



(51) International Patent Classification:
B66B 5/00 (2006.01)

(21) International Application Number: PCT/EP2021/080492

(22) International Filing Date: 03 November 2021 (03.11.2021)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) Priority Data:
20207206.2 12 November 2020 (12.11.2020) EP

(71) Applicant: INVENTIO AG [CH/CH]; Seestrasse 55, 6052 Hergiswil (CH).

(72) Inventor: **STUDER, Christian**; Grossweidstrasse 13,
6010 Kriens (CH).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW,

SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

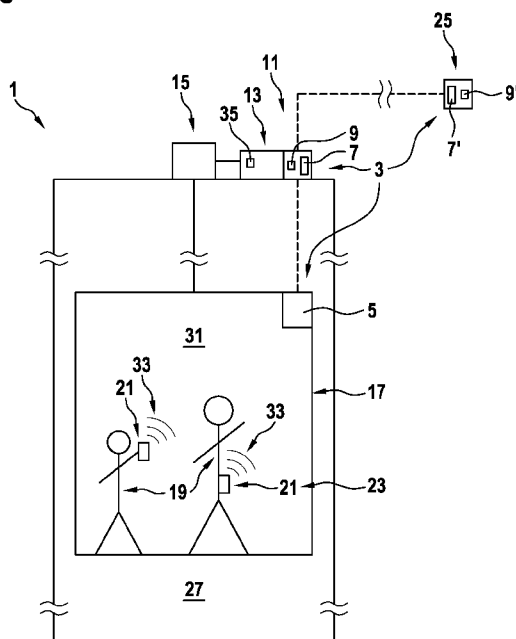
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

— *with international search report (Art. 21(3))*

(54) Title: METHOD AND SYSTEM FOR MONITORING USE OF AN ELEVATOR

Fig. 1



(57) Abstract: A method for monitoring use of an elevator and a corresponding elevator use monitoring system (3) are proposed. The method includes: - receiving short-range radio signals (33) emitted by mobile devices (23) located inside an elevator space (31), the radio signals (33) comprising unambiguous identity information associated to each individual mobile device (23); - storing identity data together with associated time stamp data, wherein the identity data is derived individually from each of the received radio signals (33) and wherein the time stamp data is indicating a point in time at which the respective radio signal (33) has been received; - upon receiving an indication that a predefined condition applies for a specific mobile device (23) from which radio signals (33) have previously been received: comparing stored time stamps associated with other mobile devices (23) with the stored time stamp associated to the specific mobile device (23) and issuing incidence information indicating those ones of the other mobile devices (23) for which the time stamp of the specific mobile device and the time stamp of the other mobile device (23) are within a predetermined time range.

Method and system for monitoring use of an elevator

The technology described herein generally relates to a method for operating an elevator.
5 More particularly, the technology relates to a method for monitoring use of the elevator.
The technology described herein further relates to an elevator use monitoring system, an
elevator, a computer program product and a computer readable medium configured for
implementing such method.

10 Elevators serve for transporting passengers with an elevator cabin throughout a building.
Typically, a multiplicity of passengers may be accommodated within the elevator cabin
and may then be transported for example from a starting floor to a destination floor in the
building. During such travel, further passengers may enter or exit the cabin during
intermediate stops at other floors.

15 Accordingly, various passengers have to share a limited elevator space within the elevator
cabin during a ride. Furthermore, a number and combination of passengers in a crowd
sharing the elevator space may change at every stop of the elevator cabin.

20 While this is generally no problem during normal operation of the elevator, there may be
situations such as during a pandemic like the Corona pandemic in which close contact or
proximity between people should be avoided and social distancing should be established
in order to reduce infection risks. Accordingly, due to the limited space in an elevator
cabin, a number of passengers being allowed to share the elevator cabin may have to be
25 restricted. However, such restriction may substantially limit a transportation capacity of
the elevator.

Accordingly, there may be a need for an alternative approach for enabling maintaining
transport capacity of the elevator during the mentioned situations as high as possible.

30 Such need may be met with the subject-matter of the independent claims. Advantageous
embodiments are defined in the dependent claims as well as in the following specification
and the associated figures.

According to a first aspect of the technology described herein, a method for monitoring use of an elevator is proposed, wherein the method comprises at least the following steps, preferably in the indicated order:

- 5 - receiving short-range radio signals emitted by mobile devices located inside an elevator space, the radio signals comprising unambiguous identity information associated to each individual mobile device;
- storing identity data together with associated time stamp data, wherein the identity data is derived individually from each of the received radio signals and wherein the time stamp data is indicating a point in time at which the respective radio signal has been
10 received;
- upon receiving an indication that a predefined condition applies for a specific mobile device from which radio signals have previously been received: comparing stored time stamps associated with other mobile devices with the stored time stamp associated to the specific mobile device and issuing incidence information indicating those ones of the
15 other mobile devices for which the time stamp of the specific mobile device and the time stamp of the other mobile device are within a predetermined time range.

According to a second aspect of the technology described herein, an elevator use monitoring system is proposed, the elevator use monitoring system being configured for
20 executing or controlling the method according to an embodiment of the first aspect of the technology described herein. Such elevator use monitoring system may comprise a short-range radio signal receiver, a data storage and a data processor. Therein, the short-range radio signal receiver is configured for receiving short-range radio signals emitted by mobile devices located inside the elevator space, the radio signals comprising
25 unambiguous identity information associated to each individual mobile device.

