to exit, for example, the current "normal operation control mode" and enter the "hoistway maintenance control mode". The scheduling control of the car **130** under the "hoistway maintenance control mode" is different from the scheduling control of the car **130** under the normal operation control mode, the elevator controller **110** at least does not respond to the passenger's call instruction (e.g., call instruction from the landing) under the hoistway maintenance control mode and can acquire first information for determining whether the corresponding functional component passes the checking of the corresponding safety checking in real time, the first information may include the current state (e.g., states of "open", "close", etc.) of the corresponding functional components and the position change information corresponding to the car in the current state, it will be understood that as the functional components vary, the content of the current state information of the corresponding functional components acquired correspondingly is different. Under the "hoistway maintenance control mode", the movement speed of the car **130** is limited (being less than or equal to a predetermined value) so that only low speed travelling is possible, further reducing the risk of the maintenance individual **90**.
(24) It is noted that a plurality of sub-modes may be provided in the "hoistway maintenance control mode", which respectively correspond to different maintenance operations in the hoistway, for example, "car roof maintenance control sub-mode", "pit maintenance control sub-mode", and the maintenance individual **90** may select a corresponding sub-mode in the hoistway maintenance control mode trigger module **230** according to a maintenance operation to be performed currently, thereby triggering the generation of a corresponding second instruction in response to which the elevator controller **110** may switch into a corresponding sub-mode.
(25) It should be noted that, in one embodiment, the car movement control module **220** may be implemented being integrated in the hoistway maintenance control mode trigger module **230**; when the elevator controller **110** receives the abovementioned second instruction, it indicates that the car movement control module **220** also receives the abovementioned second instruction, the module **220** automatically controls the car **130** to move to a position suitable for a maintenance individual to enter the car roof of car **130** or the pit of the elevator hoistway **120** respectively when switching into the "car roof maintenance control sub-mode" or the "pit maintenance control sub-mode", automatically preparing for the next safety checking operation.
(26) Continuing with FIG. **2**, a safety checking guidance module **240** and an information presentation module **260** are also provided in the mobile terminal **200**, wherein the safety checking guidance module **240** provides safety checking guidance information for guiding maintenance individuals to complete safety checking operations, the information presentation module **260** may present safety checking guidance information to the maintenance individuals **90** in the form of voice and/or user interface (UI), thereby conveniently guiding the maintenance individual **90** to perform safety checking operations on each functional component. It will be understood that the specific presentation manner of the safety checking guidance information is not limiting, and it is pre-editable.
(27) In one embodiment, the safety checking guidance module **240** has a first safety checking guidance information generation module **241** and a second safety checking guidance information generation module **242** therein that primarily generate safety checking guidance information provided by the safety checking guidance module **240**, i.e., the first safety checking guidance information and the second safety checking guidance information. It will be understood that the

contents of the safety checking guidance information provided by the safety checking guidance module **240** are not limited to being generated in whole or in part by itself.

(28) Wherein the first safety checking guidance information generation module **241** may generate first safety checking guidance information for guiding the maintenance individual **90** to perform state switching operations on the functional components: illustratively, the first safety checking guidance information may be presented by the information presentation module **260** to prompt the maintenance individual **90** for a corresponding state switching operation, for example, opening a door lock switch, pressing the car roof e-stop switch to a “stopping” state, pressing the car roof inspection switch to a “inspection” state, or the like. The first safety checking guidance information generation module **241** may be set with reference to a predefined safety checking operation procedure such that the first safety checking guidance information generated and the corresponding state switching operation conform to the corresponding safety checking operation procedure.

(29) Wherein the second safety checking guidance information generation module **242** may generate, based on the first information, second safety checking guidance information that indicates whether the corresponding functional component passes the safety checking operation, wherein the first information refers to information used to determine whether the functional component passes the corresponding safety checking operation, which may be obtained, at least in part, by the information acquisition module **111** in the elevator controller **110**. In an embodiment, the first information may include the current state of the functional component, and may further include position change information corresponding to the car in the current state.

(30) Take the functional components as the car roof e-stop switch for example, the elevator controller **110** can acquire or extract the state information of the car roof e-stop switch (e.g. acquire the state information indicating a “stopping” state) in real time when guiding the maintenance individual **90** to perform a safety checking operation on the e-stop switch, by comparing with the previous state information, it may be determined that the maintenance individual **90** or the like has performed state switching operation on the car roof e-stop switch, while the elevator controller **110** also acquires the position change information of the car **130** in the current “stopping” state (assuming that the maintenance individual **90** presses the call button of the landing under the guidance of the first safety checking guidance information), and if the acquired position change information indicates that the position of the car **130** does not change, then the triggering function corresponding to the car roof e-stop switch in the “stopping” state may be safely and reliably performed, the second safety checking guidance information generation module **242** may generate the second safety checking guiding information indicating that the car roof e-stop switch has passed the safety checking operation, and based on the presented second safety checking guiding information, the maintenance individual **90** can be successfully guided to complete the safety checking operation on the car roof e-stop switch.

(31) Note that in other embodiments, the position change information corresponding to the car **130** in the current state may not be acquired by the elevator controller **110**, for example, it may be determined manually whether the car **130** has moved, specifically the position change information may be input by prompting the maintenance individual **130** to click “it is determined that the car has not moved”.

