

ELEVATOR GROUP MANAGEMENT SYSTEM

FIELD

Embodiments described herein relate generally to a group management system for an elevator group provided
5 with a plurality of cars.

BACKGROUND

For example, in a building in a well-trafficked area, such as an office building, a plurality of cars of elevators are installed. In such a building, when a
10 hall call is registered in a hall of an arbitrary floor, one of cars of elevators is caused to move to the floor at which the hall call is registered. At this time, there is a case where the car arrives at the floor while carrying some passengers. In such a case,
15 even if in the car, space is still provided to allow a further passenger or passengers to get into the car, and if plural passengers stand in the vicinity of the car door in the car, in some cases, a passenger or passengers waiting in the hall at the floor do not get
20 into the car, and call another car.

In such a manner, when a car arrives at a floor, there is a case where a passenger or passengers waiting in the hall of the floor do not get into the car, in consideration of the state of passengers in the car.
25 However, if a passenger does not get into a car which the passenger calls, the operation efficiency of elevators remarkably lowers. Consequently, a lot of passengers continue to stay waiting at the hall, thus increasing the time for which passengers wait for a
30 car.

SUMMARY

According to one aspect, there is provided an elevator group management system which includes plural cars, and causes, in response to a hall call registered
35 at an arbitrary floor, a selected one of the cars to move to the floor at which the hall call is registered, the elevator group management system comprising:

door-opening time detection means for detecting a state of a passenger or passengers waiting at a hall within a first range from a door of the car toward the hall, and a state of a passenger or passengers present in the vicinity of the door in the car within a second range from the door of the car toward a back side of the car, when the selected car arrives at the floor and the door of the car is opened; occupancy detection means for detecting an occupancy ratio of the car; rideable/unrideable-state determination means for determining, when the door-opening time detection means detects the state of the passenger or passengers waiting at the hall, whether or not the passenger or passengers waiting at the hall are allowed to get into the car, based on the occupancy ratio of the car at a point of time at which the car arrives at the floor, which is detected by the occupancy detection means; notification control means for issuing, when the rideable/unrideable-state determination means determines that the passenger or passengers are allowed to get into the car, a notification prompting the passenger or passengers to get into the car in consideration of the state of the passenger or passengers present in the vicinity of the door of the car, which is detected by the door-opening time detection means; and operation control means for closing the door of the car and causing the car to move to a next destination floor, when the occupancy ratio of the car is increased by the notification issued by the notification control means so that the occupancy ratio of the car is higher than that at the point of time at which the car arrives at the floor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing a configuration of a group management system of elevators, according to a first embodiment.

FIG. 2 is a view for explaining an imaging range of a camera installed in a car of an elevator and a function configuration of a car controller in the first

embodiment.

FIG. 3 shows a flowchart of a processing operation of the car controller in the first embodiment.

FIG. 4 shows a flowchart of the processing operation of the car controller in the first embodiment.

FIG. 5 shows a flowchart of a registration processing for registering a dummy call in the first embodiment.

FIG. 6 is a view showing an example of a notification prompting a passenger to get into a car in the first embodiment.

FIG. 7 shows a flowchart of a processing operation of a car controller in a second embodiment.

FIG. 8 shows a flowchart of a processing operation of a car controller in a third embodiment.

DETAILED DESCRIPTION

Embodiments will be described with reference to the accompanying drawings.

An elevator group management system according to one embodiment includes plural cars, and causes, in response to a hall call registered at an arbitrary floor, one of the cars to move to the floor at which the hall call is registered.

The elevator group management system includes: hall detection means for detecting a state of a passenger or passengers waiting at a hall, when the car arrives at the floor and a door of the car is opened; occupancy detection means for detecting an occupancy ratio of the car; rideable/unrideable-state determination means for determining, when the hall detection means detects the state of the passenger or passengers waiting at the hall, whether or not the passenger or passengers waiting at the hall are allowed to get into the car, based on an occupancy ratio of the car at a point of time at which the car arrives at the floor, which is detected by the occupancy detection means;

notification control means for making, when the
ridable/unridable-state determination means determines
that the passenger or passengers are allowed to get
into the car, a notification prompting a passenger or
5 passengers to get into the car; and operation control
means for closing the door of the car and causes the
car to move to a next destination floor, when the
occupancy ratio of the car is increased by the
notification issued by the notification control means
10 so that the occupancy ratio of the car is higher than
that at the point of time at which the car arrives at
the floor.

