

ELEVATOR GROUP CONTROLLER

FIELD

Embodiments described herein relate generally to an elevator group controller for dual-access elevators, whose cars each have front and back doors.

BACKGROUND

A dual-access elevator is installed in some buildings, such as a hospital. The car of the dual-access elevator includes front and back doors. The hall of each floor includes a front hall and a back hall. In each hall, a hall call button for registering a hall call is provided.

In such a dual-access elevator, hall calls for the same direction may be registered in the front and back halls of a floor.

In the case where the floor is a high-demand floor catering to a large number of passengers, and both of the hall calls from the front and back halls are assigned to one elevator, when the elevator responds to the hall calls, the car of the elevator may be fully loaded only by passengers from one hall. This causes a problem that passengers in the other hall of the same floor cannot get on. The front and back doors of the car do not open simultaneously. After one door is opened or closed, the other door is closed or opened.

To solve such a problem of excluded passengers, a method of assigning hall calls from the front and back

halls of a floor to different elevators and causing the different elevators to respond to the hall calls has been common.

5 However, according to the method of assigning hall calls from the front and back halls to different elevators, two elevators respond to the same floor, which decreases operating efficiency. In particular, causing two elevators to respond to a low-demand floor with a small number of passengers is undesirable in
10 terms of power consumption.

 The purpose of the present invention is to provide an elevator group controller capable of performing efficient operation of dual-access elevators by preventing passengers being excluded when hall calls
15 are registered in the front and back halls of one floor.

SUMMARY

 In general, according to one embodiment, an elevator group controller comprising a plurality of
20 elevators, each comprising a car comprising a front door and a back door, and configured to control the elevators includes a management table configured to manage hall calls separately registered in a front hall and a back hall of each floor; a demand determination
25 unit configured to determine a demand of each floor; and an assignment controller configured to, when hall calls for a same direction are registered in the front

hall and back hall of a floor, assign both of the hall
calls registered in the front hall and back hall to one
of the elevators or assign one of the hall calls
registered in the front hall and back hall to another
5 one of the elevators, depending on the demand of the
floor determined by the demand determination unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a configuration of an elevator group
control system for dual-access elevators according to
10 one embodiment.

FIG. 2 shows a configuration of the front and back
halls of a dual-access elevator according to the
embodiment.

FIG. 3 shows an example of a hall call management
15 table in a group controller according to the
embodiment.

FIG. 4 is a flowchart showing operations of the
group controller according to the embodiment.

FIG. 5 is a table for explanation of a learning
20 table used in demand determination according to the
embodiment.

FIG. 6 is a diagram for explanation of a
monitoring camera used for demand determination
according to the embodiment.

25 FIG. 7 is a diagram for explanation of hall call
assignment control for a high-demand floor according to
the embodiment.

FIG. 8 is a diagram for explanation of hall call assignment control for a low-demand floor according to the embodiment.

DETAILED DESCRIPTION

5 Referring to the drawings, embodiments will be described below.

FIG. 1 shows a configuration of an elevator group control system for dual-access elevators according to one embodiment.

10 In a building, a plurality of dual-access elevators are installed in parallel. The dual-access elevator is an elevator in which a door for getting on and off a car is provided on two sides (front side and back side) of the car.

15 In the example shown in FIG. 1, group control is performed on four elevators A-D. However, the group control may be performed on any number of elevators.

A group controller 11 controls operation of each elevator in response to a hall call or an in-car call.
20 The hall call is a call signal registered by operation of a hall call button installed in each of the halls of floors. The hall call includes information on a registered floor and a destination direction (upward/downward). The in-car call is a call signal
25 registered by operation of a destination floor button in the car. The in-car call includes information on a destination floor.

The group controller 11 comprises, as functional configurations for realizing the present invention, a hall call management table 12, a demand determination unit 13, and an assignment controller 14. Explained
5 herein is the case where the group controller 11 includes therein all of the hall call management table 12, demand determination unit 13 and assignment controller 14. However, the hall call management table 12, demand determination unit 13 and assignment
10 controller 14 need not be provided in one apparatus, and may be provided in separate apparatuses.

The hall call management table 12 is storage means for managing hall calls registered in halls of floors. In the present embodiment, the halls of floors include
15 front halls 31a, 31b, 31c, . . . corresponding to the front doors of cars, and back halls 32a, 32b, 32c, . . . corresponding to the back doors of cars.

As shown in FIG. 2, front hall 31a and back hall 32a are physically separated due to the structure of
20 the building, and do not allow people to come and go therebetween. Element 35a in FIG. 2 is a front hall door, and element 36a is a back hall door. Front halls 31b, 31c, . . . and back halls 32b, 32c, . . . of the other floors have the same configurations as front hall
25 31a and back hall 32a.