(32) In an embodiment, a safety checking determination sub-module **2421** may also be provided in the second safety checking guidance information generation module **242**, that safety checking determination sub-module **2421** is used to determine whether the corresponding functional component passes the safety checking operation based on the first information, e.g., determining whether that functional component is normally triggered to perform a corresponding function based on the current state of the functional component and the position change information corresponding to the car in the current state, thereby determining whether that functional component passes the safety checking operation. The second safety checking guidance information generation module **242** further generate the second safety checking guidance information indicating whether the

corresponding functional component passes the safety checking operation based on the determination. It should be understood that the determination process performed by the second safety checking guidance information generation module **242** may be done completely automatically, and thus some manual operations of the maintenance individual **90** may be omitted, and the input errors of the maintenance individual **90** and the subjective laziness of the maintenance individual **90** may be avoided, and it is also advantageous for monitoring the safety checking operations of the maintenance individual **90**.

(33) It is noted that, for different safety checking operations, the functional components requiring safety checking operations are different, the corresponding safety checking operation procedure to be followed are not the same so that the safety checking guidance information provided by the safety checking guidance module **240** is, of course, not the same.

(34) Illustratively, when the maintenance operation is correspondingly a maintenance operation performed on the car roof of the car **130**, the functional components requiring the safety checking operation correspondingly includes a door lock switch **160** of a certain floor, a car roof e-stop switch **141**, and a car roof inspection switch **142** as shown in FIG. **1**: accordingly, the safety checking guidance information provided by the safety checking guidance module **240** includes: information for guiding the maintenance individual **90** to complete a safety checking operation for the door lock switch **160**, information for guiding the maintenance individual **90** to complete the safety checking operation for the car roof e-stop switch **141** and information for guiding the maintenance individual **90** to complete a safety checking operation for the car roof inspection switch **142**: the sequential presentation of these safety checking guidance information may guide the maintenance individual **90** to sequentially complete the safety checking or safety verification of the door lock switch **160**, the car roof e-stop switch **141**, the car roof inspection switch **142**, thereby completing a safety checking operation before the maintenance individual **90** entering the car roof of the car **130**.

(35) In yet another example, when the maintenance operation is correspondingly a maintenance operation performed in the pit of the elevator hoistway **120**, the functional components requiring the safety checking operation correspondingly includes a door lock switch **160** of a certain floor, an upper e-stop switch disposed at the pit, and a lower e-stop switch disposed at the pit: accordingly, the safety checking guidance information provided by the safety checking guidance module **240** includes: information for guiding the maintenance individual **90** to complete the safety checking operation for the door lock switch **160**, information for guiding the maintenance individual **90** to complete the safety checking operation for the upper e-stop switch and information for guiding the maintenance individual **90** to complete the safety checking operation for the lower e-stop switch. The sequential presentation of these safety checking guidance information may guide the maintenance individual **90** to sequentially complete safety checking or safety verification of the door lock switch **160**, the upper e-stop switch, the lower e-stop switch, thereby completing the safety checking operation before the maintenance individual **90** entering the pit.

(36) When the number of functional components requiring safety checking is more than one, the safety checking guidance module **240** may further provide safety checking guidance information for guiding the maintenance individual **90** to complete the safety checking operation of the next functional component based on a predefined safety checking operation procedure with determining that a certain functional component passes the safety checking, so that the maintenance individual **90** may be guided to sequentially complete the safety checking operation on the plurality of functional components in a distributed manner, therefore the safety checking operation is complete and good in continuity.

(37) Continuing with as shown in FIG. **2**, an information transmission module **113** may also be provided in the elevator controller **110**, which actively transmits the abovementioned first information acquired in the “hoistway maintenance control mode” for example, certainly other information acquired may be transmit as well: the information transmitted by the transmission

module **113** may be transmitted to the wireless signal component **150** in either wired or wireless manner, and in turn transmitted to the wireless communication module **210** of the mobile terminal **200** in a wireless manner through the wireless signal component **150**; in this way, the mobile terminal **200** and the elevator controller **110** may realize information interaction conveniently. The specific contents of the information interaction include, but not limited to, the first information, the first instruction, the second instruction and the like described above.

(38) As shown in FIG. **3**, the guiding apparatus **30** may also be applied in the elevator system **10**, which completes the safety checking operation on the corresponding functional components of the elevator system **10** by the mobile terminal **200**′ carried by the maintenance individual **90**. In contrast to the guiding apparatus **20** shown in FIG. **2**, the primary difference is that the mobile terminal **200**′ may not perform the function of generating the second safety checking guidance information, but instead performs the function of generating the second safety checking guidance information by the elevator controller **110**′: specifically and correspondingly, by disposing in the elevator controller **110**′ of the embodiment shown in FIG. **3** the second safety checking guidance information generation module **242** and the safety checking determination sub-module **2421** in the mobile terminal **200** of the embodiment shown in FIG. **2**, the mobile terminal **200**′ of the corresponding embodiment is formed as well. In addition to the second safety checking guidance information generation module **242** and the safety checking determination sub-module **2421**, the mobile terminal **200**′ is basically provided with other modules in the mobile terminal **200** in the embodiment shown in FIG. **2**, the description of which is omitted here: the elevator controller **110**′ is also provided with an information acquisition module **111** and a transmission module **113**, the description of which is omitted here as well.

(39) In the guiding apparatus **30** of the embodiment shown in FIG. **3**, the second safety checking guiding information generated by the second safety checking guiding information generation module **242** of the elevator controller **110**′ may be transmitted to the corresponding mobile terminal **200**′ by the wireless signal component **150** so that the safety checking guiding module **240** of the mobile terminal **200**′ may also provide the second safety checking guiding information, and present the second safety checking guidance information by the information presentation module **260**.