Furthermore, the data storage is configured for storing identity data together with associated time stamp data, wherein the identity data is derived individually from each of the received radio signals and wherein the time stamp data is indicating a point in time at which the respective radio signal has been received. Finally, the data processor is
30 configured for receiving indication data and for, upon receiving an indication data indicating that a predefined condition applies for a specific mobile device from which radio signals have previously been received, comparing stored time stamps associated with other mobile devices with the stored time stamp associated to the specific mobile device and issuing incidence information indicating those ones of the other mobile

devices for which the time stamp of the specific mobile device and the time stamp of the other mobile device are within a predetermined time range.

According to a third aspect of the technology described herein, an elevator is proposed,
5 the elevator comprising a short-range radio signal receiver and further comprising or being connected to a data storage and a data processor of an elevator use monitoring system according to an embodiment of the second aspect of the technology described herein.

10 According to a fourth aspect of the technology described herein, a computer program product is proposed, the computer program product comprising computer readable instructions which, upon being executed by a computer processor, instruct the computer to executing or controlling a method according to an embodiment of the first aspect of the technology described herein.

15 According to a fifth aspect of the technology described herein, a computer readable medium is proposed, the computer readable medium comprising stored thereon a computer program product according to an embodiment of the fourth aspect of the technology described herein.

20 Ideas underlying embodiments of the technology described herein may be interpreted as being based, inter alia, on the following observations and recognitions.

As briefly indicated above, limiting an allowable number of passengers using an elevator
25 in order to establish sufficient space between passengers e.g. in times of a pandemic generally results in a reduced passenger transportation capacity of the elevator.

An alternative or additional approach for preventing a wide spreading of an infection may be established by tracing contacts between people. In order to trace contacts between
30 persons which might result in a transmission of an infection from one person to another person due to the persons being in close neighbourhood for a sufficient duration, contact tracing apps have been developed. Such contact tracing apps are sometimes also referred to as Corona apps. Typically, such contact tracing app uses the fact that many persons carry mobile devices such as smartphones with them and that such mobile devices may

therefore be used as a tool for determining close proximity between the holders of the devices. In a common implementation, the contact tracing app controls the mobile device to, on the one side, emit short-range radio signals such as Bluetooth signals and, on the other side, receive short-range radio signals emitted from other mobile devices being
5 located in sufficiently close proximity. Thereby, contacts between neighbouring mobile devices may be detected. The mobile devices and/or any superordinate instance receiving data from such mobile devices may then memorise each contact between mobile devices. Typically, a criterion determining whether or not a contact shall be memorised may depend on a degree of proximity between the mobile devices and/or a duration during
10 which such proximity is established. For example, many Corona apps are configured to memorise the contact as soon as the proximity is less than 2 m and the duration is more than 15 minutes. As soon as a holder of a mobile device gets informed that he is affected by a highly transmissible disease such as Covid-19, information memorised by his mobile device about the close proximity contacts this person had within the previous days may
15 be used for informing all contacted persons such that these persons may e.g. be tested for an infection at an early stage.

However, it has been found that such contact tracing apps do generally not take into account specific situations and conditions as they appear upon using an elevator.
20 For example, conventional contact tracing apps such as Corona apps generally assume that a contact between two persons shall be classified as critical or potentially infectious when specific criteria are fulfilled. Setting such criteria may be necessary in order to limit a number of registered or memorised contacts to a reasonable extend. For example, such criteria may be set such that only contacts are registered and stored in which the persons
25 remain in close proximity of for example less than 2 m to each other longer than a predetermined time of for example more than 15 minutes.

However, it has been observed that in the specific conditions applying to elevator spaces, such criteria should be modified or other measures should be established in order to stay
30 abreast of the specific conditions.

For example, while a ride in an elevator cabin is typically not very long, particularly in general shorter than 15 minutes, passengers may have to stand next to each other in very close proximity during the ride. Furthermore, a volume within an elevator cabin may be

relatively small and an air exchange within such volume may not be sufficient for preventing an accumulation of aerosols within the cabin.

It has been found as a first observation that both, the close proximity between passengers as well as the accumulation of aerosols, and particularly a combination of both factors, may significantly increase a risk of an infection transmission between neighbouring passengers during, for example, an elevator ride. However, such increased infection risk is generally not taken into account by a contact tracing app as the proximity contact is typically shorter than the predetermined duration criterion.

Furthermore, it has been observed that aerosols exhaled by a passenger may remain within the elevator space for some extended duration, even though the passenger has already left the elevator space. Accordingly, it has been found as a second observation that even though passengers entering the elevator space at subsequent, non-overlapping time slots, i.e., a second passenger enters the elevator space after a first passenger has already left the elevator space, and these passengers do not necessarily come into close proximity to each other, there may be a substantial risk of infection transmission due to the aerosols e.g. exhaled by the first passenger and inhaled by the second passenger. However, such increased infection risk may not be taken into account by a contact tracing app as such app will not detect any proximity contact between the two affected persons.

It is assumed herein that the above-mentioned first observation might, in principle, be taken into account by temporarily modifying or adapting the contact tracing app, e.g., by modifying the criteria applied for detecting a potentially infectious proximity contact.

Such approach would imply that the contact tracing app is informed about specific conditions in its environment. However, such information transmission to the contact tracing app is generally not included in contact tracing apps and would require additional functionalities and/or hardware both on a side of the mobile device running the contact tracing app as well as on a side of the elevator in which the passenger contacts shall be traced.

Furthermore, it is assumed herein that the above-mentioned second observation may not be taken into account with conventional contact tracing apps as such apps may not have any information about mobile devices of passengers which have previously used or will

successively use the same elevator space but are not present in the elevator space at the same moment.