In front hall 31a, a first hall call button 33a is installed. The first hall call button 33a includes a

direction button for designating a destination
direction, that is, upward or downward. When a
passenger presses the first hall call button 33a, a
front hall call is originated. The front hall call is
5 sent to the group controller 11 via a transmission
cable 37.

In back hall 32a, a second hall call button 34a is
installed. Like the first hall call button 33a, the
second hall call button 34a includes a direction button
10 for designating a destination direction, that is,
upward or downward. When a passenger presses the
second hall call button 34a, a back hall call is
originated. The back hall call is sent to the group
controller 11 via a transmission cable 38 and
15 registered in the hall call management table 12.

The same applies to front halls 31b, 31c, . . .
and back halls 32b, 32c, . . . of the other floors.
Front halls 31b, 31c, . . . and back halls 32b,
32c, . . . are provided with first hall call buttons
20 33b, 33c, . . . and second hall call buttons 34b,
34c,

FIG. 3 shows an example of the hall call
management table 12.

The hall call management table 12 stores, as
25 information on a hall call registered on a floor, a
hall call origination floor (i.e., registration floor),
a hall (front/back), and a travel direction (upward or

downward). When an assignee elevator, to which a hall call is assigned, is determined for the hall call, information on the assignee elevator is stored in the hall call management table 12.

5 The assignment controller 14 provided in the group controller 11 refers to the hall call management table 12, and determines an assignee elevator for a newly-registered hall call. More specifically, the assignment controller 14 selects the most appropriate
10 elevator based on a predetermined evaluation function, and assigns the hall call to the elevator.

 If hall calls for the same direction are registered in the hall call management table 12 in the front hall and back hall of a floor, the assignment
15 controller 14 assigns both of the hall calls from the front hall and the back hall to an elevator or assigns one hall call to another elevator, depending on the demand of the floor determined by the demand
 determination unit 13.

20 The demand determination unit 13 determines the demand of each floor. The demand is determined by, for example, determining whether a floor is a high-demand floor or a low-demand floor based on the load change made when an elevator responds to the floor.

25 The high-demand floor is a floor with a large number of passengers, and more specifically is a floor with passengers, the number of which exceeds a

predetermined reference value. The low-demand floor is a floor with a small number of passengers, and more specifically is a floor with passengers, the number of which is less than or equal to the predetermined
5 reference value. The reference value is determined in accordance with the traffic situations of the floors of the building.

To the group controller 11, elevator controllers 21a, 21b, 21c, 21d corresponding to elevators (A-D in
10 this embodiment) are connected. The elevator controllers 21a, 21b, 21c, 21d separately control operations of respective elevators. More specifically, the elevator controllers 21a, 21b, 21c, 21d perform, for example, motor control for moving up and down cars
15 22a, 22b, 22c, 22d, and door open/close control.

Car 22a includes front and back doors 23a, 24a, and includes therein an operation panel 25a including operation buttons, such as destination floor buttons, a door opening button and a door closing button.
20 Further, a load detector 26a for detecting a load is installed in the bottom of the car 22a. Various signals including, for example, an operation signal of the operation panel 25a and a load detection signal of the load detector 26a are transferred via the elevator
25 controller 21a to the group controller 11.

The other cars 22b, 22c, 22d have the same configuration.

Namely, car 22b includes front and back doors 23b, 24b, an operation panel 25b, and a load detector 26b. Various signals including, for example, an operation signal of the operation panel 25b and a load detection signal of the load detector 26b are transferred via the
5 elevator controller 21b to the group controller 11.

Car 22c includes front and back doors 23c, 24c, an operation panel 25c, and a load detector 26c. Various signals including, for example, an operation signal of
10 the operation panel 25c and a load detection signal of the load detector 26c are transferred via the elevator controller 21c to the group controller 11.

Car 22d includes front and back doors 23d, 24d, an operation panel 25d, and a load detector 26d. Various
15 signals including, for example, an operation signal of the operation panel 25d and a load detection signal of the load detector 26d are transferred via the elevator controller 21d to the group controller 11.

Next, operations in the present embodiment will be
20 described.

FIG. 4 is a flowchart showing operations of the group controller 11 according to the present embodiment. The operations shown in the flowchart are performed by the group controller 11, which is a
25 computer, reading a predetermined program.

When a new hall call is originated by operation of the hall call button of a floor (Yes in step S11), hall

call information of the floor is registered in the hall
call management table 12 in the group controller 11.

The hall call information includes information on the
origination floor (registration floor), hall (front or
5 back), and travel direction (upward or downward).

