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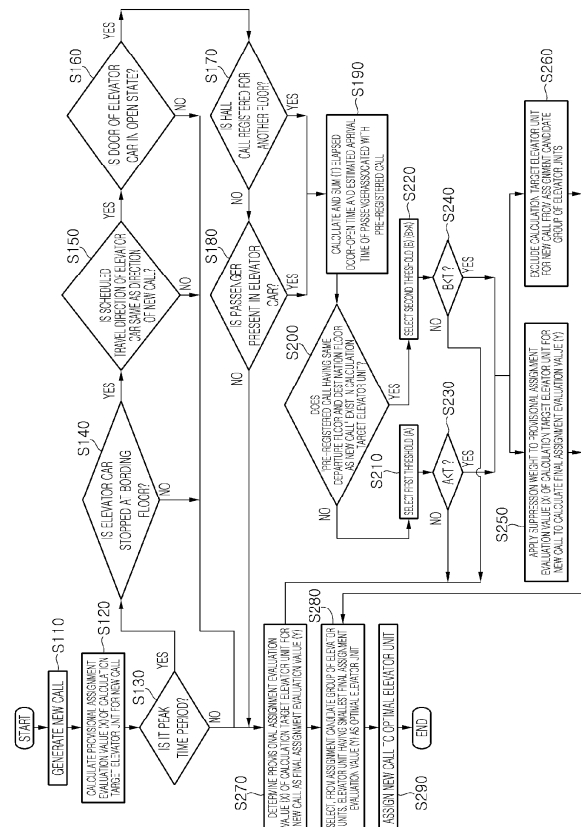
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80469 München (DE)**(30) Priority: **30.11.2023 KR 20230170563**(54) **ELEVATOR SYSTEM AND CONTROL METHOD THEREFOR**

(57) An elevator system is disclosed.

The elevator system includes a plurality of elevator units, wherein each of the plurality of elevator units includes one or more elevator cars, and when a new call is generated by a passenger and a door of the elevator car remains open for a predetermined time or more, an assignment suppression weight is applied to the corresponding elevator unit, or the elevator unit is excluded from assignment.

[FIG. 2]



Description

[Technical Field]

5 **[0001]** The present invention relates to an elevator system and a method of controlling the same.

[Background Art]

10 **[0002]** An elevator includes an elevator car configured to move along a hoistway formed in a vertical direction within a building, a hoisting machine configured to generate power to raise or lower the elevator car, a power transmission member configured to transmit the power of the hoisting machine to the elevator car, and the like.

[0003] The elevator car moves along the hoistway formed in the vertical direction within the building. A motor, a hoisting machine, and the like, for generating power to raise or lower the elevator car are installed. One or more elevators installed within the building may be integrally controlled and managed.

15 **[0004]** Non-robots such as persons, cargo, animals, and plants, and/or robots may be moved vertically within the building by the elevator. Recently, services provided by the robots have been activated. Various interworking control technologies between the robots and the elevators are being developed so that the robots may board the elevator and move between floors within the building.

20 **[0005]** Korean Patent Laid-Open Publication No. 10-1998-0009076, which is a prior art document, discloses a group management control technology for controlling a plurality of elevators installed in one building to operate organically with each other based on a predetermined assignment rule. According to the disclosure, a comprehensive evaluation value for assignment is calculated using state information and prediction information of each elevator for a generated hall call, a position evaluation value is calculated using a hall button and an assignment priority table of the elevators, and then the two evaluation values are combined to select an optimal assignment elevator unit, or a comprehensive evaluation value is
25 calculated using the state information and the prediction information of the elevators, a button position of the hall call, and the position evaluation value of the elevators to assign an optimal elevator unit.

<PRIOR ART LITERATURE>

30 <Patent Document>

[0006] Korean Patent Laid-Open Publication No. 10-1998-0009076

[Disclosure]

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[Technical Problem]

[0007] The present invention is directed to providing an elevator system for improving traffic flow and a method of controlling the same.

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[Technical Solution]

45 **[0008]** According to an aspect of the present invention for achieving the object, an elevator system is provided, including a plurality of elevator units, wherein each of the plurality of elevator units includes one or more elevator cars, and when a new call is generated by a passenger and a door of the elevator car remains open for a predetermined time or more, an assignment suppression weight is applied to the corresponding elevator unit, or the elevator unit is excluded from assignment.

[0009] According to another aspect of the present invention for achieving the object, a method of controlling the elevator system is provided, including: 1) generating a new call; 2) calculating and summing (T) an elapsed door-open time of an elevator car and an estimated arrival time of a passenger associated with a pre-registered call; and 3) selecting a threshold.

[0010] The method may further include, between step 1) and step 2), 1-1) calculating a provisional assignment evaluation value (X) of a calculation target elevator unit for the new call.

50 **[0011]** The method may further include, between step 1-1) and step 6): 5-1) determining the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call as a final assignment evaluation value (Y); and
55 5-2) selecting, from an assignment candidate group of elevator units, an elevator unit having the smallest final assignment evaluation value (Y) as an optimal elevator unit.

