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(54) **ELEVATOR DOOR SYSTEM AND A METHOD FOR CALLING AN ELEVATOR CAR**

(57) An elevator door system (1) is proposed which comprises at least an elevator door (2, 3). A control unit (5) of the elevator door system (1) can open and close the elevator door (2, 3) in response to a control signal (6). The elevator door system (1) comprises a vibration sensor (10) to detect a vibration activity on the elevator

door (2, 3) and a data storage (7) for saving a reference data. The elevator door system (1) comprises further a signal conditioner circuit (8) to compare the detected vibration with the saved reference data and send the control signal (6) to the control unit (5) depending on a comparison result.

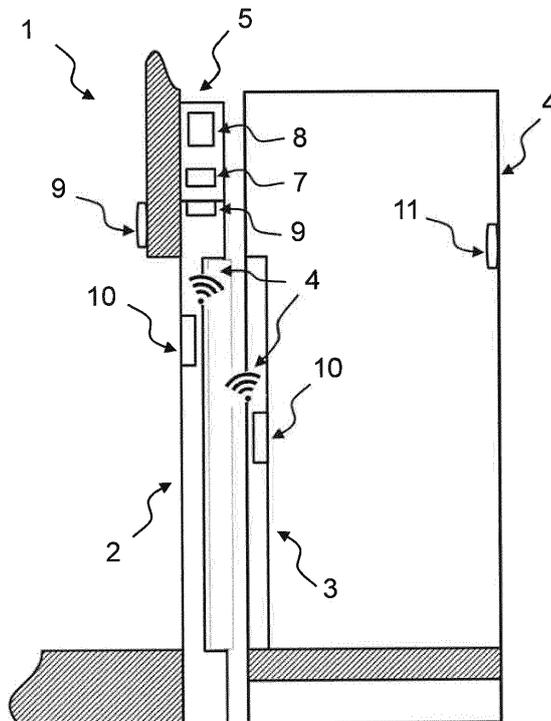


Fig. 1

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Description

[0001] The present invention relates to an elevator door system and a method for calling an elevator car.

[0002] An elevator system may comprise an elevator car that is movable vertically in an elevator hoistway or elevator shaft by an electrical drive and/or that may be stopped at different floors of a building. Furthermore, the elevator may comprise automatically actuatable hoistway doors (also called as landing doors or shaft doors) at the floors that may be opened and closed, when the elevator car stops at the floors.

[0003] Usually, an elevator system has a car operating panel (COP) inside of an elevator car to give an elevator car call and a floor-control-panel outside of the elevator car to give an elevator floor call or to provide an elevator car calling, whereat the floor-control-panel is normally mounted on a wall in a floor and adjacent to a hoistway door. Some elevators have lobby operation panels (LOP) situated at the different floors. A LOP in this application is to understand as a control panel which is different to a conventional floor-control-panel, as LOP provides a possibility for passengers to give a destination floor, e.g. the port-technology. A floor-control-panel provides a user interface with one or more buttons which may be pushed by a passenger for generating a floor call and optionally for selecting the direction (up or down). On a LOP it is usually no more necessary to provide one or two buttons for selecting a car moving direction. Passengers who will travel by an elevator may call an elevator car by using floor-control-panels at first at the floor and then request a target floor by using a COP in the elevator car. For an elevator with a LOP, the passengers may just only input a target floor, at the same time this inputting is accepted as a calling the elevator car and the selecting moving direction.

[0004] Almost all elevator systems typically require input from a physical pressing of a pushbutton of an operation panel, touching a touch screen, turning a key switch, and similar devices. While the force requirements for these input devices and their location is accessible for access challenged persons, sometimes these input devices are still unavailable to accessibly challenged persons due to physical limitations of their conditions or unavailable to visually handicapped or blind people. For instance, a floor-control-panel or a LOP poses several challenges to a person disabled - particularly those who are wheelchair bound, because calling buttons are often difficult for a disabled person to use. In the other hand, it may be also difficult for person whose both hands are so full that none of them can undertake anything else. Accordingly, there is an ongoing demand for more convenience for elevator passengers.