(40) The mobile terminal **200** or **200**′, the guiding apparatus **20** or **30** of the above embodiments may guide the maintenance individual **90** to complete the safety checking operation, which may effectively prevent the maintaining individual **90** from using a inspection switch or the like to control the car to move prior to completing the safety checking operation, ensuring the safety of the maintenance individual **90**; in addition, the maintenance individual **90** may be effectively guided to perform safety checking operation, for example, according to the safety checking operation procedure, avoiding wrong operations and substandard of operation, thereby greatly improving the maintenance experience of the maintenance individual and effectively guaranteeing the safety of the next maintenance operation: moreover, the mobile terminal **200** or **200**′, the guiding apparatus **20** or **30** of the above embodiments may even reduce some manual operation with subjective factors, thereby taking the place of the maintenance individual to perform part of the safety maintenance operation, thus greatly improving the efficiency of the safety checking operation.

(41) In an elevator system **40** of yet another embodiment, as shown in FIG. **4**, the maintenance individual **90** may even be replaced by an electronic safety control module (e.g., PESSRAL, Programmable Electronic Systems in Safety Related Applications for Lifts) **170** to automatically or remotely complete the state switching operation on the functional components currently under safety checking without the need of the maintenance individual **90**, greatly improving the safety checking operation experience and improving the efficiency of the safety checking operation.

(42) As shown in FIG. **4**, compared to the elevator system **10** shown in FIG. **1**, the elevator system **40** also includes an electronic safety control module **170**, which may be disposed corresponding to the elevator controller **110** and connected with the elevator controller **110** in wired manner, for example, the electronic safety control module **170** may even be disposed on car roof of the car.

Thus, the mobile terminal **200** or **200′** may actually perform information interaction with the electronic safety control module **170** indirectly. The first safety checking guidance information generated by the first safety checking guidance information generation module **241** of the mobile terminal **200** or **200′** may be transmitted to the elevator controller **110** through the wireless signal component **150**, and even further to the electronic safety control module **170**, which may automatically complete the state switching operation on the functional components currently under safety checking in response to the first safety checking guidance information (e.g., guiding the maintenance individual **90** to input instructions for triggering the electronic safety control module **170** to automatically perform at least part of the safety checking operation). Specifically, the transmission of the first safety checking guidance information described above may be performed in response to for example an input (e.g., a click of "confirm", etc.) on a user interface of the mobile terminal **200** or **200′** of the guided maintenance individual **90**, triggering the abovementioned transmission, further triggering the electronic safety control module **170** to automatically perform, in simulation, the state switching operation on the functional components currently under safety checking. It is noted that a safety checking operation execution module (e.g., following a preset safety checking operation execution program) is specifically disposed in the electronic safety control module **170**, thereby automatically performing the safety checking operation on the corresponding component under the trigger of an instruction input by the maintenance individual **90**.

(43) Illustratively, when the first safety checking guidance information is correspondingly the information guiding the maintenance individual **90** to perform a state switching operation (e.g., pressing to switch to a "stopping" state) on the car roof e-stop switch **141**, the information is transmitted to the electronic safety control module **170** in real time, thus, the electronic safety control module **170** may automatically complete the state switching operation on the car roof e-stop switch **141** currently under safety checking in response to the information without the need of the maintenance individual **90** to enter the elevator hoistway **120** to press the car roof e-stop switch **141** to the "stopping" state, avoiding such trouble of field operation, for example, in the elevator hoistway **120**, greatly improving the experience and efficiency of the safety checking operation.

(44) FIG. **5** shows a flowchart of a method for guiding a maintenance individual to perform a safety checking operation on functional components of an elevator system according to an embodiment of the present invention: FIG. **6** shows a flowchart of a method for guiding a maintenance individual to perform a safety checking operation on functional components of an elevator system according to yet another embodiment of the present disclosure. Further in conjunction with FIGS. **1**-**6** below, a method for guiding a maintenance individual to perform a safety checking operation on functional components of an elevator system (hereinafter referred to simply as a "guiding method") of an embodiment of the present invention is illustrated as an example, and the function of a corresponding component or module in the guiding apparatus **20** or **30** is specifically illustrated, accordingly.

(45) In the guiding method shown in FIG. **5**, the maintenance operation is illustrated as an example of a maintenance operation performed on the car roof of the car, and specifically, the safety checking operation that required to be performed before entering the car roof of the car is described as an example, wherein the corresponding functional components that need safety checking include a door lock switch **160**, a car roof e-stop switch **141**, and a car roof inspection switch **142** as shown in FIGS. **1** and **4**. Also, FIG. **5** schematically shows the steps of the guiding method completed in the mobile terminal **200** and the steps of the guiding method completed in the elevator controller **110**.

(46) First, the maintenance individual **90** carries the mobile terminal **200** of the embodiment shown in FIG. **2** of the present invention to be guided to perform a safety checking operation before entering onto the car roof of the car for a maintenance operation. The elevator system to be maintained may be determined and the corresponding authority (e.g., authority to establish a