[0012] The method may further include, between step 1) and step 2), 1-2) determining whether a time at which the new call is generated is a peak time period, wherein, when the time at which the new call is generated is the peak time period in

step 1-2), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0013] The method may further include, between step 1) and step 2), 1-3) determining whether the elevator car is stopped at a boarding floor, wherein, when the elevator car is stopped at the boarding floor in step 1-3), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0014] The method may further include, between step 1) and step 2), 1-4) determining whether a scheduled travel direction of the elevator car is the same as a direction of the new call, wherein, when the scheduled travel direction of the elevator car is the same as the direction of the new call in step 1-4), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0015] The method may further include, between step 1) and step 2), 1-5) determining whether a door of the elevator car is in an open state, wherein, when the door of the elevator car is in the open state in step 1-5), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0016] The method may further include, between step 1) and step 2), 1-6) determining whether a hall call is registered for another floor, wherein, when the hall call is registered for another floor in step 1-6), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0017] The method may further include, between step 1) and step 2), 1-7) determining whether a passenger is present in the elevator car, wherein, when the passenger is present in the elevator car in step 1-7), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) in step 2).

[0018] The method may further include, between step 2) and step 3), 2-1) determining whether a pre-registered call having the same departure floor and destination floor as the new call exists in the calculation target elevator unit.

[0019] The threshold may include a first threshold (A) and a second threshold (B) in step 3), wherein, when the pre-registered call having the same departure floor and destination floor as the new call does not exist in the calculation target elevator unit in step 2-1), after the first threshold (A) is selected in step 3), it may be determined whether a sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) in step 4), wherein, when the pre-registered call having the same departure floor and destination floor as the new call exists in the calculation target elevator unit in step 2-1), after the second threshold (B) is selected in step 3), it may be determined whether the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) in step 4).

[0020] The method may further include: 4) determining whether the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the threshold; 5) applying a suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y), or excluding the calculation target elevator unit for the new call from the assignment candidate group of elevator units; and 6) assigning the new call to the optimal elevator unit, wherein, when the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the threshold in step 4), the suppression weight may be applied to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y), or the calculation target elevator unit for the new call may be excluded from the assignment candidate group of elevator units in step 5).

[0021] When information on a passenger who has registered the new call is available, a value of the threshold may be differently applied depending on a type of the passenger.

[0022] The type of the passenger may include a robot, a priority passenger, and a general passenger, a threshold applied to the robot may be greater than a threshold applied to the general passenger, and a threshold applied to the priority passenger may be greater than the threshold applied to the general passenger.

[Advantageous Effects]

[0023] According to the present invention, it is possible to alleviate concentration of new calls on a specific elevator unit. In addition, waiting time of passengers can be reduced. Further, traffic flow for a plurality of elevators can be facilitated. Furthermore, it is possible to contribute to energy saving.

[Description of Drawings]

[0024]

FIG. 1 is a diagram schematically illustrating a state in which a robot and a non-robot are on board an elevator car included in an elevator system of the present invention.

FIG. 2 is a schematic flowchart of a method of controlling an elevator system according to an embodiment of the present invention.

FIG. 3 is a diagram schematically illustrating a distance between a passenger and an elevator unit at a boarding floor.

FIG. 4 is a diagram schematically illustrating a distance between a security gate and the elevator unit at the boarding floor.

[Mode of Invention]

[0025] Hereinafter, configurations and actions relating to preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The present invention may be variously utilized and applied in the fields of robot control and elevator control. In addition, the following embodiments may be altered in various other forms, and the scope of the present invention is not limited to the following embodiments.

[0026] FIG. 1 is a diagram schematically illustrating a state in which a robot 310 and a non-robot 320, such a person, are on board an elevator car EC included in an elevator system of the present invention.

[0027] Referring to FIG. 1, not only the non-robot 320, such as a person, cargo, animal, and plant, but also the robot 310 may board the elevator car EC included in the elevator system of the present invention. In the present specification, the robot 310 is used as a concept broadly encompassing autonomous moving bodies, unmanned moving bodies, or other mechanical devices that move and/or perform tasks automatically or by external control. The robot 310 may be a service robot for providing a service on at least one floor within a building.

[0028] According to the elevator system and the method of controlling the same of the present invention, when a new call is generated by a passenger and a door of the elevator car remains open for a predetermined time or more compared to a general case, an assignment suppression weight is applied to the corresponding elevator unit, or the corresponding elevator unit is excluded from assignment. A detailed description thereof is as follows.

[0029] FIG. 2 is a schematic flowchart of a method of controlling an elevator system according to an embodiment of the present invention.

[0030] Referring to FIG. 2, the method of controlling the elevator system according to the present embodiment may include one or more of generating a new call (S110), calculating a provisional assignment evaluation value (X) of a calculation target elevator unit for the new call (S120), determining whether it is a peak time period (S130), determining whether the elevator car is stopped at a boarding floor (S140), determining whether a scheduled travel direction of the elevator car is the same as a direction of the new call (S150), determining whether a door of the elevator car is in an open state (S160), determining whether a hall call is registered for another floor (S170), determining whether a passenger is present in the elevator car (S180), calculating and summing (T) an elapsed door-open time and an estimated arrival time of a passenger associated with a pre-registered call (S190), determining whether the pre-registered call having the same departure floor and destination floor as the new call exists in the calculation target elevator unit (S200), selecting a first threshold (A) (S210), and selecting a second threshold (B) (S220), determining whether a sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) (S230), determining whether the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) (S240), applying a suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate a final assignment evaluation value (Y) (S250), excluding the calculation target elevator unit for the new call from an assignment candidate group of elevator units (S260), determining the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call as the final assignment evaluation value (Y) (S270), selecting, from the assignment candidate group of elevator units, an elevator unit having the smallest final assignment evaluation value (Y) as an optimal elevator unit (S280), and assigning a new call to the optimal elevator unit (S290).

(1) Generating a new call (S110)

[0031] A new call is generated when a subject generating the new call inputs a "destination floor" to which the subject intends to go. In the present specification, the subject generating the new call including the robot 310 and the non-robot 320 is referred to as a "passenger".