5 In order to overcome such deficiencies, it is therefore suggested herein to implement an additional functionality in an elevator by providing an elevator use monitoring system which enables a method for tracing passengers in the elevator space without having to modify the functionality of a contact tracing app and/or the hardware of a mobile device running such app. Instead, the elevator use monitoring system itself comprises hardware and functionalities which enable the tracing of passengers in the elevator space, which
10 passengers may be subject to an increased infection transmission risk due to using the elevator.

In the following, details of embodiments of the elevator use monitoring method and of hardware and functionalities of an elevator use monitoring system for implementing such
15 method shall be described.

Therein, according to an embodiment, it shall be assumed that one or more of the following conditions or situations may apply:

- the short-range radio signals are Bluetooth signals;
- 20 - the mobile device is a smartphone;
- a contact tracing app is executed on the mobile device; and
- the predefined condition is a positive test result regarding a highly transmissible infection concerning a passenger possessing the mobile device.

Furthermore, the elevator space may be assumed to be an inner volume of an elevator
25 cabin.

However, it shall be noted that these conditions or situations are only preferred options and do not form necessary features or requirements for the technology described herein.

In detail, the elevator use monitoring system may comprise several devices or
30 components including a short-range radio signal receiver enabling receiving short-range radio signals emitted by one or more mobile devices located within the elevator space. Short-range radio signals allow transmitting information in a wireless manner over short distances. The short-range radio signals may be transmitted in various electromagnetic frequency ranges. A transmission frequency in a GHz-range may be preferred,

particularly in a range of 2.4 – 2.5 GHz. The signals may be emitted with a power in a range of 0.1 – 100mW, preferably 1 – 10mW. Particularly, the short-range radio signals should have characteristics which allow determining a distance between an emitting device and a receiving device. Such distance determination should be enabled in a range from a few centimetres to a few metres, particularly e.g. in a range from 0.1m to 10m, more specifically in a range from 0.2 to 3 m. Characteristics of the receiver as well as of the short-range radio signals should be such that such short distances may be determined with a precision lying in a range of a few millimetres to several tens of centimetres, for example in a range from 1 cm to 1 m, preferably in a range from 3 cm to 30 cm.

Particularly, the short-range radio signals and the receiver may conform with the Bluetooth standard and technology.

The mobile device emitting the short-range radio signals may be any small device being portable and/or handheld by a passenger and including hardware and/or software for generating and emitting the radio signals. Particularly, the radio signals should comprise identity information, which is unambiguous, i.e. unique, such as to individually identify the mobile device emitting the radio signals. For example, the radio signals may represent or encrypt a code which is unambiguously attributed to the emitting mobile device. Inter alia, the mobile device may comprise a microwave signal generator for generating an electric microwave signal, an antenna for emitting an electromagnetic microwave signal upon receiving the electric signal and/or a controller including a processor for controlling the microwave signal generator and/or the antenna. There are various types of mobile devices having the required hardware already included, for example for implementing other functionalities. Accordingly, such mobile devices may be used for emitting the short-range radio signals required upon implementing the method proposed herein. For example, such mobile device may be a smartphone which a passenger or holder typically carries close to his body, for example in a pocket. Alternatively, such mobile device may be a computer, a laptop, a notebook, a tablet or a similar electronic device.

The mobile device may be running a contact tracing app. The contact tracing app may control the mobile device such that the above-mentioned short-range radio signals are emitted continuously or in short time intervals.

Accordingly, the elevator use monitoring system may use its short-range radio signal receiver for receiving the radio signals emitted by mobile devices in its proximity. The received radio signals may then be processed in order to extract identity data comprised therein, such identity data representing unambiguous identity information associated to the emitting mobile device. The identity data may then be stored together with associated time stamp data using for example the data storage of the elevator use monitoring system. Therein, the time stamp data indicate a point in time at which the radio signal comprising the identity information has been received, i.e. a point in time at which the mobile device and its holding passenger are present within the elevator space. Such procedure of receiving radio signals and storing identity data together with associated time stamp data may be applied to radio signals from each and every mobile device entering the elevator space and may be executed continuously or in short time intervals. Furthermore, the procedure may be continued during an operation of the elevator. The procedure may be temporarily interrupted, or an additional procedure may be initiated upon a predefined condition being recognised as a trigger.

The predefined condition, an indication of which shall be used as triggering the step of comparing stored time stamps and issuing incidence information upon time stamps of different mobile devices being recognised as lying within a predetermined time range, may be for example a positive test result regarding a highly transmissible infection or disease such as Covid-19. Such positive test result may be received by a passenger being the holder or possessor of one of the mobile devices.

In other words, the elevator use monitoring system may continuously be waiting for receiving indication data. Such receiving indication data may indicate that the predetermined conditions such as a positive Covid-19 test result apply for an affected passenger which has previously used the elevator and for whom identity data and associated time stamp data have therefore been previously stored.

It may then be checked whether other passengers were present in the elevator space simultaneously with the affected passenger or have entered the elevator space briefly after the affected passenger has left the elevator space. For such purpose, the elevator use monitoring system may use its data processor. Upon receiving the indication data indicating for example the positive Covid-19 test result of an affected passenger, the

processor may then compare the stored time stamp associated with the other mobile devices of other passengers with the stored time stamp associated to the specific mobile device of the affected passenger. In case both time stamps lie within a predetermined time range, incidence information may then be issued.

5

The incidence information may be issued such that it is received by the passengers owning the other mobile devices. Accordingly, upon receiving the incidence information, these passengers may be informed, e.g., about the risk that they might have been infected by a person with which they shared the elevator space. Accordingly, the incidence information may have a warning content.