wireless communication connection) or authentication may be obtained by scanning the two-dimensional code (QR code) through the mobile terminal **200** or entering manually and the like.
(47) In step S**511**, the mobile terminal **200** senses the wireless signal to establish a wireless communication connection with, for example, the wireless signal component **150** in the car **130**. By this step, a connection between the mobile terminal **200** and the elevator controller **110** of the elevator system **10** that needs to be maintained may be completed to prepare for the following information interaction between them.
(48) In step S**512**, enter the "hoistway maintenance control mode" from the APP component to transmit a corresponding instruction to the elevator controller **110**. In this step, the maintenance individual **90** may operate a corresponding APP component on the mobile terminal **200**, for example, select to enter the "hoistway maintenance control mode", specifically, for example, select a "car roof maintenance control sub-mode", by which operation the mobile terminal **200** actually transmits instructions equivalent to the first and second instructions described above to the elevator controller **110**. Thus, this step S**512** may be accomplished by means of the car movement control module **220**, the hoistway maintenance control mode trigger module **230** shown in FIG. **2**.
(49) In step S**513**, the elevator controller **110** receives the instruction accordingly.
(50) In step S**514**, in response to the instruction, the elevator controller **110** enters a "hoistway maintenance control mode", specifically, for example, enters a "car roof maintenance control sub-mode".
(51) In step S**515**, control the car **130** to move to a position suitable for the maintenance individual **90** to enter the car roof of the car, where the car roof of the car **130** is substantially flush with the floor of the landing (e.g., a landing of floor n as shown in FIG. **1**) where the maintenance individual **90** is currently located. After step S**515** is completed, the elevator controller **110** may feedback the corresponding information to the mobile terminal **200** to indicate that the mobile terminal **200** may start conducting the guiding operation.
(52) In step S**521**, generating safety checking guidance information for the safety checking operation of the door lock switch **160**. In this step S**521**, the safety checking guidance information for the door lock switch **160** may be generated according to a corresponding safety checking operation procedure. This step S**521** may be accomplished by means of the first safety checking guidance information generation module **241** shown in FIG. **2**.
(53) In step S**522**, the maintenance individual is guided to perform a state switching operation (e.g., opening the door lock switch **160**) on the door lock switch **160**, and to perform the operation of pressing the call button in the landing. In this step S**522**, the partial safety checking guidance information generated in step S**521** is to be presented in the form of, for example, a user interface and a voice prompt, the maintenance individual **90** will be guided to perform a state switching operation, e.g., opening on the door lock switch, and optionally, the maintenance individual **90** may also be guided by way of the presentation of a user interface and/or a voice prompt to press on the call button in the landing to verify whether the external call is still active in the state that the door lock switch **160** is opened.
(54) In step S**523**, acquiring information for determining whether the door lock switch **160** passes the corresponding checking of the safety checking, e.g., acquiring the current state of the door lock switch **160** and the position change information corresponding to the car in the current state (e.g. whether the car is moving or not). This step S**523** may be accomplished by the information acquisition module **111** in the elevator controller **110**, and the acquired information may be transmitted to the mobile terminal **200**.
(55) In step S**524**, it is determined or decided whether a safety checking operation of the door lock switch is passed. In step S**524**, a determination or decision operation is performed based on the information acquired in step S**523**; for example, if the acquired information includes: the door lock switch **160** is in an open state and the car **130** is not moving, then it may be determined that the door lock switch **160** has experienced the state switching operation and the function is normal,

thereby determining as “yes”, that is, it is determined that the safety checking operation of the door lock switch **160** is passed, thus entering step S**525**, otherwise returning to step S**522** to continue guiding the maintenance individual **90** to perform the safety checking operation for the door lock switch **160**. This step S**524** may be accomplished by the safety checking determination sub-module **2421** in the mobile terminal **200**.

(56) In step S**525**, it is displayed that the door lock switch **160** passes the safety checking operation, and the safety checking operation of the door lock switch **160** has been completed. By this step S**525**, the maintenance individual **90** may be guided to get to know that the door lock switch **160** has passed the a safety checking operation, preparing for the safety checking operation of the next functional component (e.g., the car roof e-stop switch **141**). This step S**525** may be accomplished by the information presentation module **260** in the mobile terminal **200**.

(57) In step S**531**, the safety checking guidance information for the safety checking operation of the car roof e-stop switch **141** is generated. In this step S**531**, safety checking guidance information for the car roof e-stop switch **141** may be generated according to the corresponding safety checking operation procedure. This step S**531** may be accomplished by means of the first safety checking guidance information generation module **241** shown in FIG. **2**.

(58) In step S**532**, the maintenance individual is guided to perform the state switching operation on the car roof e-stop switch **141** (e.g., pressing the car roof e-stop switch to a “stopping” state), and to perform the operation of pressing the call button in the landing. In this step S**532**, the partial safety checking guidance information generated in step S**531** will be presented, for example, in the form of a user interface and a voice prompt, the maintenance individual **90** will be guided to, for example, perform a state switching operation of pressing the car roof e-stop switch **141** to a “stopping” state, then be guided to close the landing door to close the door lock switch, optionally, the maintenance individual **90** may also be guided to press the call button in the landing by way of the presentation of a user interface and/or a voice prompt to verify whether the external calling is still active in the state that the door lock switch **160** is opened.

(59) In step S**533**, acquiring information for determining whether the car roof e-stop switch **141** passes the corresponding checking of the safety checking, for example, acquiring the current state of the car roof e-stop switch **141** and the position change information corresponding to the car in the current state (e.g., whether the car is moving or not). This step S**533** may be accomplished by the information acquisition module **111** in the elevator controller **110**, and the acquired information may be transmitted to the mobile terminal **200**.

(60) In step S**534**, it is determined or decided whether the safety checking operation of the car roof e-stop switch **141** is passed. In step S**534**, a determination or decision operation is performed based on the information acquired in step S**533**: for example, if the acquired information includes: the car roof e-stop switch **141** is in a “stopping” state and the car **130** is not moving, then it may be determined that the car roof e-stop switch **141** has experienced the state switching operation and the function is normal, thereby determining as “yes”, that is, it is determined that the safety checking operation of the car roof e-stop switch **141** is passed, thus entering step S**535**, otherwise returning to the step S**532** to continue guiding the maintenance individual **90** to perform the safety checking operation for the door roof e-stop switch **141**. This step S**534** may be accomplished by the safety checking determination sub-module **2421** in the mobile terminal **200**.