[0032] The new call may be generated when the passenger inputs the destination floor through a call device installed at an elevator hall, or may be generated when the passenger remotely inputs the destination floor through an application

installed on a smartphone, and the like. In addition, when the robot 310 is the passenger, the new call may also be generated as the robot 310 or a robot management system transmits a destination floor input signal.

[0033] When the passenger inputs the destination floor through the call device installed at the elevator hall, a floor at which the call device is installed, that is, a floor associated with generation of the new call, may be a "boarding floor" on which the passenger intends to board an elevator.

[0034] When the passenger remotely inputs the destination floor, a floor on which the passenger is located may be set as the boarding floor (when a location of the passenger is identifiable by smartphone location tracking and the like), or the passenger may directly input the boarding floor.

[0035] When the passenger is the robot 310, a floor on which the robot 310 is located may be set as the boarding floor, and the robot 310 or the robot management system may transmit boarding-floor information.

[0036] When the new call is generated (S110), a provisional assignment evaluation value (X) of a calculation target elevator unit for the new call may be calculated (S120).

(2) Calculating the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call (S120)

[0037] When the new call is generated, the provisional assignment evaluation value (X) of the calculation target elevator unit is calculated. The provisional assignment evaluation value (X) is a value calculated in a previous step to determine a final assignment evaluation value (Y), and an elevator unit having the smallest final assignment evaluation value (Y) is selected as an optimal elevator unit.

[0038] The provisional assignment evaluation value (X) is calculated by using, as parameters, values such as an estimated arrival time of the calculation target elevator unit in a floor-direction of the new call, and an estimated arrival time of the calculation target elevator unit in a floor-direction of a pre-registered call, and the lower the provisional assignment evaluation value (X), the more the elevator unit is evaluated as being suitable for assignment. The "calculation target elevator unit" may include all elevator units installed within a building, and the provisional assignment evaluation value (X) may be calculated for each elevator unit, respectively.

[0039] In the present specification, the elevator unit refers to an ID set for each hoistway. In general, one elevator car EC is disposed in one elevator unit, however, the present invention is not limited thereto, and a plurality of elevator cars EC may be disposed in one elevator unit.

(3) Determining whether it is a peak time period (S130)

[0040] In order to improve traffic flow during a peak time period in which traffic flow is not smooth, it may be determined whether a time at which the new call is generated is the peak time period.

[0041] Whether it is the peak time period may be determined according to whether a current traffic volume is equal to or greater than a reference value. In order to recognize the current traffic volume and determine the reference value, a machine learning method may be used.

[0042] When a time at which the new call is generated is the peak time period ("Yes" in S130), it may be determined whether the elevator car EC is stopped at the boarding floor. When the time at which the new call is generated is not the peak time period ("No" in S130), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(4) Determining whether the elevator car is stopped at the boarding floor (S140)

[0043] When the elevator car EC is not stopped at the boarding floor, the passenger may not board the elevator car EC from the boarding floor, and the door of the elevator car EC may not be in an open state at the boarding floor, and thus it is determined whether the elevator car EC is stopped at the boarding floor at which the passenger intends to board the elevator.

[0044] When the elevator car EC is stopped at the boarding floor ("Yes" in S140), it may be determined whether a scheduled travel direction of the elevator car EC is the same as a direction of the new call (S150). When the elevator car EC is not stopped at the boarding floor ("No" in S140), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(5) Determining whether the scheduled travel direction of the elevator car is the same as the direction of the new call (S150)

[0045] When the scheduled travel direction of the elevator car EC stopped at the boarding floor is different from the direction of the new call, the corresponding elevator car EC does not move to a floor desired by the passenger making the

new call, and thus it is determined whether the scheduled travel direction of the elevator car EC stopped at the boarding floor is the same as the direction of the new call. For example, when the boarding floor of the new call is the third floor and the destination floor of the new call is the tenth floor, it is determined whether the elevator car EC stopped at the third floor, which is the boarding floor, is scheduled to travel upward.

[0046] When the scheduled travel direction of the elevator car EC is the same as the direction of the new call ("Yes" in S150), it may be determined whether the door of the elevator car EC is in an open state (S160). When the scheduled travel direction of the elevator car EC is not the same as the direction of the new call ("No" in S150), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(6) Determining whether the door of the elevator car is in an open state (S160)

[0047] In order to measure an elapsed door-open time when the door of the elevator car is in an open state (may include closing), it is determined whether the door of the elevator car EC stopped at the boarding floor is in an open state (may include closing). When the door of the corresponding elevator car EC is in an open state ("Yes" in S160), it may be determined whether a hall call is registered for another floor (S170). When the door of the corresponding elevator car EC is in a closed state ("No" in S160), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(7) Determining whether the hall call is registered for another floor (S170)

[0048] It is determined whether the hall call is registered for another floor that is not the boarding floor. When the hall call is not registered for a floor other than the boarding floor and also no passenger is present in the elevator car EC, there are no other passengers who would feel inconvenience even when a door-open time becomes longer, and thus it may not be necessary to particularly consider the elapsed door-open time and the like.

[0049] The hall call refers to a passenger outside the elevator car EC calling the elevator unit to the boarding floor, and a car call refers to a passenger on board the elevator car EC inputting a destination floor.