[0005] To meet these challenges, various schemes have been proposed to utilize a remote-control device, e.g. a smartphone, to call elevator cars. Unfortunately, these schemes still tend to suffer from various shortcomings. For example, it needs to modernize elevators and

to provide a handheld device that will provide input to elevator car calling function. Additionally, it is still necessary to provide a desired level of distinction between different elevators.

5 **[0006]** EP 1604933 A1 describes an invention concerning an elevator with a COP to register elevator calls. A COP is freely configurable, user-friendly, conform to the norms concerning handicapped people.

10 **[0007]** CN 101293608 A discloses an elevator device which is movable to a destination floor even if a visually handicapped person in an elevator car by oneself and suppressed in the lowering of elevator operating efficiency. When a car call is detected by the contact detection means of the elevator device, an elevator car will move to a destination floor and opens the door of the elevator car, and keeps the door open until the destination floor registration button is operated.

15 **[0008]** The Object of this invention may be to further optimize the control function of an elevator door system to meet the ongoing demand for more convenience for elevator passengers, especially for handicapped people.

20 **[0009]** Such an object may be achieved by the subject-matter of the independent claims. Further exemplary embodiments are evident from the dependent claims and the following description.

25 **[0010]** According to the present invention, an elevator door system is proposed to comprise at least one elevator door and a control unit to open and close this elevator door in response to a control signal. The elevator door comprises a hoistway door or/and a car door of an elevator car. A vibration sensor of the elevator door system can detect a vibration activity on the elevator door. The elevator door system comprises further a data storage for saving a reference data and a signal conditioner circuit to compare the detected vibration activity to the saved reference data and send the control signal to the control unit depending on a comparison result.

30 **[0011]** Usually, a LOP and a floor-control-panel are alternative operation panels for an elevator, because an elevator having a LOP doesn't need more to comprise a floor-control-panel at the floor and a COP inside of an elevator car. With an elevator door system pursuant to this invention, a conventional elevator will have such LOP-functions too, even if this elevator has just only a floor-control-panel outside of an elevator car. In other word to say that an elevator with an elevator door system pursuant to this invention has now combined the functions of car call, floor call, port-technology and certain gesture recognition.

35 **[0012]** A passenger, especially a visually handicapped person or a moving disabled person thus may knock or scratch on a hoistway door at a floor, then the elevator car will arrive at this floor to pick him/her up. This passenger doesn't need to know or find the floor-control-panel or the LOP exactly. Even if a passenger is a disabled person without hand or his both hands are not free, he can just knock the door with his elbow, foot or head.

40 **[0013]** According to an embodiment of the invention,

the elevator door system will ignore the detected vibration activity if this vibration activity is too strong or too heavy. This is aimed to protect the door system or the passenger in the car against violence or a vigorous activity. In this case, the signal conditioner circuit of the elevator door system will evaluate whether the strength or duration of the detected vibration activity is out of a data range of the saved reference data in addition to a tolerance scope. For instance, if the knocking craft is more than five Newton, the vibration activity is longer than a certain time period or a target floor that resulted from this evaluation doesn't exist, the elevator door system will ignore the vibration activity. If a critical situation is determined, an alarm will be generated in form of an acoustic signal or a light signal. In addition, if the saved reference data comprises at least one pattern of a multitude of vibration activities, the signal conditioner circuit determines whether the count of detected vibration activities matches the number of vibration activities of the at least one of the saved reference data vibration patterns. If there is no match in the count of vibration activities, then the elevator door system will also ignore the vibration activity.

[0014] According to an embodiment of the invention, the vibration sensor is installed on or in the elevator door and/or a wall of an elevator car. The elevator door comprises at least one hoistway door (also called as landing door or shaft door) and/or at least one car door of the elevator car. It is meaningful that the vibration sensor is arranged inside of an elevator car, when e.g. passengers enter the elevator car without giving any floor call afore. Such a case could happen, when a passenger gets in an already waiting car with an opened elevator door. A vibration activity executed on the hoistway door or inside of the elevator car on its door or wall is then detectable by the vibration sensor.