(61) In step S**535**, it is displayed that the car roof e-stop switch **141** passes the safety checking operation, and the safety checking operation of the car roof e-stop switch has been completed. By this step S**535**, the maintenance individual **90** may be guided to get to know that the car roof e-stop switch **141** has passed the safety checking operation, preparing for the safety checking operation of the next functional component (e.g., the car roof inspection switch **142**). This step S**535** may be accomplished by the information presentation module **260** in the mobile terminal **200**.

(62) In step S**541**, the safety checking guidance information for the safety checking operation of the car roof inspection switch **142** is generated. In this step S**541**, the safety checking guidance

information for the car roof inspection switch **142** may be generated according to the corresponding safety checking operation procedure. This step S**541** may be accomplished by means of the first safety checking guidance information generation module **241** shown in FIG. **2**.

(63) In step S**542**, the maintenance individual is guided to perform the state switching operation on the car roof inspection switch **142** (e.g., pressing the car roof e-stop switch to the "inspection" state) and to perform the operation of pressing the call button in the landing.

(64) In this step S**542**, the partial safety checking guidance information generated in step S**541** will be presented by way of, for example, a user interface and a voice prompt, and the maintenance individual **90** will be guided to perform the state switching operation of, for example, pressing the car roof inspection switch **142** to an "inspection" state, then be guided to close the landing door to close the door lock switch, optionally, the maintenance individual **90** may also be guided to press the call button in the landing by way of the presentation of the user interface and/or the voice prompt to verify whether the external calling is still active in the state that the door lock switch **160** is opened.

(65) In step S**543**, acquiring the information for determining whether the car roof inspection switch **142** passes the corresponding checking of the safety checking, for example acquiring the current state of the car roof inspection switch **142** and the position change information corresponding to the car in the current state (e.g., whether the car is moving or not). This step S**543** may be accomplished by the information acquisition module **111** in the elevator controller **110**, and the acquired information may be transmitted to the mobile terminal **200**.

(66) In step S**544**, it is determined or decided whether the safety checking operation of the car roof inspection switch **142** is passed. In step S**544**, a determination or decision operation is performed based on the information acquired in step S**543**: for example, if the acquired information includes: the car roof inspection switch **142** is in the "stopping" state and the car **130** is not moving, then it may be determined that the car roof inspection switch **142** has experienced the state switching operation and the function is normal, thereby determining as "yes", that is, it is determined that the safety checking operation of the car roof inspection switch **142** is passed, entering step S**545**, otherwise returning to step S**542** to continue guiding the maintenance individual **90** to perform the safety checking operation for the car roof inspection switch **142**. This step S**544** may be accomplished by the safety checking determination sub-module **2421** in the mobile terminal **200**.

(67) In step S**545**, it is displayed that the car roof inspection switch **142** passes the safety checking operation and the safety checking operation of the car roof inspection switch has been completed. By this step S**545**, the maintenance individual **90** may be guided to get to know that the car roof inspection switch **142** has passed the safety checking operation. This step S**535** may be accomplished by the information presentation module **260** in the mobile terminal **200**.

(68) In step S**550**, it is displayed that the safety checking operation of entering the elevator hoistway to perform the car roof maintenance operation is completed. To this end, the corresponding safety checking operation is completed under guidance, the functions of the door lock switch **160**, the car roof e-stop switch **141** and the car roof inspection switch **142** may be ensured to be normal, and dangerous accidents in the maintenance process are prevented.

(69) In the guiding method of the above embodiments, the maintenance individual **90** to enter the car roof of the car for maintenance operation will be effectively guided to operate according to the safety checking operation procedure, avoiding the occurrence of nonstandard operating behaviors such as wrong operations and missing operations, thus the safety performance of the maintenance operation requiring to entering the car roof of the car is ensured; and during the process of the safety checking operation, some operations (e.g., opening and closing the door repeatedly) may be omitted, and compared with the existing safety checking operation mode, the workload is reduced and the efficiency is improved, greatly improving the experience of the maintaining individual **90**.

(70) Note that in other alternative embodiment, in steps S**522**, S**532**, S**542**, corresponding operations may be performed on the mobile terminal **200** as shown in FIG. **4**, by controlling the

completion of the above-described state switching operations, and even calling operations through the electronic safety control module **170** as shown in FIG. **4**, the workload of the maintenance individual is further reduced (e.g., especially without need of repeatedly entering the elevator hoistway **120** to perform the operation of pressing the corresponding button), improving efficiency and the maintaining experience.

(71) It should be noted that after the car roof maintenance operation is completed, the maintenance individual **90** may also be guided to complete the safety checking operation following the maintenance operation based on similar guiding methods as above, which will not be exemplarily described in detail herein any more.

(72) In the guiding method shown in FIG. **6**, the maintenance operation is illustrated as an example of a maintenance operation performed at the pit, and specifically, the safety checking operation that required to be performed before entering the pit is described as an example, wherein the corresponding functional components that requiring safety checking include the door lock switch **160**, an upper e-stop switch and a lower e-stop switch disposed in the pit. Also, FIG. **6** schematically shows the steps of the guiding method completed in the mobile terminal **200**′ and the steps of the guiding method completed in the elevator controller **110**′.