[0050] However, by inputting the destination floor in advance by the call device installed at the elevator hall, a smartphone, or the like, the hall call is registered from outside the elevator car EC, and, when the corresponding car performs the corresponding hall call service in a state consistent to a call direction (i.e., when the corresponding car arrives at the floor at which the passenger is waiting in the state consistent to the call direction), a group management system automatically registers the destination floor of the passenger in the corresponding car without requiring any additional action by the corresponding passenger on board the corresponding car, thereby causing the corresponding car to travel to the destination floor.

[0051] When the hall call is not registered for another floor ("No" in S170), it may be determined whether a passenger is present in the elevator car EC (S180). When the hall call is registered for another floor ("Yes" in S170), the elapsed door-open time and an estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) (S190).

(8) Determining whether a passenger is present in the elevator car (S180)

[0052] It is determined whether a passenger is present in the elevator car EC stopped at the boarding floor. When no hall call is registered for a floor other than the boarding floor and also no passenger is present in the elevator car EC, there are no other passengers who would feel inconvenience even when the door-open time becomes longer, and thus it may not be necessary to particularly consider the elapsed door-open time and the like.

[0053] In order to determine whether a passenger is present in the elevator car EC, an imaging apparatus or a weight sensor installed inside the elevator car EC may be used.

[0054] When a passenger is present in the elevator car EC stopped at the boarding floor ("Yes" in S180), the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call may be calculated and summed (T) (S190). When no passenger is present in the elevator car EC stopped at the boarding floor ("No" in S180), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(9) Calculating and summing (T) the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call (S190)

[0055] In order to compare a sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call with thresholds (A and B), each of the door-open time of the elevator car EC stopped

at the boarding floor and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T).

[0056] Even when the elapsed door-open time of the elevator car EC becomes longer, and a new call continues to be registered to the corresponding elevator unit, a delay time of the corresponding elevator car EC may become longer.

[0057] In addition, when the new call is registered while a passenger is located far away from the elevator unit, it may take a long time until the passenger arrives at the elevator car EC at the boarding floor.

[0058] Even in such a case, when passengers already on board the elevator car EC have to continue waiting, inconvenience and dissatisfaction of not only the passengers on board the elevator car EC but also passengers waiting on other floors will increase. In addition, when the waiting time of the elevator car EC becomes longer, it may also adversely affect the overall traffic flow.

[0059] Accordingly, the door-open time of the elevator car EC stopped at the boarding floor and the estimated arrival time of the passenger associated with the pre-registered call are summed, and a value thereof is used as a factor affecting selection of an optimal elevator unit.

[0060] In order to calculate the estimated arrival time of the passenger associated with the pre-registered call, the estimated arrival time may be derived using data of existing passengers.

[0061] FIG. 3 is a diagram schematically illustrating a distance between a passenger and an elevator unit at a boarding floor. Referring to FIG. 3, the estimated arrival time of the passenger may be calculated based on a distance (d) between passengers 310 and 320 and an elevator unit 340 at the boarding floor. In order to calculate the estimated arrival time of the passenger, communication with a smart terminal, an image recognized by the imaging apparatus 330, and the like may be utilized.

[0062] FIG. 4 is a diagram schematically illustrating a distance between a security gate and the elevator unit at the boarding floor. Referring to FIG. 4, the estimated arrival time of the passenger may be calculated based on a security gate 350 that has recognized the passenger's security information (employee ID, smart device, and the like) and a distance (d') to the elevator unit 340 at the boarding floor. When the passenger is the robot 310, the passenger may pass through the security gate 350 by obtaining authorization through communication with a security system associated with the security gate 350. In order to calculate the estimated arrival time of the passenger, the image recognized by the imaging apparatus 330 may be utilized.

[0063] When it is possible to predict an arrival time of the corresponding passenger in real time (e.g., when location tracking is possible by a smartphone, when the passenger is the robot 310, and the like), a real-time estimated arrival time of the corresponding passenger may be used.

(10) Determining whether a "pre-registered call having the same departure floor and destination floor as the new call" exists in the calculation target elevator unit (S200), selecting a first threshold (A) (S210), and selecting a second threshold (B) (S220)

[0064] In order to select the first threshold (A) or the second threshold (B) depending on whether there has been a pre-registered call, it is determined whether a "pre-registered call having the same departure floor and destination floor as the new call" exists in the calculation target elevator unit of which the provisional assignment evaluation value (X) was calculated (S120).

[0065] When the "pre-registered call having the same departure floor and destination floor as the new call" does not exist in the calculation target elevator unit ("No" in S200), the first threshold (A) may be selected (S210). When the "pre-registered call having the same departure floor and destination floor as the new call" exists in the calculation target elevator unit ("Yes" in S200), the second threshold (B), which is a value greater than the first threshold (A), may be selected (S220).

[0066] When the "pre-registered call having the same departure floor and destination floor as the new call" exists, rather than excluding the new call from the corresponding elevator unit, it may be more efficient, in terms of the overall traffic flow, to assign the new call to the corresponding elevator unit even though a waiting time of a passenger already on board the elevator car EC becomes even longer. Accordingly, in such a case, the second threshold (B), which is a value greater than the first threshold (A), may be selected to further broaden a registration range of the new call.

(11) Determining whether a sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) (S230)

[0067] When the first threshold (A) is selected (S210), it may be determined whether a sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) (S220). When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A), it may be determined that a delay time of the corresponding elevator unit becomes too long, and assignment of a new call to the corresponding elevator unit may be restricted or excluded.

[0068] When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) ("Yes" in S230), a suppression weight may be applied to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), or the calculation target elevator unit for the new call may be excluded from an assignment candidate group of elevator units (S260). When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is less than or equal to the first threshold (A) ("No" in S230), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(12) Determining whether the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) (S240)

[0069] When the second threshold B is selected (S220), it may be determined whether the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) (S240). When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B), it may be determined that a delay time of the corresponding elevator unit becomes too long, and assignment of a new call to the corresponding elevator unit may be restricted or excluded.