[0015] Vibration measurement is complex because of its many variable - displacement, velocity, acceleration, and frequencies. Also, a vibration can be measured in different ways, e.g. peak-to-peak, peak, average, RMS (root mean square). Advantageously, TIR (Total Indicator Reading)-Tracking is used, which displays the difference between the most negative and most positive measurements (Peak-to-Peak) and indicates the total vibration. As the vibration is a time continuous signal, the detected vibration signal needs to be transferred into a discrete signal so that a computer is able to analyze these vibration activities. For this reason, the detected vibration activity is sampled by using a A/D-converter in a time-discrete signal.

[0016] According to an embodiment of the invention, the signal conditioner circuit calculates and analyses the sampled time-discrete signal through a signal-transform algorithm, especially by using of DFT (Discrete Fourier Transform) or FFT (Fast Fourier Transform). The FFT requires much less processing power than DFT and consequently is executed more quickly by a computer.

[0017] According to an embodiment of the invention, the generated control signal can be canceled by another

vibration activity or depending on another comparison result, if this vibration activity is evaluated as a cancel command and recognized as such by the control unit. Furthermore, an optional indication device, e.g. a LED or a loudspeaker, indicates whether the vibration activity is registered as an elevator car calling or not or already canceled, whereas an indication could be a visible and/or an acoustical signal. Then the passenger will be notified whether her/his calling has been accepted by the elevator.

[0018] In embodiments, a target floor or the elevator car travel direction to a given target floor can be defined by a strength or/and a number of vibration activities or/and a time interval length between two vibration activities or/and a combination of two or more vibration activities, whereat these vibration activities could be knocking, scratching or slashing etc.

[0019] A further aspect of the invention relates to a method for calling an elevator car. The method comprises:

detecting a vibration activity on an elevator door; comparing the detected vibration activity with a saved reference data; generating a control signal depending on a comparison result; opening and/or closing the elevator door in response to the control signal.

[0020] Below embodiments of the present invention are described in more detail with reference to the attached drawings.

[0021] Embodiments of the invention are described with reference to the accompanying drawings. In the drawings, like reference numbers may indicate identical or functionally similar elements.

[0022] Fig. 1 shows a schematic view of an elevator door system according to the invention.

[0023] The reference symbols used in the drawings, and their meanings, are listed in summary form in the list of reference symbols. In principle, identical parts are provided with the same reference symbols in the figures.

[0024] Fig. 1 represents an elevator door system 1 with an elevator door which comprises a hoistway door 2 and a car door 3 of an elevator car 4. A control unit 5 of this elevator door system 1 opens and closes the elevator door 2, 3 in response to a control signal 6. A vibration sensor 10, e.g. an accelerometer, is to be fixed to or integrated in at least one of the hoistway door 2, the car door 3 or/and a wall of the elevator car 4. A vibration activity e.g. knocking or scratching on the hoistway door, and/or the car door, and/or on the wall of the elevator car 4 is then detectable.

[0025] The elevator door system 1 comprises further a signal conditioner circuit 8 to compare the detected vibration activity with a saved reference data in a data storage 7 and send the control signal 6 to the control unit 5. This control signal 6 is generated depending on a comparison result. The signal conditioner circuit 8 and the

data storage 7 can be integrated in the control unit 5 or arranged outside.

[0026] The transmission of the control signal 6 could be carried out through cable, bus system, network or by using a wireless data communication technology, e.g. blue tooth, WLAN etc. This generated control signal 6 can be deleted, if a second vibration activity on the hoistway door 2 and the car door 3 is recognized as a cancel command. A LED-lamp or a loudspeaker 11 will give the passenger a visible or an acoustical indication whether the executed vibration activity has been registered as a floor call, a car call or not, or the cancel command has been given successfully.