(73) First, the maintenance individual **90** carries the mobile terminal **200**′ of the embodiment shown in FIG. **3** of the present invention to be guided to perform a safety checking operation before entering into the pit for a maintenance operation. The elevator system to be maintained may be determined and the corresponding authority (e.g., authority to establish a wireless communication connection) or authentication may be obtained by scanning the two-dimensional code (QR code) through the mobile terminal **200**′ or entering manually and the like.

(74) In step S**611**, the mobile terminal **200**′ senses the wireless signal to establish a wireless communication connection with, for example, the wireless signal component **150** in the car **130**.

(75) In step S**612**, enter the “hoistway maintenance control mode” from the APP component to transmit a corresponding instruction to the elevator controller **110**′.

(76) In step S**613**, the elevator controller **110**′ receives the instruction accordingly.

(77) In step S**614**, in response to the instruction, the elevator controller **110**′ enters a “hoistway maintenance control mode”, specifically, for example, enters a “pit maintenance control sub-mode”.

(78) Note that the above steps S**611** to S**614** are substantially the same as the steps S**511** to S**514** of the embodiment shown in FIG. **5**, respectively, and detailed description thereof is omitted herein.

(79) In step S**615**, control the car **130** to move to a position suitable for the maintaining individual **90** to enter the pit. After step S**615** is completed, the elevator controller **110**′ may feedback the corresponding information to the mobile terminal **200**′ to indicate that the mobile terminal **200**′ may start performing the guiding operation.

(80) In step S**621**, safety checking guidance information for the safety checking operation of the door lock switch **160** is generated.

(81) In step S**622**, the maintenance individual is guided to perform a state switching operation (e.g., opening the door lock switch) on the door lock switch **160**, and to perform the operation of pressing the call button in the landing.

(82) In step S**623**, acquiring information for determining whether the door lock switch **160** passes the corresponding checking of the safety checking.

(83) In step S**624**, it is determined or decided whether a safety checking operation of the door lock switch **160** is passed.

(84) In step S**625**, it is displayed that the door lock switch **160** passes the safety checking operation, and the safety checking operation of the door lock switch has been completed.

(85) Note that the above steps S**621** to S**625** are substantially the same as steps S**521** to S**525** of the embodiment shown in FIG. **5**, respectively, and detailed description thereof is omitted herein.

(86) In step S**631**, the safety checking guidance information for the safety checking operation of the

upper e-stop switch is generated.
(87) In step S**632**, the maintenance individual is guided to perform the state switching operation on the upper e-stop switch (e.g., pressing the upper e-stop switch to a “stopping” state), and to perform the operation of pressing the call button in the landing.
(88) In step S**633**, acquiring information for determining whether the upper e-stop switch passes the checking of the corresponding safety checking.
(89) In step S**634**, it is determined or decided whether the safety checking operation of the upper e-stop switch is passed.
(90) In step S**635**, it is displayed that the upper e-stop switch passes the safety checking operation, and the safety checking operation of the upper e-stop switch has been completed.
(91) In step S**641**, the safety checking guidance information for the safety checking operation of the lower e-stop switch is generated.
(92) In step S**642**, the maintenance individual is guided to perform the state switching operation on the lower e-stop switch (e.g., pressing the lower e-stop switch to the “stopping” state) and may also be guided to perform the state recovering operation on the upper e-stop switch (e.g., pressing the upper e-stop switch to the “normal” state) and to perform the operation of pressing the call button in the landing.
(93) In step S**643**, acquiring the information for determining whether the lower e-stop switch passes the checking of the corresponding safety checking.
(94) In step S**644**, it is determined or decided whether the safety checking operation of the lower e-stop switch is passed.
(95) In step S**645**, it is displayed that the lower e-stop switch passes the safety checking operation and the safety checking operation of the lower e-stop switch has been completed.
(96) Note that the above steps S**631** to S**635** are substantially the same as the steps S**531** to S**535** of the embodiment shown in FIG. **5**, respectively, and the above steps S**641** to S**645** are also substantially the same as the steps S**531** to S**535** of the embodiment shown in FIG. **5**, respectively, and the detailed description thereof is omitted.
(97) In S**650**, it is displayed that the safety checking operation of entering the pit of the elevator hoistway to perform maintenance operation is completed. To this end, the corresponding safety checking operation is completed under guidance, the functions of the door lock switch **160**, the upper e-stop switch and the lower e-stop switch may be ensured to be normal, and dangerous accidents in the maintenance process are prevented.
(98) In the guiding method of the above embodiment, the maintenance individual **90** to enter the pit for maintenance operation will be effectively guided to operate according to the safety checking operation procedure, avoiding the occurrence of nonstandard operating behaviors such as wrong operations and missing operations, thus the safety performance of the maintenance operation requiring entering the pit of the car is ensured; and during the process of the safety checking operation, some operations (e.g., opening and closing the door repeatedly) may be omitted, and compared with the existing safety checking operation mode, the workload is reduced and the efficiency is improved, greatly improving the experience of the maintaining individual **90**.
(99) It will be understood that the “safety checking guidance information” herein is not limited to the information used to guide the maintenance individual **90** to directly complete an overall checking operation (e.g., guiding a user to open or close the door switch, inspect the switch, etc.), but also includes the information for guiding the maintenance individual **90** to indirectly complete the overall checking operation (e.g., for guiding the maintenance individual **90** to input instructions to automatically complete a specific overall checking operation through the electronic safety control module **170**).
(100) It is noted that, the mobile terminal **200** or **200**′ of the above embodiment of the present invention may be implemented by the computer program instructions, for example, implemented by dedicated APPs, these computer program instructions may be provided to the processor of a

general purpose computer, a dedicated computer, or other programmable data processing device to constitute the mobile terminal **200** or **200′** of an embodiment of the present invention, also, these instructions, which may be executed by a processor of a computer or other programmable data processing device to create units or components for implementing the functions/operations specified in these flowcharts and/or blocks and/or one or more flowcharts.