[0070] When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) ("Yes" in S240), the suppression weight may be applied to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), or the calculation target elevator unit for the new call may be excluded from the assignment candidate group of elevator units (S260). When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is less than or equal to the second threshold (B) ("No" in S240), the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call may be determined as the final assignment evaluation value (Y) (S270).

(13) Applying the suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), and excluding the calculation target elevator unit for the new call from the assignment candidate group of elevator units (S260)

[0071] When the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) or the second threshold (B) ("Yes" in S230 or S240), the suppression weight may be applied to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), or the calculation target elevator unit for the new call may be excluded from the assignment candidate group of elevator units (S260).

[0072] That the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the thresholds (A or B) refers to that waiting time of a passenger already on board the elevator car EC or a passenger waiting on another floor becomes longer, and thus, in this case, a smaller number of new calls are assigned to the corresponding elevator car EC, or no new call is assigned thereto.

[0073] When applying the suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), the suppression weight is applied to the elevator unit of which the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) or the second threshold (B) so as to increase the final assignment evaluation value (Y). Since the corresponding elevator unit is not excluded from assignment, when a final assignment evaluation value (Y) of another elevator unit is higher due to other factors, the corresponding elevator unit may be selected as the optimal elevator unit.

[0074] When the calculation target elevator unit for the new call is excluded from the assignment candidate group of elevator units, any elevator unit of which the sum value (T) of the elapsed door-open time and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) or the second threshold (B) is excluded from the assignment candidate group of elevator units, and thus the corresponding elevator unit is not selected as the optimal elevator unit.

[0075] Whether to apply the suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y) (S250), or to exclude the calculation target elevator unit for the new call from the assignment candidate group of elevator units (S260), may be selected by a customer, or may be selected by an elevator management system according to circumstances.

(14) Determining the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call as the final assignment evaluation value (Y) (S270)

[0076] The provisional assignment evaluation value (X) of the calculation target elevator unit for the new call, which was calculated in the previous step (S120), is determined as the final assignment evaluation value (Y) that serves as a criterion for selecting the optimal elevator unit.

(15) Selecting, from the assignment candidate group of elevator units, an elevator unit having the smallest final assignment evaluation value (Y) as the optimal elevator unit (S280), and assigning a new call to the optimal elevator unit (S290)

[0077] Among the assignment candidate group of elevator units, an elevator unit having the smallest final assignment evaluation value (Y) is selected as the optimal elevator unit (S280), and a new call is assigned to the selected optimal elevator unit (S290).

[0078] According to the present invention, when information on a passenger who has registered the new call is available, values of the thresholds (S210 and S220) may be applied differently depending on a type of the passenger. For example, when the passenger is the robot 310, when a new call is automatically generated as the passenger contacts an employee ID with a gate or the like, when the passenger registers a new call after verifying one's identity at a call device, or when the passenger provides one's information to an application of a smartphone, the information of the passenger who registered the new call may become available. In addition, information on the passenger who has registered the new call may be identified through the imaging apparatus. It is possible to recognize a wheelchair, a stroller, and the like through the imaging apparatus, and a customized passenger service corresponding thereto may be provided.

[0079] For example, the type of the passenger may be divided into the robot 310, a priority passenger, and a general passenger. The robot 310 may differ from the non-robot 320, such as a person, in terms of movement speed, boarding conditions, and the like, and thus a threshold having a value suitable for the robot 310 may be separately set. In a case of the robot 310, the threshold value may be set to be greater than that of the general passenger. The priority passenger may be, for example, a passenger having a relatively slow movement speed, such as a disabled person or an elderly person, or a passenger to whom convenience is to be provided, such as a VIP or an employee. In a case of the priority passenger, the threshold value may be set to be greater than that of the general passenger. The general passenger may be a passenger other than the robot 310 and the priority passenger.

[0080] The threshold value may be adjusted manually, or may be automatically adjusted according to preset conditions.

[0081] According to the present invention, in a system in which a plurality of elevators are operated, concentration of new calls on a specific elevator unit may be alleviated. Accordingly, waiting time of passengers may be reduced and furthermore, traffic flow of the system in which a plurality of elevators are operated may be facilitated, and improved elevator operation efficiency may contribute to energy saving.

[0082] It will be apparent to those skilled in the art that the present invention is not limited to the above-described embodiments, and may be variously modified and altered without departing from the technical spirit of the present invention.

<Description of Reference Numerals>

[0083]

EC:	Elevator car	310:	Robot
320:	Non-robot	330:	Imaging apparatus
340:	Elevator unit	350:	Security gate

Claims

1. An elevator system comprising

a plurality of elevator units,
wherein each of the plurality of elevator units includes one or more elevator cars, and
when a new call is generated by a passenger and a door of the elevator car remains open for a predetermined time or more, an assignment suppression weight is applied to the corresponding elevator unit, or the elevator unit is excluded from assignment.

2. A method of controlling the elevator system of claim 1, the method comprising:

- 1) generating a new call;
- 2) calculating and summing (T) an elapsed door-open time of an elevator car and an estimated arrival time of a passenger associated with a pre-registered call; and
- 3) selecting a threshold.

3. The method of claim 2, further comprising, between step 1) and step 2),

- 1-1) calculating a provisional assignment evaluation value (X) of a calculation target elevator unit for the new call.