(First embodiment)

FIG. 1 is a block diagram showing a structure of a
15 group management system of elevators, according to a
first embodiment. In the example shown in FIG. 1,
plural elevators (three elevators A, B and C in the
example) are group-managed. It should be noted that
the term "elevator" used herein basically means the car
20 of an elevator.

In FIG. 1, reference numbers 11a to 11c denote car
controllers, and reference numbers 12a to 12c denote
cars. The car controllers 11a to 11c control the
operations of the cars 12a to 12c, respectively. To be
25 more specific, they control motors (traction machines)
not shown and opening/closing of doors of the cars.
The car controllers 11a to 11c comprise computers.

The cars 12a to 12c are moved up or down in
elevator shafts by driving of the motors (traction
30 machines), respectively. Load detectors 13a to 13c for
detecting live loads in the cars are disposed at bottom
portions of the cars 12a to 12c. Load data obtained by
detection processing of the load detectors 13a to 13c
is transmitted to a group management controller 10
35 through the car controllers 11a to 11c, respectively.

In the car 12a of elevator A, a car door 14a, an
operation panel 15a, a speaker 16a, etc., are

installed. The car door 14a is installed in such a way as to be openable/closable in the front doorway of the car 12a.

5 When the car reaches the hall, the car door 14a is engaged with a hall door not shown in a hall, and opened. The operation panel 15a is installed close to, for example, the car door 14a in the car. The operation panel 15a is provided with plural operation buttons including a destination floor button, a door-
10 opening button, a door-closing button, etc. The speaker 16a is installed in the operation panel 15a. It should be noted that in the example shown in FIG. 1, as a matter of convenience, the operation panel 15a and the speaker 16a are individually shown; however,
15 actually, the speaker 16a is located in the operation panel 15a. The speaker 16a is used in the case of making, for example, a voice announcement (see FIG. 6) for prompting a passenger or passengers to get into the car.

20 It should be noted that in the first embodiment, a monitoring camera 17a is installed close to the car door 14a in the car 12a. The camera 17a can perform imaging to obtain images of several frames per second, like a car-mounted camera. The camera 17a is installed
25 to face the car door 14a; and when the car 12a reaches any of floors and the car door of the car 12a is opened, the camera 17a images a state of the hall at the floor and a state of the vicinity of the car door 14a (see FIG. 2).

30 Each of images (video) obtained by the imaging performed by the camera 17a is subjected in real time to an analytical processing by an image processor 18a. The image processor 18a extracts, for example, an image of a person (a passenger who uses an elevator) from
35 each image, and performs, for example, an analytical processing to follow the motion of the person. It should be noted that the image processor 18a is

provided independent of the car controller 11a;
however, the car controller 11a may have the function
of the image processor 18a.

5 The car 12b of elevator B and the car 12c of
elevator C have the same structure as the car 12a of
elevator A.

To be more specific, in the car 12b of elevator B,
a car door 14b, an operation panel 15b, a speaker 16b,
etc., are installed. A monitoring camera 17b is
10 installed close to the car door 14b in the car 12b.
Furthermore, an image processing apparatus 18b which
performs in real time an analytical processing to each
of images (video) obtained by imaging performed by the
camera 17b is provided independent of the camera 17b.

15 In the car 12c of elevator C, a car door 14c, an
operation panel 15c, a speaker 16c, etc., are
installed. A monitoring camera 17c is installed close
to the car door 14c in the car 12c. Furthermore, an
image processing apparatus 18c which performs in real
20 time an analytical processing to each of images (video)
obtained by imaging of the camera 17c is provided
independent of the camera 17c.

In a hall (elevator hall) of each of the floors,
hall call buttons 21a, 21b, 21c, . . . for registering
25 hall calls are provided. The hall call buttons 21a,
21b, 21c, . . . are connected to the group management
control apparatus 10. The hall call buttons 21a, 21b,
21c, . . . comprise up buttons and down buttons, and
are each set such that the up button or down button of
30 each hall call button is pressed in accordance with a
passenger's intended destination direction. Of the
floors, at the lowest floor, only an up button is
provided, and at the highest floor, only a down button
is provided.