(101) Likewise, the elevator controller **110** or **110′** of the elevator system **10** of the above embodiment of the present invention may be implemented by computer program instructions, for example, implemented by dedicated programs, these computer program instructions may be provided to the processor to constitute the information acquisition module **111** of the embodiments of the present invention, also, these instructions may be executed by a processor of a computer or other programmable data processing device to create units or components for implementing the functions/operations specified in these flowcharts and/or blocks and/or one or more flowcharts.

(102) Furthermore, these computer program instructions may be stored in a computer-readable memory, which may instruct a computer or other programmable processor to implement functions in a particular manner such that these instructions stored in the computer-readable memory constitute fabrication products containing the instruction components implementing the functions/operations specified in one or more blocks of the flowcharts and/or block diagrams.

(103) It should also be noted that, in some alternative implementations, the functions/operations shown in the blocks may not occur on the order shown in the flowcharts. For example, two blocks shown in succession may, in fact, be executed substantially concurrently or these blocks may sometimes be executed in the reverse order, specifically depending upon the function/operation involved.

(104) It is noted that the elements disclosed and depicted herein (including flowcharts and block diagrams in the figures) mean logical boundaries between elements. However, according to software or hardware engineering practice, the depicted elements and their functions may be executed on a machine by a computer executable medium with a processor capable of executing program instructions stored thereon, the program instructions being in form of a monolithic software structure, of a stand-alone software module, or of a module using external programs, code, services, and the like, or any combination thereof, and all such execution schemes may fall within the scope of the present disclosure.

(105) Although the different non-limiting implementations have particularly illustrated components, implementations of the invention are not limited to these particular combinations. It is possible to use some of the assemblies or features from any of the non-limiting implementations in combination with features or assemblies from any other non-limiting implementations.

(106) Although particular order of steps is shown, disclosed, and claimed, it should be appreciated that the steps may be implemented, separated or combined in any order, unless otherwise indicated and still benefit from the present disclosure.

(107) The foregoing description is exemplary and is not defined to be limited thereto. Various non-limiting implementations are disclosed herein, however, one of ordinary skill in the art will recognize that various modifications and alternations will fall within the scope of the appended claims in light of the above teachings. It is, therefore, to be appreciated that the content of the disclosure may be practiced otherwise than as specifically disclosed within the scope of the appended claims. For this reason, the appended claims should be studied to determine the true scope and content.

Claims

1. An apparatus for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising: a wireless signal component connected with an elevator controller of the elevator system and establishing a wireless communication

connection with a mobile terminal carried by the maintenance individual to enter an elevator hoistway for maintenance operation by broadcasting a wireless signal; wherein the apparatus is configured to perform an information interaction about the functional component by a wireless communication module of the mobile terminal and the elevator controller, and to provide safety checking guidance information for guiding the maintenance individual to complete the safety checking operation by a safety checking guidance module of the mobile terminal, wherein the safety checking guidance information provided includes first safety checking guidance information and second safety checking guidance information; the elevator controller comprising: an information acquisition module for acquiring, in response to a state switching operation on the functional component, first information for determining whether the functional component passes a corresponding safety checking operation in real time; the apparatus is further configured to perform the following actions by the safety checking guidance module of the mobile terminal: generating first safety checking guidance information for guiding the maintenance individual to perform the state switching operation on the functional component, and generating, based on the first information, second safety checking guidance information indicating whether the functional component passes the safety checking operation; the information interaction including an interaction of the first information.

2. The apparatus of claim 1, wherein the elevator controller is configured to, in response to a first instruction transmitted from the mobile terminal, control a car to move to a position suitable for the maintenance individual to enter a pit of the elevator hoistway or to enter a car roof of the car.

3. The apparatus of claim 1, wherein the elevator controller is configured to operate in a hoistway maintenance control mode in response to a second instruction transmitted from the mobile terminal; wherein the elevator controller at least does not respond to a passenger's calling instruction in the hoistway maintenance control mode and can acquire the first information in real time.

4. The apparatus of claim 1, wherein the apparatus is configured to present the safety checking guidance information to the maintenance individual in the form of a sound and/or a user interface by an information presentation module of the mobile terminal.

5. The apparatus of claim 1, further comprising: a safety checking determination sub-module disposed in the elevator controller or the mobile terminal for determining, based on the first information, whether a corresponding functional component passes the safety checking operation, wherein the first information includes a current state of the functional component and position change information corresponding to a car in the current state.

6. The apparatus of claim 1, wherein the apparatus is further configured to: with determining that currently the functional component passes the safety checking operation, further provide safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component using a safety checking guidance module of the mobile terminal based on a predefined safety checking operation procedure, if it is determined.

7. The apparatus of claim 1, wherein the maintenance operation comprises a maintenance operation performed on a car roof of the car, the functional components requiring the safety checking operation correspondingly include a door lock switch, a car roof e-stop switch, and/or a car roof inspection switch; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the car roof e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the car roof inspection switch.

8. The apparatus of claim 1, wherein the maintenance operation comprises a maintenance operation performed in the pit of the elevator hoistway, the functional components requiring the safety checking operation correspondingly include a door lock switch, an upper e-stop switch disposed at

the pit, and/or a lower e-stop switch disposed at the pit; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the upper e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the lower e-stop switch.