10

The incidence information may for example be send by the elevator use monitoring system directly towards the mobile devices of the other passengers. Alternatively, for example in case data protection regulations prevent that the identities of these mobile devices are accessible to the elevator use monitoring system, the incidence information may be, e.g., sent to a superordinate instance and/or to all mobile devices running a contact tracing app such that the superordinate instance and/or each mobile device may then check the incidence information and may determine whether or not an increased infection risk applies to the device owner based on the contents comprised in the incidence information.

15

20

Summarised, the method proposed herein may be interpreted as an alternative or a supplementary approach to a functionality of a conventional contact tracing app which takes into account the specific conditions applying upon usage of an elevator.

25

Particularly, the methods may enable tracing passengers having an increased risk of infection after having used an elevator space which is also used by other passengers. Such elevator space may be the inner volume of an elevator cabin, wherein such volume is typically small and comprises for example between 1m^3 and 50m^3 . Accordingly, passengers in such an elevator cabin might have to stand very close to each other.

30

Furthermore, the volume of the elevator cabin is generally enclosed by cabin walls such that an air exchange is restricted to a limited extent. Accordingly, it may be assumed that there is a high probability of infection transmission in case two passengers share the elevator cabin simultaneously. There may even be a high probability of infection transmission in case two passengers are not in the elevator cabin simultaneously but a

second passenger enters the elevator cabin shortly after a first passenger left the elevator cabin. Accordingly, with the method proposed herein, the tracing of passenger contacts may be, in some respect, simplified in that an infection transmission is assumed for all passengers having been in the elevator space within a predetermined time range. Thus, neither a degree of proximity between two passengers has to be determined nor a duration during which these passengers have been in close proximity has to be measured. Instead, each and every passenger accessing the elevator space with its mobile device is memorised by storing corresponding identity data and time stamp data. The stored data are then used at a later point in time, in case a passenger realises that he is infected and then a suitable indication to the elevator use monitoring system is provided. The system may then inform all other passengers which have been present in the elevator space within the predetermined time range by issuing incidence information.

It may be noted that the method may not only be applied for tracing passengers in an elevator space formed by the inner volume of an elevator cabin but may also be applied in other elevator spaces. For example, passengers may be traced in an elevator space formed by a room or floor in front of an elevator door while for example waiting for the elevator cabin to arrive. Also, in such room or floor, an area accessible to passengers may be small and/or air exchange may be limited.

According to an embodiment, the time stamp data indicate at least one point in time of the time span starting with the mobile device entering the elevator space and ending with the mobile device exiting the elevator space.

In other words, the time stamp data associated to identity data of a detected mobile device may indicate any point in time in a time interval in which the mobile device was present in the elevator space. For example, the time stamp data may indicate the point in time when the passenger enters the elevator space and the predetermined time range may indicate a time span starting with such initial point in time. The predetermined time range may then, e.g., cover an entire duration in which the respective passenger stands within the elevator space plus, optionally, an additional duration after the passenger has left the elevator space.

In an alternative approach, the time stamp data do not only indicate one point in time but two or more points in time for a time interval. For example, the time stamp data may represent both, the point in time when the passenger enters the elevator space and the point in time when the passenger leaves the elevator space. The predetermined time range
5 may then include the time interval defined by such starting and ending point in time and may further include an additional duration subsequent to the ending point in time.

According to an embodiment in which the elevator space is the inner volume of the elevator cabin, the predetermined time range may be longer than a trip of the elevator
10 cabin between two adjacent floors. Preferably, the predetermined time range may be longer than a trip of the elevator cabin between two maximally distant floors served by the elevator.

Expressed differently, the predetermined time range taken into account upon determining
15 whether two passengers might have infected each other upon staying in the elevator space, may be set such that it is longer than the time interval during which a passenger is typically present within the elevator space. Such time interval may be assumed to correspond to the duration of a trip of the elevator cabin. Such trip extends at least between two adjacent floors served by the elevator. Preferably, the predetermined time
20 range shall be longer than a longest possible time interval during which a passenger is present within the elevator space under normal circumstances. Such longest possible time interval may be assumed to correspond to the duration of the trip of the elevator cabin upon travelling from a floor at one end of a travelling path to a floor at an opposite end of the travelling path served by the elevator cabin, i.e., a trip along the maximum distance
25 the elevator cabin may travel. The predetermined time range may be longer than the mentioned trip duration by an additional duration. Such additional duration may take into account that, due to aerosols exhaled by passengers during a trip, there may still be a risk of infecting other passengers after the exhaling passenger has left the elevator cabin.

According to an exemplary embodiment, the predetermined time range may be longer
30 than 1 min, preferably longer than 2 min, longer than 5 min or even longer than 10 min.

According to an embodiment in which the elevator space is the inner volume of the elevator cabin, the predetermined time range may be equal to or shorter than a sum of a

duration of a trip of an elevator cabin between two maximally distant floors and a duration required for performing a complete air exchange in the elevator cabin.

5 In other words, the predetermined time range may include both, the duration during which a passenger is present within the elevator cabin upon riding along a maximum distance throughout a building as well as an additional duration during which the air in the elevator cabin has to be exchanged completely. Taking into account such additional duration, it may be guaranteed that no aerosols exhaled by the passenger are still present within the elevator cabin and accordingly no substantial infection risk is to be assumed
10 for any passengers subsequently using the elevator cabin.

The duration required for the complete air exchange may depend on a size of the elevator cabin as well as on an air flow generated throughout the elevator cabin using for example a fan, an air conditioning device or any similar devices. Generally, such additional
15 duration may be assumed to be in a range of several minutes, for example in a range of between 0.2 and 10 minutes or between 1 and 5 minutes.