4. The method of claim 3, further comprising, between step 1-1) and step 6):

- 5-1) determining the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call as a final assignment evaluation value (Y); and
- 5-2) selecting, from an assignment candidate group of elevator units, an elevator unit having the smallest final assignment evaluation value (Y) as an optimal elevator unit.

5. The method of claim 2, further comprising, between step 1) and step 2),

- 1-2) determining whether a time at which the new call is generated is a peak time period, wherein, when the time at which the new call is generated is the peak time period in step 1-2), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

6. The method of claim 2, further comprising, between step 1) and step 2),

- 1-3) determining whether the elevator car is stopped at a boarding floor, wherein, when the elevator car is stopped at the boarding floor in step 1-3), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

7. The method of claim 2, further comprising, between step 1) and step 2),

- 1-4) determining whether a scheduled travel direction of the elevator car is the same as a direction of the new call, wherein, when the scheduled travel direction of the elevator car is the same as the direction of the new call in step 1-4), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

8. The method of claim 2, further comprising, between step 1) and step 2),

- 1-5) determining whether a door of the elevator car is in an open state, wherein, when the door of the elevator car is in the open state in step 1-5), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

9. The method of claim 2, further comprising, between step 1) and step 2),

- 1-6) determining whether a hall call is registered for another floor, wherein, when the hall call is registered for another floor in step 1-6), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

10. The method of claim 2, further comprising, between step 1) and step 2),

- 1-7) determining whether a passenger is present in the elevator car, wherein, when the passenger is present in the elevator car in step 1-7), the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call are calculated and summed (T) in step 2).

11. The method of claim 2, further comprising, between step 2) and step 3),
2-1) determining whether a pre-registered call having the same departure floor and destination floor as the new call exists in the calculation target elevator unit.

12. The method of claim 11,

wherein, the threshold includes a first threshold (A) and a second threshold (B) in step 3),
wherein, when the pre-registered call having the same departure floor and destination floor as the new call does not exist in the calculation target elevator unit in step 2-1), after the first threshold (A) is selected in step 3), it is determined whether a sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the first threshold (A) in step 4),
wherein, when the pre-registered call having the same departure floor and destination floor as the new call exists in the calculation target elevator unit in step 2-1), after the second threshold (B) is selected in step 3), it is determined whether the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the second threshold (B) in step 4).

13. The method of any one of claims 2 to 12, further comprising:

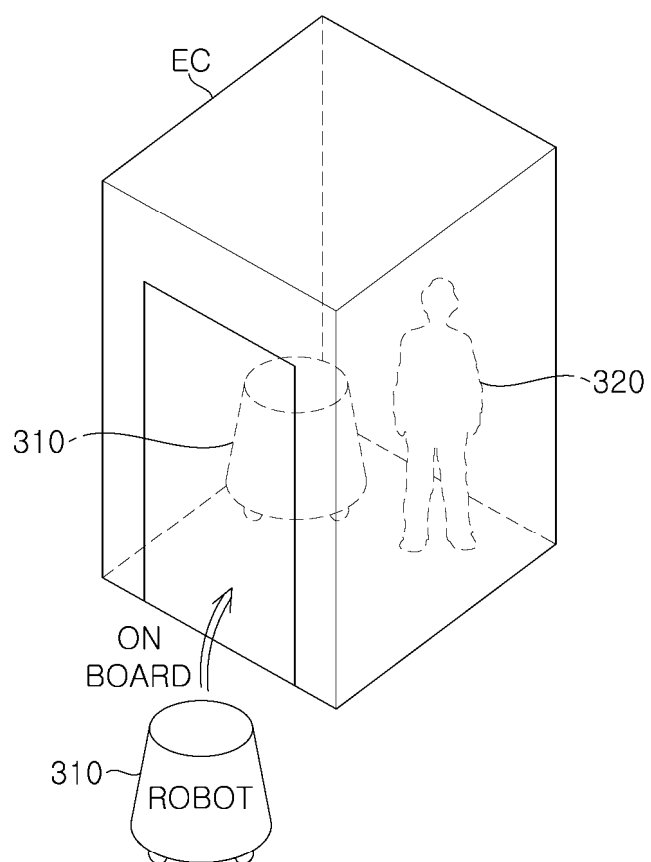
4) determining whether the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the threshold;
5) applying a suppression weight to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y), or excluding the calculation target elevator unit for the new call from the assignment candidate group of elevator units; and
6) assigning the new call to the optimal elevator unit,
wherein, when the sum value (T) of the elapsed door-open time of the elevator car and the estimated arrival time of the passenger associated with the pre-registered call is greater than the threshold in step 4), the suppression weight is applied to the provisional assignment evaluation value (X) of the calculation target elevator unit for the new call to calculate the final assignment evaluation value (Y), or the calculation target elevator unit for the new call is excluded from the assignment candidate group of elevator units in step 5).

14. The method of any one of claims 2 to 12,
wherein, when information on a passenger who has registered the new call is available, a value of the threshold is differently applied depending on a type of the passenger.