35 It should be noted that "hall call" corresponds to
a signal which indicates a call registered by operating
any of the hall call buttons installed in the hall of

each of the floors, and which includes information on a registration floor and a destination direction. "Car call" corresponds to a signal which indicates a call registered by operating any of the destination floor buttons installed in a car, and which includes information on a destination floor.

Furthermore, in the hall of each floor, lanterns 22a, 22b and 22c are installed. The lantern 22a is lit to indicate that the car 12a of elevator A arrives at the hall. Similarly, the lantern 22b is lit to indicate that the car 12b of elevator B arrives at the hall. The lantern 22c is lit to indicate that the car 12c of elevator C arrives at the hall. It should be noted that in the example shown in FIG. 1, the lanterns 22a, 22b and 22c are installed only at a single floor; however, actually, at each of the floors, lanterns 22a, 22b and 22c are installed.

The group management controller 10 is an apparatus for exerting a group management control of the operations of elevators A to C. The group management controller 10 as well as the car controllers 11a to 11c comprises a computer. When a new hall call is issued, the group management controller 10 selects an optimal one of the cars 12a to 12c, and assigns the hall call to the selected car.

To be more specific, the group management controller 10 selects an optimal one of the elevators based on information on operation states (the positions, driving directions, opening/closing states of the doors, etc.) of the elevators which is obtained from the car controllers 11a to 11c, information on whether a hall call or a car call is issued or not, a load, etc.; and outputs a hall-call assignment signal to the selected elevator. The hall-call assignment signal is sent to one of the car controllers 11a to 11c which is associated with the selected elevator. For example, if elevator A is selected, the hall-call

assignment signal is transmitted to the car controller 11a for elevator A. Thereby, the car controller 11a causes the car 12a to move to a registration floor, i.e., a floor at which the hall call is registered.

5 FIG. 2 is a view for explaining an imaging range of the camera 17a installed in the car 12a of elevator A and a function configuration of the car controller 11a. It should be noted that the following explanation is given referring to by way of example elevator A, and
10 can also be applied to the other elevators, i.e., elevators B and C.

 In the car 12a, the camera 17a is installed to face the car door 14a. When the car 12a arrives at an arbitrary floor and its door opens, the camera 17a
15 images the state of a hall 20 and that of the vicinity of the car door 14a in the car 12a. The range of the imaging at this time is adjusted such that $L1 + L2$ ($L1 > L2$). L1 is an imaging range on a hall side, and a distance from the car door 14a to a location in the
20 hall 20, for example, 5 m. L2 is an imaging range on a car side, and a distance from the car door 14a to a location in the car, for example, 50 cm. It should be noted that L2 and L1 are distances in a depth direction of the car and the opposite direction of the depth
25 direction, and it is assumed that the range of the imaging in a width direction (perpendicular to the depth direction and the opposite direction thereof) is greater than at least the width of the car 12a.

 Images (video) obtained by the imaging performed
30 by the camera 17a are subjected in real time to an analytical processing by the image processor 18a, and the images and the result of the analytical processing are sent to the car controller 11a. In contrast, to the car controller 11a, load data indicating the live
35 load of the car 12a is transmitted from the load detector 13a, which is installed at a bottom portion of the car 12a.

Furthermore, as functions of the present invention, the image processor 18a is provided with a hall detector 31 and a riding-state detector 35. The car controller 11a comprises an occupancy detector 32,
5 a rideable/unrideable-state determination module 33, a notification control module 34, an operation control module 36, and a dummy-call registration module 37.

In the image processor 18a, the hall detector 31 detects a waiting state of a passenger or passengers
10 waiting at the hall 20, when the car 12a arrives at a registration floor at which a hall call is registered and its door is opened. To be more specific, the hall detector 31 detects a waiting state of a passenger or passengers in the imaging range L1 as shown in FIG. 2
15 on the basis of the result of an analysis of an image obtained by imaging performed by the camera 17a, which is installed in the car 12a to face the car door 14a.