The assignment controller 14 of the group
controller 11 refers to the hall call management table
12, and determines whether hall calls for the same
direction are registered in the front hall and back
10 hall of the same floor (step S12).

If hall calls for the same direction are not
registered in the front hall and back hall of the same
floor (No in step S12), the assignment controller 14
performs normal assignment processing, and assigns the
15 hall call to the most appropriate elevator (step S13).

The case where hall calls in the same direction
are not registered at the front hall and back hall of
the same floor includes the following cases:

- A hall call is registered in one of the front
20 hall and back hall.

- Hall calls in different directions (upward and
downward) are registered in the front hall and back
hall.

In the normal assignment processing, the most
25 appropriate elevator is selected using a predetermined
evaluation function in response to a new hall call
regardless of whether the hall call is originated in

the front hall or back hall, and the hall call is assigned to the selected elevator.

If hall calls for the same direction are registered in the front hall and back hall of the same floor (Yes in step S12), the assignment controller 13 determines by the demand determination unit 13 whether the floor is a low-demand floor or a high-demand floor (step S14).

(Demand determination method)

10 (a) Load change

The demand of a floor may be determined by the load change made when an elevator responds to the floor. When an elevator responds to the floor, the number of passengers is estimated based on the difference between load values before and after door opening. If the number of passengers exceeds a reference value, the demand determination unit 13 determines that the floor is a high-demand floor. If the number of passengers is less than or equal to the reference value, the demand determination unit 13 determines that the floor is a low-demand floor.

The loads of elevators are obtained by the load detectors 26a, 26b, 26c, 26d. The sum of the numbers of the passengers in the front hall and the back hall of a floor is the number of the passengers of the floor. The demand determination unit 13 regularly (e.g., every ten minutes) determines whether each floor

is a high-demand floor or a low-demand floor by the above method, and reports the result to the assignment controller 14.

(b) Learning

5 The demand of a floor may also be determined by leaning the demand (the number of passengers) of each floor in every time period in advance. The demand determination unit 13 includes a learning table 41 shown in FIG. 5. The demand determination unit 13
10 refers to the learning table 41, and determines, based on the current time period, whether the floor is a high-demand floor or a low-demand floor.

 In the example of FIG. 5, the learning table 41 shows that, in the time period from 6 to 7, 10
15 passengers got on elevator A from the front hall of the first floor, and 5 passengers got on elevator A from the back hall of the same floor.

 In this case, $10+5=15$ is the number of passengers who got on elevator A of the first floor. The same
20 applies to the other elevators B, C, D. The number of passengers of each elevator is obtained by the load change made when the elevator responds to each floor as described in (a), above.

 The sum of the passengers of the elevators is the
25 number of passengers in the time period.

 Namely, the number of passengers of the first floor in the time period from 6 to 7 is $15+9+7+5=36$.

If the reference value is, for example, 50, the demand determination unit 13 determines that the first floor is a low-demand floor in the time period from 6 to 7.

(c) Monitoring camera

5 As shown in FIG. 6, monitoring cameras 42a, 42b, 42c . . . may be installed in front halls 31a, 31b, 31c . . . of respective floors. Similarly, monitoring cameras 43a, 43b, 43c . . . may be installed in back halls 32a, 32b, 32c . . . of respective floors.

10 The images of the front monitoring cameras 42a, 42b, 42c . . . and the back monitoring cameras 43a, 43b, 43c . . . are analyzed at an image analyzer 44, and the number of passengers who get on each elevator on each floor is estimated. The image analyzer 44 may
15 be installed in the group controller 11 or at another place.

 For image analysis, a common method is used, and the detailed description of the method is omitted herein. The demand determination unit 13 determines
20 whether each floor is a high-demand floor or a low-demand floor based on the analysis result of the image analyzer 44.

 Referring back to FIG. 4, when hall calls for the same direction are registered in the front hall and the
25 back hall of a floor, and it is determined that the floor is a low-demand floor (Yes in step S15), the assignment controller 14 assigns both of the hall calls

from the front and back halls to one elevator (step S16) as shown in FIG. 8.

If it is determined that the floor is a high-demand floor (No in step S15), the assignment
5 controller 14 assigns one of the hall calls from the front and back halls to another elevator (step S17) as shown in FIG. 7.

The assignment result of the assignment controller 14 is reported to the elevator controllers 21a, 21b,
10 21c, 21d of relevant elevators, whereby the elevator controllers cause the assignee elevators to respond to the hall calls.

FIG. 7 is a diagram for explanation of hall call assignment control for a high-demand floor.

15 For example, let us assume that a hall call registered in the front hall of a high-demand floor has already been assigned to elevator C. If a hall call for the same direction is registered in the back hall of the same floor, the hall call is assigned to the
20 appropriate elevator other than elevator C.