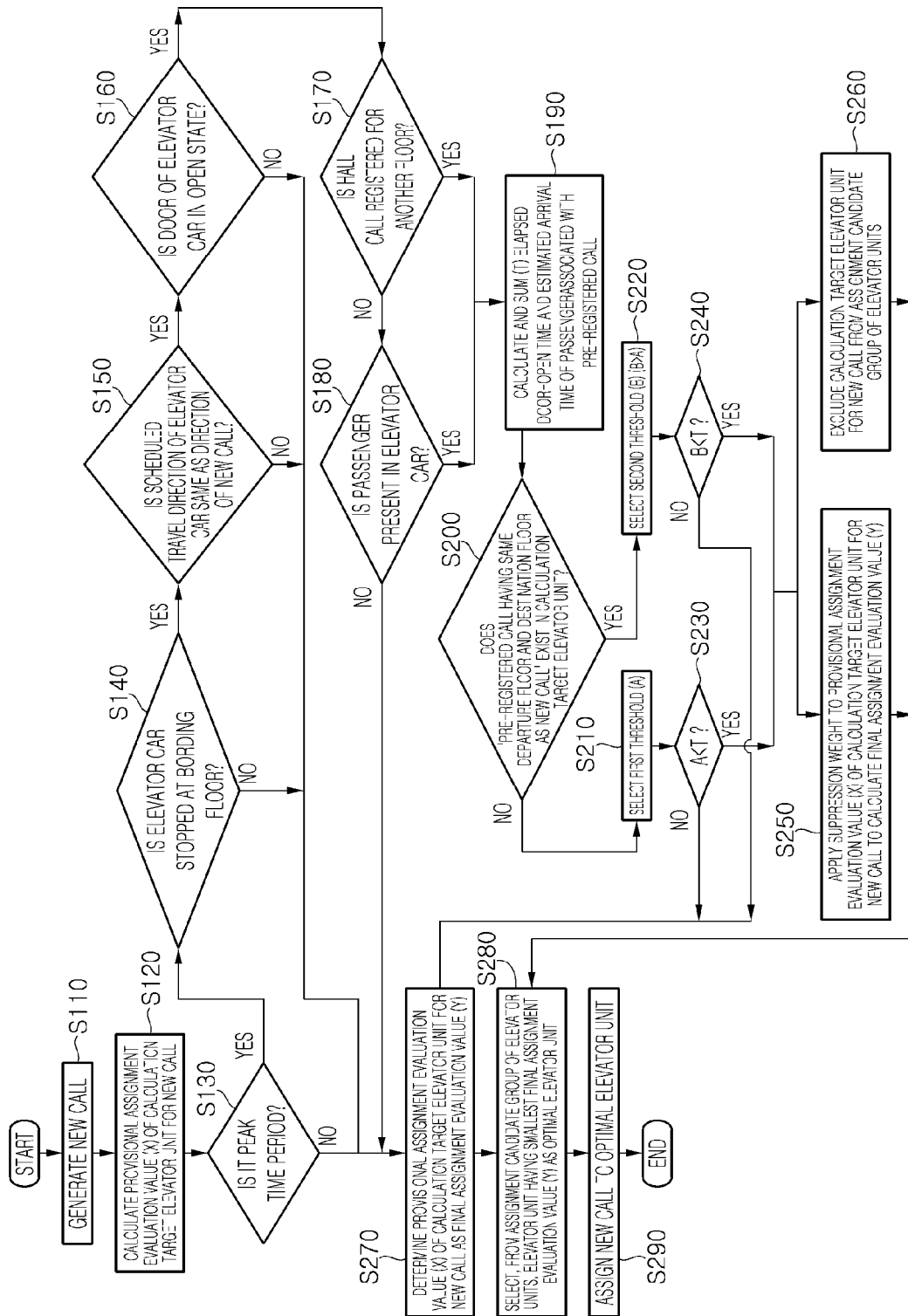
15. The method of claim 14,

wherein the type of the passenger includes a robot, a priority passenger, and a general passenger,
a threshold applied to the robot is greater than a threshold applied to the general passenger, and
a threshold applied to the priority passenger is greater than the threshold applied to the general passenger.