Instead of assuming a physical air exchange in the elevator cabin as a result of an air flow, it may also be assumed that characteristics of the air in the elevator cabin may be
20 modified for example due to disinfection measures, such change of characteristics also corresponding to an air exchange. For example, the complete air volume comprised in the elevator cabin may be filtered and/or germs, viruses and/or other infectious substances may be removed or killed using disinfection measures such as irradiating with high-energy radiation such as e.g. UV radiation.

25 According to an exemplary embodiment, the predetermined time range may be shorter than 15 min, preferably shorter than 10 min. Thus, the predetermined time range taken into account in the method proposed herein may be slightly shorter or even substantially shorter than a duration criterion typically assumed in conventional contact tracing apps
30 for determining whether or not any proximity contact is to be classified as being potentially infectious.

According to an embodiment, the monitoring method proposed herein is further configured such that, for each of the received radio signals, information about at least one

of a boarding floor and a destination floor is acquired, the boarding floor being a floor where a passenger carrying the mobile device is entering an elevator cabin and the destination floor being a floor where the passenger carrying the mobile device is leaving the elevator cabin. Therein, the method further comprises, upon receiving the indication that the predefined condition applies for the specific mobile device from which radio signals have previously been received, issuing localised incidence information with regard to one of the boarding floor and the destination floor. For implementing such functionality, an embodiment of the elevator use monitoring system may further comprise a trip tracking device, wherein the trip tracking device as well as the data processor are configured for executing or controlling the above-mentioned method steps.

In other words, in a specific implementation of the method proposed herein, additional information may be acquired during normal operation of the elevator and may then be used at a later point in time at which it is for example realised that a passenger having used the elevator is affected by a highly transmissible infection. Specifically, during the normal operation of the elevator, not only the short-range radio signals may be received from each mobile device entering the elevator, but, additionally, data representing at which floor the passenger carrying the mobile device has entered the elevator space as well as data representing at which floor of the passenger has left the elevator space may also be acquired. Such additional information may later be used for issuing specific localised incidence information. Such localised incidence information may for example indicate that a floor from which the infected passenger came before entering the elevator cabin and/or a floor at which the infected passenger left the elevator cabin may be subject to increased infection risk. Accordingly, for example people living or working at the respective floor may be warned.

For example, the trip tracking device may communicate with an elevator controller in order to determine at which floor a passenger entered and/or left the elevator cabin. For such purpose, the trip tracking device may request information about a current position of the elevator cabin at a point in time when receiving the radio signal from the mobile device of the passenger for the first time, i.e. when the passenger enters the elevator cabin, and/or when losing the radio signal, i.e. when the passenger exits from the elevator cabin.

Alternatively, the trip tracking device may communicate with other devices in the elevator, such other devices being operative for determining a passenger's entering and destination floor for example for other purposes. For example, elevator arrangements are available in which an access controller controls whether and where a passenger may enter and leave an elevator cabin based on identity data relating to the passenger. Such identity data may be provided to the elevator arrangement for example via a mobile device on which such identity data is stored. Alternatively, the identity data may be transmitted for example via a specific token, RFID tag or similar technical means. The trip tracking device may acquire such information from the access controller in order to thereby determine the boarding floor and the destination floor of a passenger.

In an elevator according to the third aspect of the technology described herein in which passenger contacts shall be monitored with the method and the elevator use monitoring system proposed herein, the short-range radio signal receiver may be positioned in or close to the elevator space to be supervised. For example, such receiver may be included or attached to a wall of the elevator cabin. Accordingly, the receiver may receive short-range radio signals from all locations within the elevator space. In cases of large elevator spaces, plural receivers may be provided at distributed locations.

While the radio signal receiver should be included directly in the elevator at the elevator space, the data storage and the data processor of the elevator use monitoring system may or may not be included in the elevator itself. Generally, each elevator may comprise its own data storage and data processor such that identity data and time stamp data may be stored and processed locally within the elevator. As an alternative, such data storage and/or data processor may be provided at a remote location such as for example in a remote elevator monitoring centre. Accordingly, data relating to the signals received by the radio signal receiver may be transmitted from the elevator towards the remote elevator monitoring centre and is may be processed and stored there for later use of each of the identity data and time stamp data.

In both implementations, the data storage may be a memory device which may store data in an electronic, electromagnetic, optic or any other physical manner. The data processor may be connected to both, the radio signal receiver and the data storage such as to enable exchanging signals and/or data. The data processor is configured for retrieving data from

the data storage and comparing retrieved time stamp data. Furthermore, the data processor is configured for initiating issuing of the incidence information. The elevator use monitoring system may comprise one or more data interfaces via which such incidence information may be transmitted to other devices. For example, the incidence information may be submitted to a superordinate instance device which may then e.g. process and/or forward such information to mobile devices.

Embodiments of the method described herein may be implemented in hardware, software or a combination thereof. Particularly, a computer program product may comprise computer readable instructions which instruct a computer processor to execute or control the method steps. The computer processor may be for example the data processor of the elevator use monitoring system. The computer program may be provided in any computer readable language.

Such computer program product may be stored on a computer readable medium from which the instructions of the program product may be read. Such computer readable medium may be for example a volatile or non-volatile data memory. For example, the computer readable medium may be a flash memory, a DVD, a CD, a ROM, a RAM, an EPROM or similar devices. Alternatively, the computer readable medium may be part of another computer or server or of a data cloud from which the computer program product may be downloaded for example via a network such as the Internet.

It shall be noted that possible features and advantages of embodiments of the technology described herein are described herein partly with respect to a method for monitoring use and/or passengers in an elevator space and partly with respect to an elevator use monitoring system being configured for implementing such method. One skilled in the art will recognize that the features may be suitably transferred from one embodiment to another and features may be modified, adapted, combined and/or replaced, etc. in order to come to further embodiments of the technology described herein.