[0027] A passenger, e.g. a blind person, who wants to call an elevator car 4, just needs to knock on the hoistway door 2. Furthermore, this passenger can also give a target floor or an elevator car travel direction through vibration activities. For example, the target floor can be defined by a strength and/or a count of vibration activities, a time interval length between two vibration activities and/or a combination of two or more vibration activities. For instance, three knocks for third floor, two fast and short knocks plus one slow scratch for 21st floor, a scratching move or a slash from up to down for traveling downwards. This way, the passenger doesn't need to know exactly where a floor-control-panel or a LOP is located and does not need to find it.

[0028] As an advantage, vibrations are analyzed and evaluated with the help of computer technology. Therefore, an A/D-converter 9 is used to transform the detected vibration signal in a time-discrete signal. Like the signal conditioner circuit 8 and the data storage 7, the A/D-converter 9 can also be integrated in the control unit 5 or arranged outside. Then the signal conditioner circuit 8 calculates and analyses the sampled time-discrete signal through a signal-transform algorithm, e.g. DFT (Discrete Fourier Transform) or FFT (Fast Fourier Transform).

[0029] To protect the elevator or passengers in the elevator car against violence or a vigorous activity, the elevator door system 1 will ignore a detected vibration activity if this vibration activity is too strong or too heavy. The signal conditioner circuit 8 can determine whether it is just a ball hitting the door, a knock or something more sinister such as a strike aims to break the elevator door 2, 3 or force it to open. For this case, it is to evaluate whether the strength or the duration of the detected vibration activity or the count of vibration activities (hammering against the elevator door) is out of a data range of the saved reference data in addition to a tolerance scope. If a critical situation is determined, an alarm will be generated or sent to a remote monitoring center or directly to a police center.

[0030] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood

and effected by those skilled in the art and practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or controller may fulfil the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

List of reference signs

[0031]

1	Elevator door system
2	Hoistway door
3	Car door
4	Elevator car
5	Control unit
6	Control signal
7	Data storage
8	Signal conditioner circuit
9	A/D-converter
10	Vibration sensor
11	Indication device

Claims

1. Elevator door system (1) for an elevator, comprising:
 - at least one elevator door (2, 3), a control unit (5) to open and close the elevator door (2, 3) in response to a control signal (6), **characterized in that** the elevator door system (1) comprises a vibration sensor (10) to detect vibration activity on the elevator door (2, 3) and a data storage (7) for saving a reference data, and the elevator door system (1) comprises a signal conditioner circuit (8) to compare a detected vibration activity with the saved reference data and to send the control signal (6) to the control unit (5) depending on a comparison result.
2. Elevator door system (1) of claim 1, wherein the elevator door system (1) ignores a detected vibration activity if its strength, its duration or a count of vibration activities is out of a data range of the saved reference data in addition to a tolerance scope.
3. Elevator door system (1) of claim 1, wherein the vibration sensor (10) is installed on or in the elevator door (2, 3) and/or a wall of an elevator car (4),

whereat the said elevator door (2,3) comprises at least one hoistway door (2) and at least one car door (3) of the elevator car (4).

4. Elevator door system (1) of one of claims 1 to 3, wherein the detected vibration activity is sampled by a A/D-converter (9) in a time-discrete signal. 5
5. Elevator door system (1) of claim 4, wherein the signal conditioner circuit (8) calculates and analyses the sampled time-discrete signal through a signal-transform algorithm, especially by using of DFT (Discrete Fourier Transform) or FFT (Fast Fourier Transform). 10
6. Elevator door system (1) of one of claims 1 to 5, wherein the generated control signal (6) can be canceled depending on another comparison result. 15
7. Elevator door system (1) of one of claims 1 to 6, wherein an indication device (11) indicates whether the vibration activity is registered as an elevator car calling or not or canceled, said indication device comprising a visible and/or an acoustical signal. 20
8. Elevator door system (1) of one of claims 1 to 7, wherein a target floor or a direction in which the elevator car (4) moves to a target floor is defined by a strength or/and count of a number or vibration activities, a time interval length between two vibration activities or/and a combination of two or more vibration activities. 25
9. Method for calling an elevator car (4), the method comprising: 30
- detecting a vibration activity on an elevator door (2, 3);
- comparing the detected vibration activity with a saved reference data;
- generating a control signal (6) depending on a comparison result; 35
- opening and/or closing the elevator door (2, 3) in response to the control signal (6). 40
10. Method of claim 9, wherein the detected vibration activity will be ignored if its strength, its duration or a count of vibration activities is out of a data range of the saved reference data in addition to a tolerance scope. 45
11. Method of claim 9 or 10, further comprising: 50
- sampling the detected vibration activity in a time-

discrete signal.