The riding-state detector 35 detects a state of a passenger or passengers who are in the vicinity of the
20 car door 14a in the car 12a. To be more specific, the riding-state detector 35 detects a state of a passenger or passengers who are present in the imaging range L2 as shown in FIG. 2 on the basis of the result of an analysis of an image obtained by imaging performed by
25 the camera 17a, which is installed in the car 12a to face the car door 14a.

In the car controller 11a, the occupancy detector 32 detects an occupancy ratio of the car 12a. To be more specific, the occupancy detector 32 detects the
30 occupancy ratio of the car 12a based on load data of a load detector 13a installed in the car 12a.

When the hall detector 31 detects a state of a passenger or passengers waiting at the hall 20, the rideable/unrideable-state determination module 33
35 determines whether a passenger or passengers waiting at the hall 20 can get into the car 12a or not, on the basis of the occupancy ratio detected by the occupancy

detector 32 at the point of time at which the car 12a arrives at the hall 20.

When the rideable/unrideable-state determination module 33 determines that a passenger or passengers can
5 get into the car 12a, the notification control module 34 issues a notification prompting a passenger or passengers to get into the car 12a. To be more specific, for both the hall side and the car side, i.e., the passenger or passengers waiting in the hall
10 20 and the passenger or passengers in the car 12a, the notification control module 34 makes an announcement for prompting a passenger or passengers to get into the car 12a through the speaker 16a installed in the car 12a.

15 After the announcement made by the notification control module 34, if the occupancy ratio of the car 12a is increased higher than that at the point of time when the car 12a arrived at the hall, the operation control module 36 closes the door of the car 12a and
20 causes the car 12a to start to move to a next destination floor.

When the rideable/unrideable-state determination module 33 determines that a passenger or passengers cannot get into the car 12a, or the number of the
25 passengers waiting in the hall 20 is not decreased after the announcement made by the notification control module 34, the dummy-call registration module 37 registers a dummy call for causing one of the other cars, i.e., the cars 12b and 12c, to move to the above
30 registration hall, before the car 12a starts to move to the next destination floor.

Next, an operation of the elevator group management system will be explained.

FIGS. 3 and 4 are flowcharts showing processing
35 operations of each of the car controllers according to the first embodiment.

Suppose for example, a hall call for upward

movement is registered in the hall 20 at the first floor, and is assigned to the car 12a of elevator A. When the car 12a arrives at the first floor (a registration floor at which the hall call is registered) (Yes in step S11), the car controller 11a opens the door of the car 12a to allow a passenger or passengers waiting in the hall 20 to get into the car 12a (step S12).

As explained above with reference to FIG. 2, when the car door 14a of the car 12a is opened at the hall 20, the state of the hall 20 and that of the vicinity of the car door 14a in the car 12a are imaged by the camera 17a installed in the vicinity of the car door 14a. Images (video) obtained by the imaging performed by the camera 17a are subjected in real time to an analytical processing by the image processor 18a, and then sent along with the result of the analytical processing to the car controller 11a. At this time, the live load of the car 12a is detected by the load detector 13a installed at the bottom portion of the car 12a, and load data indicating the live load is transmitted to the car controller 11a.

The car controller 11a first detects a state of a passenger or passengers waiting in the hall 20 on the basis of the result of the analytical processing regarding the above obtained image of the hall 20 (step S13). In this case, it is assumed that if a person or persons who are present in the imaging range L1 shown in FIG. 2 can be detected, they are regarded as passengers waiting in the hall 20 (passengers who intend to get into the car).

It should be noted that in the first embodiment, it is detected that at least one passenger waiting in the hall 20 stays waiting; however, the number of passengers (waiting persons) who stay waiting in the hall 20, etc., may also be accurately detected using, for example, a precision image analytical technique.

Then, the car controller 11a detects the occupancy ratio of the car 12a at the point of time at which the car 12a arrives at the registration floor, based on the load data (step S14). The occupancy ratio is
5 determined from the ratio between the rated load and live load of the car 12a.

For example, if the rated load of the car 12a is 1,400 kg (a passenger capacity of 20), and the live load detected when the car 12a arrives at the first
10 floor (the registration floor at which the hall call is registered) is 700 kg, it is determined that the occupancy ratio is 50%. "Occupancy ratio of 50%" means that available space in the car 12a is 50%.