In the following, advantageous embodiments of the technology described herein will be described with reference to the enclosed drawing. However, neither the drawing nor the description shall be interpreted as limiting the technology described herein.

Fig. 1 shows an elevator use monitoring system comprised in an elevator according to an embodiment of the technology described herein.

The figure is only schematic and not to scale. Same reference signs refer to same or similar features.

Fig. 1 shows an elevator 1 and an elevator use monitoring system 3. The elevator use monitoring system 3 comprises a short-range radio signal receiver 5, a data storage 7 and a data processor 9. The short-range radio signal receiver 5 is installed within an elevator cabin 17. The elevator cabin 17 may be displaced within an elevator shaft 27 using an elevator engine 15 controlled by an elevator controller 13 and being connected to the elevator cabin 17 via suspension traction means 29. As a possible option, the data storage 7 and the data processor 9 may be comprised in a monitoring controller 11 being part of the elevator 1. For example, such monitoring controller 11 may be part of or may be connected to the elevator controller 13. In another possible option, the data storage 7' and the data processor 9' may be located in a remote elevator monitoring centre 25 monitoring functionalities of the elevator 1.

During operation of the elevator 1, two or more passengers 19 may be present within an elevator space 31. In the example, this elevator space 31 is the inner volume of the elevator cabin 17. Each of the passengers 19 may have a mobile device 23 such as a smartphone 21 carried at or close to a body of the passenger 19. On such a mobile device 23, a contact tracing app may be executed. Accordingly, the mobile device 23 may continuously or periodically emit short-range radio signals 33 such as Bluetooth signals.

Using the proposed elevator use monitoring system 3, passengers 19 entering and leaving the elevator space 31 during operation of the elevator 1 may be traced. For such purpose, short-range radio signals 33 emitted by each of the mobile devices 23 of each of the passengers 19 may be received by the short-range radio signal receiver 5. The radio signals 33 comprise identity information which is unambiguous, and which is associated to each of the mobile devices 23 individually. Based on the received radio signals 33, the short-range radio signal receiver 5 may transmit data for example to the monitoring controller 11 and/or to the remote elevator monitoring centre 25. Accordingly, identity

data derived from such received radio signals 3 may be stored in the data storage 7 together with associated time stamp data indicating a point in time at which the respective radio signal 33 has been received. Optionally, the identity data and the associated time stamp data may be processed by the data processor 9. Accordingly, data indicating the presence and identity of a mobile device 23 within the elevator space 31 as well as a point in time of such presence are stored for later use.

When, at a later point in time, it is realised that a passenger 19 is affected by a predefined condition such as a positive test result of a highly transmissible infection, an indication may be transmitted to the elevator use monitoring system 3. Based on such indication, the elevator use monitoring system 3 may check whether a mobile device 23 belonging to this passenger 19 has previously been present within the elevator space 31.

Particularly, the system 3 may check whether identity data belonging to the mobile device 23 of this passenger 19 is stored within the data storage 7, 7'. If this is the case, the elevator use monitoring system 3 may check whether any other passengers 19 have been present within the elevator space 31 simultaneously with the affected passenger 19 or within a predetermined time range. Such checking may be established by comparing stored time stamps associated with other mobile devices 23 of other passengers 19 with the stored time stamp associated to the specific mobile device 23 of the affected passenger 19. Based on such comparison, incidence information indicating those ones of the other mobile devices 23 for which the time stamp of the specific mobile device 23 of the affected passenger 19 and the time stamp of the other mobile device 23 of another passenger 19 are within a predetermined time range may be generated. Based on such incidence information, the other passengers 19 may be informed that they might have been infected with the transmissible infection during a ride in the elevator 1.

As an optional component, the elevator use monitoring system 3 may additionally comprise or be connected to a trip tracking device 35. For example, such trip tracking device 35 may be included in the elevator controller 13. The trip tracking device 35 may acquire information about a boarding floor and/or a destination floor of a passenger 19 when the passenger 19 enters or leaves, respectively, the elevator space 31 in the elevator cabin 17. Such information may later be used e.g. by the data processor 9 for issuing localised incidence information with regard to the boarding floor and/or the destination

floor. Such localised incidence information may comprise e.g. warning information informing about a possible increased infection transmission risk in or close to the boarding floor and/or destination floor.

5 In the following, possible details, features and advantages of embodiments of the presented method and system are briefly described with a different wording as follows:

10 Passengers have tracing apps installed on their smartphones, as developed now in many countries and also by major IT companies. These apps register Bluetooth signals of other persons' mobile phones in proximity and store this information. If a person is reported to be infected, all persons which have been in proximity to the infected person get a notification.

15 One aspect is that the elevator may also be a part of this network, i.e. the elevator also has or behaves like a Bluetooth enabled device and also runs a dedicated tracing app, registering the Bluetooth signals of the other passengers' mobile phones which have the tracing app installed. The elevator is thus treated like a person and also gets notification if an infected person has used the elevator. In addition, the elevator can also indicate to passengers via tracing app that it was likely highly contaminated due to the presence of an
20 infected person.

Basically, it could be stated that passengers using tracing apps who have travelled together in an elevator already have the direct link between them and do not need an additional information through the elevator, i.e., the passengers are already in the tracing
25 network of the infected people.