In this way, hall calls registered in the front hall and back hall of a high-demand floor with a large number of passengers are assigned to different elevators, thereby solving the problem that an elevator
25 is fully occupied by passengers from one hall and passengers from the other hall cannot get on.

FIG. 8 is a diagram for explanation of hall call

assignment control for a low-demand floor.

For example, let us assume that a hall call registered in the front hall of a low-demand floor has already been assigned to elevator C. If a hall call
5 for the same direction is registered in the back hall of the same floor, the hall call is assigned to elevator C.

In this way, hall calls registered in the front hall and back hall of a low-demand floor with a small
10 number of passengers are assigned to the same elevator, thereby reducing the number of stops of the other elevators and increasing the operating efficiency of the entire elevator system. Further, the power consumption can be reduced by preventing two elevators
15 from being sent to the same floor.

(Another embodiment)

In the above embodiment, hall call assignment is changed depending on the demand of each floor. However, the hall call assignment may be changed
20 depending on the time period.

For example, in the case of an office building, it is possible to determine in advance a peak time, such as a clock-in time and a clock-out time, and an off-peak time, such as night. In this case, in the peak
25 time, all the floors are high-demand floors. In the off-peak time, all the floors are low-demand floors. Therefore, the assignment controller 14 is provided

with the function of determining the current time period, and the following assignment control is performed:

5 For example, if hall calls are registered in the front hall and the back hall of the same floor in the peak time, the assignment controller 14 adopts assignment control for high-demand floors, and assigns the hall calls registered in the front hall and the back hall to different elevators.

10 If hall calls are registered in the front hall and the back hall of the same floor in the off-peak time, the assignment controller 14 adopts assignment control for low-demand floors, and assigns the hall calls registered in the front hall and the back hall to the
15 same elevator.

Accordingly, changing hall call assignment control between the peak time and the off-peak time produces the same effects as the ones produce in the above embodiment.

20 According to at least one of the above-described embodiments, an elevator group controller capable of performing efficient operation of dual-access elevators by preventing passengers being excluded when hall calls are registered in the front and back halls of one floor
25 can be provided.

While certain embodiments have been described, these embodiments have been presented by way of example

only, and are not intended to limit the scope of the
inventions. Indeed, the novel embodiments described
herein may be embodied in a variety of other forms;
furthermore, various omissions, substitutions and
5 changes in the form of the embodiments described herein
may be made without departing from the spirit of the
inventions. The accompanying claims and their
equivalents are intended to cover such forms or
modifications as would fall within the scope and spirit
10 of the inventions.

WHAT IS CLAIMED IS:

1. An elevator group controller comprising a plurality of elevators, each comprising a car comprising a front door and a back door, and configured to control the elevators, characterized by comprising:

5 a management table configured to manage hall calls separately registered in a front hall and a back hall of each floor;

10 a demand determination unit configured to determine a demand of each floor; and

15 an assignment controller configured to, when hall calls for a same direction are registered in the front hall and back hall of a floor, assign both of the hall calls registered in the front hall and back hall to one of the elevators or assign one of the hall calls registered in the front hall and back hall to another one of the elevators, depending on the demand of the floor determined by the demand determination unit.

20 2. The elevator group controller of Claim 1, characterized in that when the floor is a low-demand floor, the assignment controller assigns both of the hall calls registered in the front hall and back hall to one of the elevators, and when the floor is a high-demand floor, the assignment controller assigns one of the hall calls registered in the front hall and back hall to another one of the elevators.

25 3. The elevator group controller of Claim 1,

characterized in that the demand determination unit regularly determines the demand of each floor based on a load change made when each of the elevators responds to the floor.

5 4. The elevator group controller of Claim 1, characterized in that the demand determination unit comprises a leaning table obtained by learning the demand of each floor in every time period in advance, and determines the demand of each floor in a current
10 time period by referring to the learning table.

 5. The elevator group controller of Claim 1, characterized in that the demand determination unit analyses an image of a monitoring camera installed in each of the front hall and the back hall of each floor,
15 and determines the demand of each floor from a result of the analysis.

 6. The elevator group controller of Claim 1, characterized in that the assignment controller determines, based on a predetermined peak time and off-
20 peak time, that both of the hall calls registered in the front hall and back hall be assigned to one of the elevators or one of the hall calls registered in the front hall and back hall be assigned to another one of the elevators.

25 7. The elevator group controller of Claim 6, characterized in that the assignment controller performs assignment control for the high-demand floor

and assigns the hall calls registered in the front hall
and back hall to different cars of the elevators in the
peak time, and performs assignment control for the low-
demand floor and assigns the hall calls registered in
5 the front hall and back hall to one of the elevators in
the off-peak time.