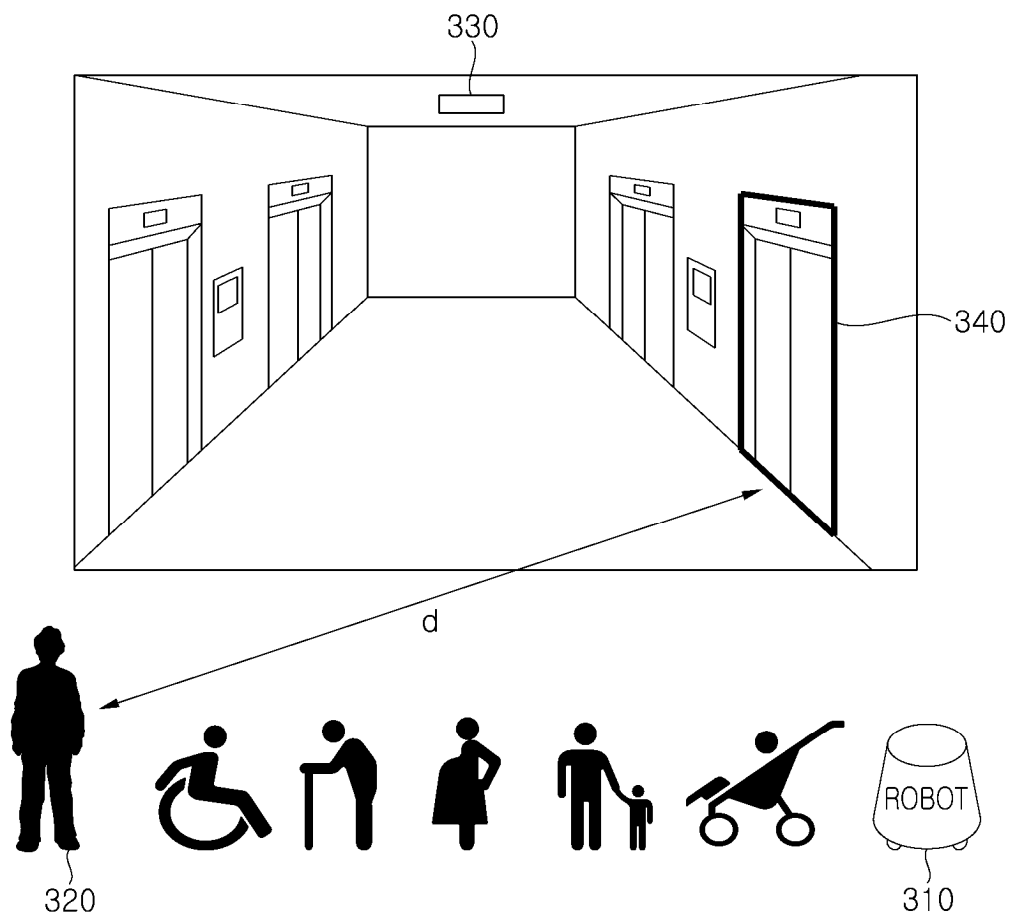
【FIG. 1】



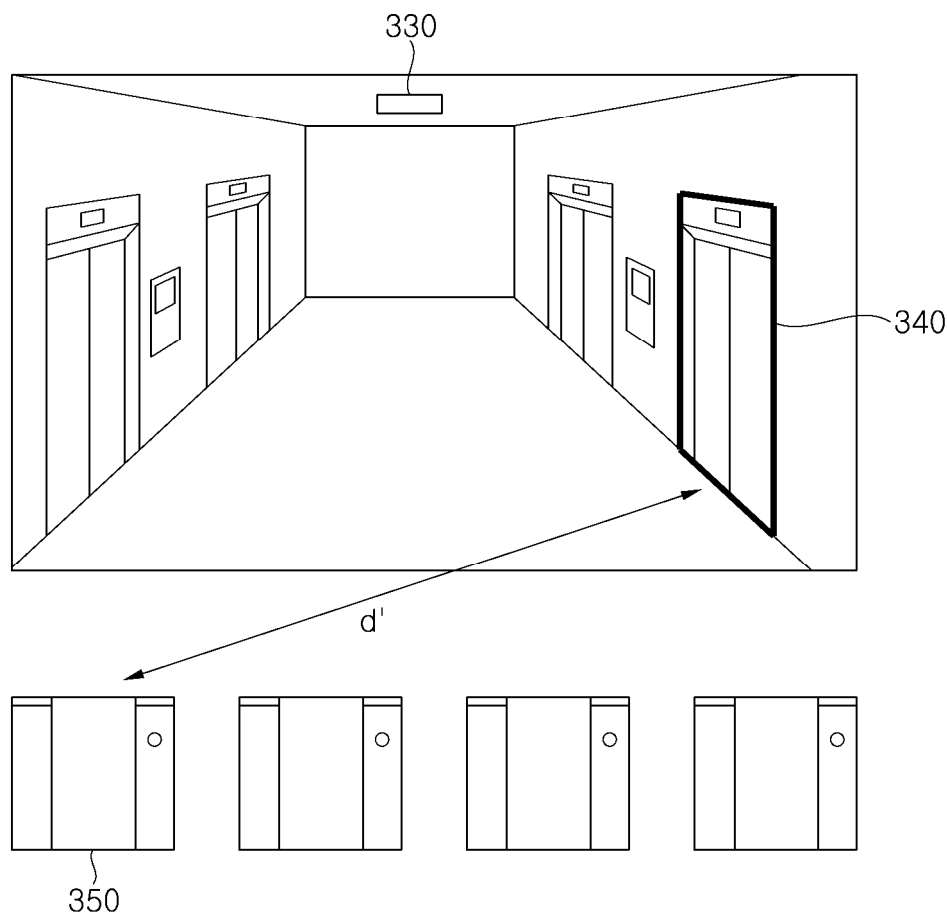
【FIG. 2】



【FIG. 3】



【FIG. 4】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/014467

A. CLASSIFICATION OF SUBJECT MATTER**B66B 1/46**(2006.01)i; **B66B 1/24**(2006.01)i

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 1/46(2006.01); B25J 13/00(2006.01); B25J 13/08(2006.01); B66B 1/18(2006.01); B66B 1/24(2006.01);
B66B 1/34(2006.01); B66B 13/14(2006.01); B66B 3/00(2006.01)

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

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 엘리베이터(elevator), 승객(passenger), 신규 호출(new call), 도어(door), 할당
(allocation)**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-1154804 B1 (MITSUBISHI ELECTRIC CORPORATION) 18 June 2012 (2012-06-18) See paragraphs [0057]-[0063], [0080], [0082], [0085], [0093], [0118]-[0119], [0228]- [0229] and [0235] and figure 3.	1-11
Y		14-15
A		12-13
Y	KR 10-2022-0009324 A (NAVER LABS CORPORATION) 24 January 2022 (2022-01-24) See paragraphs [0097] and [0151]-[0152].	14-15
A	US 2012-0041593 A1 (ICHINOSE et al.) 16 February 2012 (2012-02-16) See paragraphs [0125]-[0132].	1-15
A	KR 10-2583584 B1 (HYUNDAI ELEVATOR CO., LTD.) 06 October 2023 (2023-10-06) See claim 2.	1-15

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“&” document member of the same patent family

Date of the actual completion of the international search

24 December 2024

Date of mailing of the international search report

24 December 2024

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/014467

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2024/014467

5	Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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55				

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REFERENCES CITED IN THE DESCRIPTION

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