However, the following arguments consider the elevator as an additional participant in the tracing app network:

- 30 - Passengers in trips which are just following the trips of an infected person are not part anymore of the tracing network of the infected due to the missing proximity. However, due to potential surface contaminations as well as droplets still in the air, infection risk may still be given;
- Normally (however this is in the flow), tracing apps only build up tracing networks if people are closer together for a longer time, e.g. 15 min. In the densely packed elevator,

however, also a much shorter time may be enough for an infection. It would probably make sense to adapt the exposure time which is required to be registered in a tracing network to the specific situation, i.e., in an elevator also short exposure times should be registered, while outside longer exposure times are adequate to be registered. This can only be achieved if the elevator is part of the tracing network.

In this sense, the following points are suggested:

- An elevator is part of a tracing network, having a Bluetooth enabled device, running a tracing app;

- The elevator registers all Bluetooth IDs of mobile phones, i.e., also of passengers which have a tracing app installed on their mobile phones and which ride the elevator, whereas the elevator additionally adds a time stamp to every registration. So, in difference to a classical tracing app, the elevator registers Bluetooth IDs of the passengers' mobile phones with the app installed independent of the duration of the contact due to the close proximity in an elevator. Additionally, the elevator registers the time stamp, as well as an optional trip origin and a destination;

- The elevator is notified via a tracing app if one of its passengers has been infected;

- The elevator derives at which time this infected passenger rode in the elevator and identifies all Bluetooth IDs of registered passengers' mobile phones within this trip as well as in a defined number of subsequent trips, and informs associated passengers on the infection risk;

- In addition, the elevator can report to a building management on which floors the infected persons has been, in case the floors of the trip origin and the destination of Bluetooth IDs also have been registered.

Finally, it should be noted that the term “comprising” does not exclude other elements or steps and the “a” or “an” does not exclude a plurality. Also, elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Claims:

1. Method for monitoring use of an elevator (1) by passengers (19), wherein the method comprises:
 - 5 - receiving short-range radio signals (33) emitted by mobile devices (23) located inside an elevator space (31), the radio signals (33) comprising unambiguous identity information associated to each individual mobile device (23);
 - storing identity data together with associated time stamp data, wherein the identity data is derived individually from each of the received radio signals (33) and wherein the time stamp data is indicating a point in time at which the respective radio signal (33) has been received;
 - 10 - upon receiving an indication that a predefined condition applies for a specific mobile device (23) from which radio signals (33) have previously been received: comparing stored time stamps associated with other mobile devices (23) with the stored time stamp associated to the specific mobile device (23) and issuing incidence information indicating those ones of the other mobile devices (23) for which the time stamp of the specific mobile device and the time stamp of the other mobile device (23) are within a predetermined time range.
- 20 2. Method of claim 1, wherein at least one of the following applies:
 - the short-range radio signals (33) are signals according to a Bluetooth standard;
 - the mobile device (23) is a smartphone (21);
 - a contact tracing app is executed on the mobile device (23); and
 - 25 -the predefined condition is a positive test result regarding a highly transmissible infection concerning a passenger (19) possessing the mobile device (23).
3. Method of one of the preceding claims, wherein the time stamp data indicate at least one point in time of a time span starting with the mobile device (23) entering the elevator space (31) and ending with the mobile device (23) exiting the elevator space
30 (31).
4. Method of one of the preceding claims, wherein the elevator space (31) is an inner volume of an elevator cabin (17).

5. Method of claim 4, wherein the predetermined time range is longer than a trip of an elevator cabin (17) between two adjacent floors, preferably longer than a trip of the elevator cabin (17) between two maximally distant floors.

5 6. Method of one of the preceding claims 4 and 5, wherein the predetermined time range is longer than 1 min.

7. Method of one of the preceding claims 4 to 6, wherein the predetermined time range is one of equal to and shorter than a sum of a duration of a trip of an elevator cabin (17) between two maximally distant floors and a duration required for performing a complete air exchange in the elevator cabin (17).

10

8. Method of one of the preceding claims 4 to 7, wherein the predetermined time range is shorter than 15 min.

15

9. Method of one of the preceding claims, wherein, for each of the received radio signals (33), information about at least one of a boarding floor and a destination floor is acquired, the boarding floor being a floor where a passenger (19) carrying the mobile device (23) is entering an elevator cabin (17) and the destination floor being a floor where the passenger (19) carrying the mobile device (23) is leaving the elevator cabin (17), and wherein the method further comprises, upon receiving the indication that the predefined condition applies for the specific mobile device (23) from which radio signals (33) have previously been received, issuing localised incidence information with regard to one of the boarding floor and the destination floor.

20

10. Elevator use monitoring system (3) being configured for one of executing and controlling the method according to one of the preceding claims.

25

11. Elevator use monitoring system (3) of claim 10, comprising:

- 30
- a short-range radio signal receiver (5),
 - a data storage (7, 7'), and
 - a data processor (9, 9'),

wherein

- the short-range radio signal receiver (5) is configured for receiving short-range radio

signals (33) emitted by mobile devices (23) located inside the elevator space (31), the radio signals (33) comprising unambiguous identity information associated to each individual mobile device (23);

- the data storage (7) is configured for storing identity data together with associated time stamp data, wherein the identity data is derived individually from each of the received radio signals (33) and wherein the time stamp data is indicating a point in time at which the respective radio signal has been received; and

- the data processor (9) is configured for receiving indication data and for, upon receiving an indication data indicating that a predefined condition applies for a specific mobile device (23) from which radio signals (33) have previously been received, comparing stored time stamps associated with other mobile devices (23) with the stored time stamp associated to the specific mobile device (23) and issuing incidence information indicating those ones of the other mobile devices (23) for which the time stamp of the specific mobile device (23) and the time stamp of the other mobile device (23) are within a predetermined time range.