12. Method of claim 11, further comprising:

calculating and analyzing the detected vibration activity through a signal-transform algorithm, especially by using of DFT (Discrete Fourier Transform) or FFT (Fast Fourier Transform).

13. Method of one of claims 9 to 12, wherein the generated control signal (6) can be canceled depending on another comparison result.

14. Method of one of claims 9 to 13, further comprising:

with a visible and/or an acoustical signal indicating whether the vibration activity is registered as an elevator car calling or not or canceled.

15. Method of one of claims 9 to 14, further comprising:

defining a direction in which an elevator car (4) moves to a target floor through a strength of the vibration activity, a time interval length between two vibration activities or a combination of two or more vibration activities.

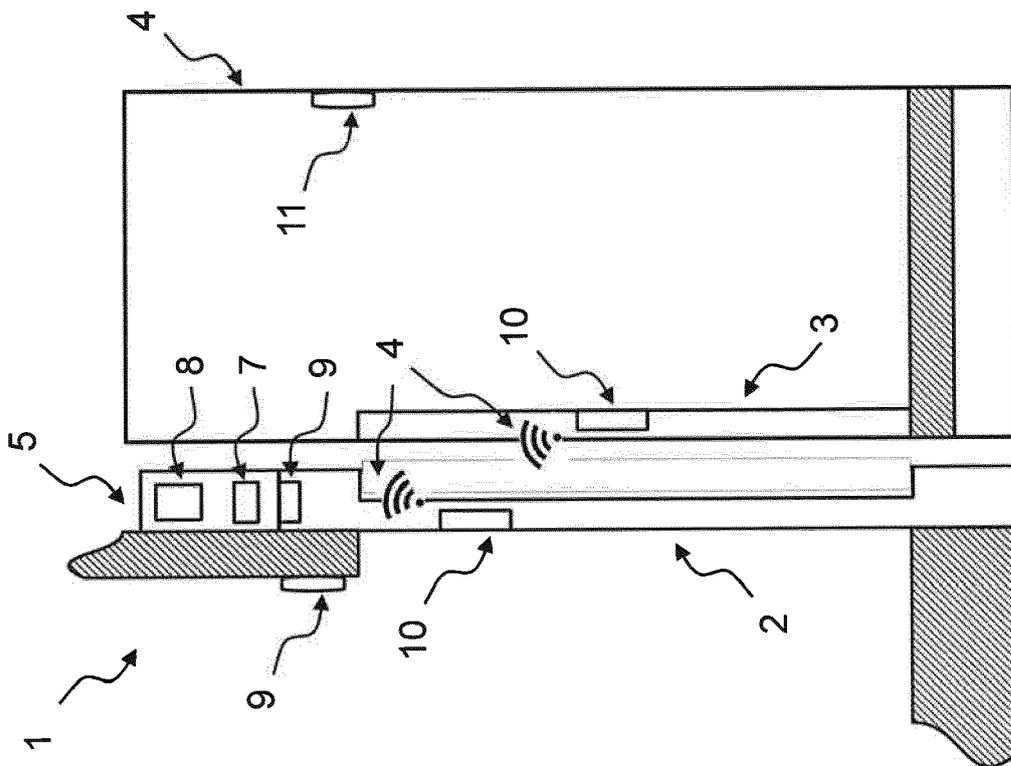


Fig.1



EUROPEAN SEARCH REPORT

Application Number
EP 17 20 5807

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 June 2018	Examiner Miklos, Zoltan
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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