9. The apparatus of claim 1, wherein the wireless signal component is a Bluetooth module or a Bluetooth Low Energy module.

10. The apparatus of claim 1, wherein the apparatus is further configured to comprise: an electronic safety control module that automatically completes the state switching operation on the functional component currently under a safety checking in response to the first safety checking guidance information.

11. The apparatus of claim 1, further comprising: a wireless communication module of the mobile terminal for establishing the wireless communication connection with the wireless signal component, and performing the information interaction about the function component with the elevator controller.

12. An elevator system comprising a car and an elevator controller for controlling the car to move in an elevator hoistway, further comprising: an apparatus for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system according to claim 1.

13. A method for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising: establishing, by an elevator controller, a communication connection with a mobile terminal carried by the maintenance individual to enter an elevator hoistway for a maintenance operation by means of a wireless signal component in the elevator system; performing an information interaction about the functional component between the mobile terminal and the elevator controller; and providing, by means of the mobile terminal, safety checking guidance information for guiding the maintenance individual to complete the safety checking operation; acquiring, by the elevator controller in real time, first information for determining whether the functional component passes a corresponding safety checking operation in response to a state switching operation on the functional component; the providing safety checking guidance information includes: generating, by means of the mobile terminal, first safety checking guiding information for guiding the maintenance individual to perform the state switching operation on the functional component; and generating, by means of the mobile terminal based on the first information, second safety checking guidance information for determining whether the functional component passes the safety checking operation; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information, the information interaction including an interaction of the first information.

14. The method of claim 13, further comprising: controlling the car to move to a position suitable for the maintaining individual to enter a pit of the elevator hoistway or to enter a car roof of the car in response to the first instruction transmitted from the mobile terminal.

15. The method of claim 13, further comprising: with determining that currently the functional component passes the safety checking operation, further providing safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component by means of the mobile terminal based on a predefined safety checking operation procedure.

16. The method of claim 13, further comprising: automatically completing, by an electronic safety control module, a state switching operation on the functional component currently under a safety checking in response to the first safety checking guidance information.

17. A method for guiding a maintenance individual to perform a safety checking operation on a

functional component of an elevator system, comprising: establishing a wireless communication connection with a wireless signal component connected with an elevator controller of the elevator system, and performing an information interaction about the functional component with the elevator controller; and providing safety checking guidance information for guiding the maintenance individual to complete the safety checking operation; wherein the providing the safety checking guidance information comprises generating first safety checking guiding information for guiding the maintenance individual to perform the state switching operation on the functional component; receiving first information from the elevator controller for determining whether the functional component passes a corresponding safety checking operation; the providing the safety checking guidance information further comprises: generating, based on the first information, second safety checking guidance information indicating whether the functional component passes the safety checking operation; wherein the safety checking guidance information provided includes the first safety checking guidance information and the second safety checking guidance information; the information interaction including an interaction of the first information.

18. The method of claim 17, further comprising: transmitting a first instruction to the elevator controller, wherein the first instruction is used for triggering the elevator controller to control the car to move to a position suitable for the maintenance individual to enter a pit of the elevator hoistway or to enter a car roof of the car.

19. The method of claim 17, further comprising: presenting the safety checking guidance information in the form of a sound and/or a user interface.

20. The method of claim 17, further comprising: transmitting, to the elevator controller, a second instruction to trigger the elevator controller to enter or exit a hoistway maintenance control mode in response to an input of the maintenance individual; wherein the elevator controller at least does not respond to the passenger's calling instruction in a hoistway maintenance control mode and can acquire first information for determining whether the functional component passes a checking of a corresponding safety check in real time.

21. The method of claim 17, further comprising: determining whether a corresponding functional component passes a safety checking operation based on the first information, wherein the first information includes a current state of the functional component and position change information corresponding to a car in the current state.

22. The method of claim 17, further comprising: with determining that the functional component passes the safety checking operation, further providing, based on a predefined safety checking operation procedure, safety checking guidance information for guiding the maintenance individual to complete the safety checking operation of yet another functional component.

23. The method of claim 17, wherein a maintenance operation of the maintenance individual comprises the maintenance operation performed on a car roof of the car, the functional components requiring the safety checking operation correspondingly include a door lock switch, a car roof e-stop switch, and/or a car roof inspection switch; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for the car roof e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the car roof inspection switch.

24. The method of claim 17, wherein a maintenance operation of the maintenance individual comprises the maintenance operation performed in a pit of an elevator hoistway, the functional components requiring the safety checking operation correspondingly include a door lock switch, an upper e-stop switch disposed at the pit, and/or a lower e-stop switch disposed at the pit; accordingly, the safety checking guidance information provided includes: information for guiding the maintenance individual to complete the safety checking operation for the door lock switch, information for guiding the maintenance individual to complete the safety checking operation for

the upper e-stop switch, and/or information for guiding the maintenance individual to complete the safety checking operation for the lower e-stop switch.

25. The method of claim 17, wherein the established wireless communication connection is a Bluetooth connection or a Bluetooth Low Energy connection.

26. A non-transitory computer readable storage medium having stored thereon a computer program, wherein the program is executed by a processor to implement a method for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system according to claim 17.

27. A mobile terminal for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system, comprising a memory, a processor, and a computer program stored on the memory and executable on the processor, wherein when the program is executed by the processor, a method for guiding a maintenance individual to perform a safety checking operation on a functional component of an elevator system according to claim 17 is implemented.