12. Elevator use monitoring system (3) of one of claims 10 and 11, further comprising a trip tracking device (35), wherein the trip tracking device (35) is configured for, for each of the received radio signals (33), acquiring information about at least one of a boarding floor and a destination floor, the boarding floor being a floor where a passenger (19) carrying the mobile device (23) is entering an elevator cabin (17) and the destination floor being a floor where the passenger (19) carrying the mobile device (23) is leaving the elevator cabin (17) and wherein the data processor (9) is further configured for, upon receiving the indication that the predefined condition applies for the specific mobile device (23) from which radio signals (33) have previously been received, issuing localised incidence information with regard to one of the boarding floor and the destination floor.

13. Elevator (1) comprising a short-range radio signal receiver (5) and further being one of comprising and being connected to a data storage (7) and a data processor (9) of an elevator use monitoring system (3) according to one of claims 10 to 12.

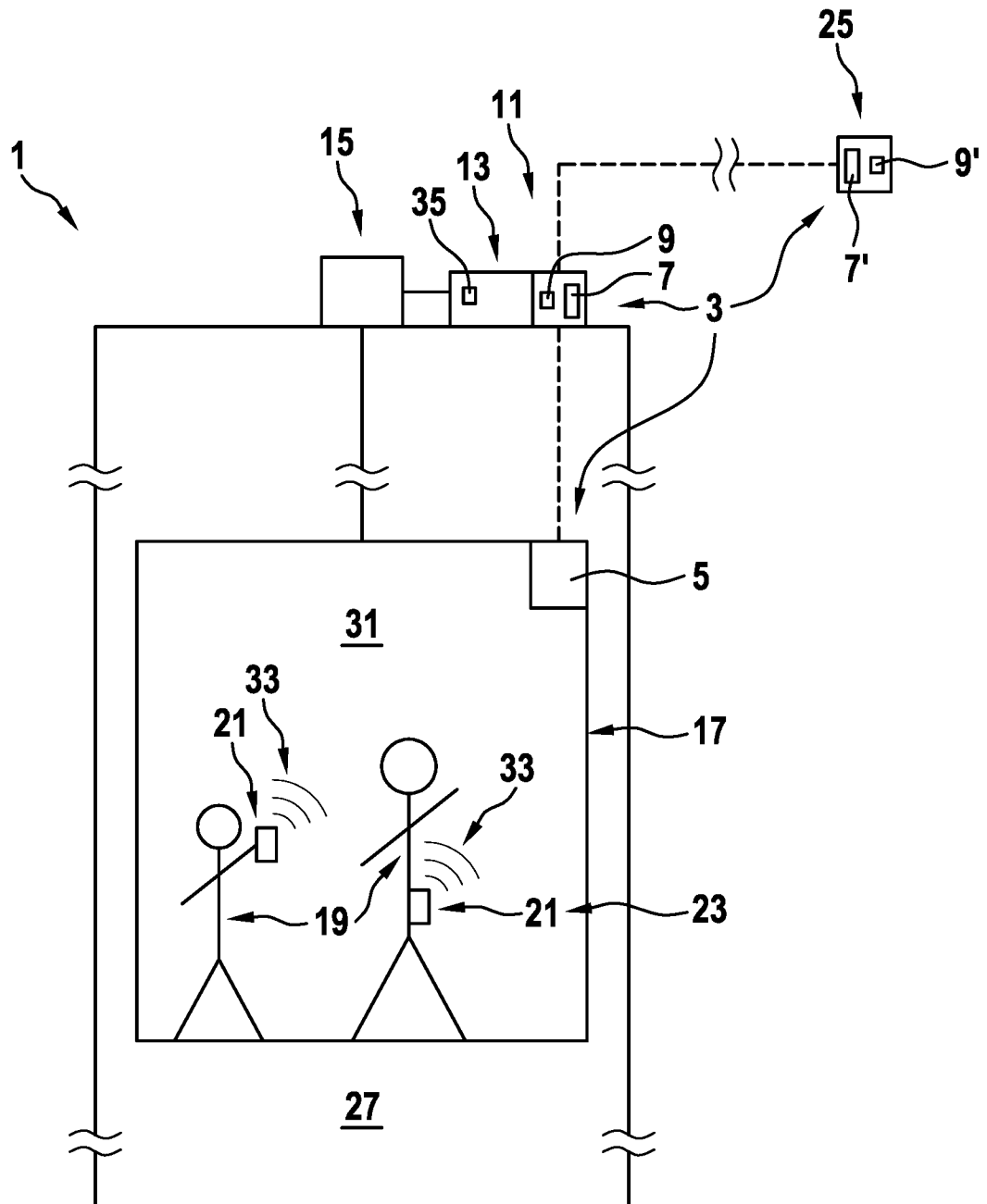
14. Computer program product comprising computer readable instructions which, upon being executed by a computer processor, instruct the computer to one of executing

and controlling a method according to one of claims 1 to 9.

15. Computer readable medium comprising stored thereon a computer program product according to claim 14.

1 / 1

Fig. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/080492

A. CLASSIFICATION OF SUBJECT MATTER INV. B66B5/00 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B66B G16H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111 339 992 A (DENG GUOHAO; LUO ZHIMING) 26 June 2020 (2020-06-26) abstract; figures 1-4 paragraphs [0053] - [0058], [0071], [0110], [0147] -----	1-15
A	CN 111 202 861 A (FOSHAN RUICHENG CLOUD INTELLIGENT LIGHTING TECH CO LTD) 29 May 2020 (2020-05-29) abstract; figure 1 -----	1-15
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 27 January 2022		Date of mailing of the international search report 07/02/2022
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Miklos, Zoltan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/080492

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CN 111339992	A	26-06-2020	NONE	

CN 111202861	A	29-05-2020	NONE	