Furthermore, for example, if the occupancy ratio is
15 20%, it means that the available space in the car 12a is 80%.

It should be noted that if no passenger is in the hall 20, that is, no passenger can be detected in the imaging range L1 (No in step S15), the door of the car
20 controller 11a is closed after a predetermined period (for example, 10 seconds) from the time when the door of the car 12a is opened, and then the car 12a is caused to start to move to the next destination floor (step S24). "Next destination floor" is a floor for
25 which a car call is registered, and also which is located closest to the floor from which the car 12a starts to move, or a registration floor at which a hall call is registered.

In contrast, if it is detected that a passenger or
30 passengers stay waiting in the imaging range L1 (Yes in step S15), the car controller 11a determines whether a passenger or passengers waiting in the hall 20 can get into the car 12a or not, based on the occupancy ratio of the car 12a (step S16). In this case, if the
35 occupancy ratio of the car 12a is less than or equal to a predetermined reference value (for example, 50%) for use in determining whether a passenger can get into a

car or not, it is determined that a passenger or passengers can get into the car 12a.

5 If it is determined that a passenger or passengers can get into the car 12a (Yes in step S16), the car controller 11a issues a notification prompting a passenger or passengers to get into the car 12a (step S17). More specifically, as shown in FIG. 6, for example, the following voice announcement is output from the speaker 16a in the car 12a: "a further
10 passenger or passengers can get into the car. Passengers standing close to the door in the car are requested to move back to the rear. Thank you for your cooperation". Because of such a voice announcement, the passengers in the car 12a are requested to
15 cooperate to enable a further passenger or passengers to get into the car 12a. Also, the voice announcement is made in the hall 20, and can thus prompt a passenger or passengers in the hall 20 to get into the car 12a.

20 It should be noted that the notification method is not limited to one using voice. That is, a notification method using a display may be applied, and a notification method using both voice and a display may be applied. In the case of applying the notification method using the display, a display not
25 shown is installed in the car 12a, and such a message as shown in FIG. 6 is indicated on the display. Furthermore, it may be set that a speaker and a display are both installed in the hall 20, and the same notification as in the car is made in the hall 20.

30 In addition, in the case where a notification prompting a passenger or passengers to get into a car is issued, in order to increase the number of passengers which can get into the car 12a as much as possible, the door of the car 12a may be closed after
35 the elapse of a period longer than a predetermined period by a given time (for example, 5 seconds).

After the above prompt, the car controller 11a

determines whether or not the occupancy ratio of the car 12a is increased higher than that at the time of arrival of the car (step S18). If the occupancy ratio of the car 12a is increased higher than that at the time of arrival of the car, it can be determined that a passenger or passengers waiting in the hall 20 have gotten into the car 12a. It should be noted that even if a further passenger gets into the car 12a, there is a case where a passenger or passengers in the car 12a get off the car 12a, and as a result the occupancy ratio is not increased. That is, if the number of passengers who get off the car 12a is greater than or equal to that of passengers who get into the car 12a, the occupancy ratio of the car 12a is not increased. In such a case, step S19 to be described later is carried out.

If the occupancy ratio of the car 12a is increased (Yes in step S18), the car controller 11a closes the door of the car 12a after the elapse of the predetermined period, and causes the car 12a to move to the next destination floor (step S24).

Furthermore, in the case where the occupancy ratio of the car 12a is not increased even after the above prompt (No in step S18), the car controller 11a detects a waiting state of a passenger or passengers based on the result of the analytical processing on an image of the hall 20 which is obtained by imaging (step S19). In this case, the ratio of passengers present in the imaging range L1 shown in FIG. 2 is detected. As the ratio increases, it is determined that a greater number of passengers stay in the hall, i.e., a greater number of passengers stay wait for a car. It may be set that using a precision image analysis technique, the number of passengers who stay waiting in the hall 20 (the number of waiting persons) is accurately detected, and it is determined whether the number of the passengers is greater than or equal to a predetermined number (for

example, 2) or not.

It should be noted that if the number of passengers who stay waiting is decreased than that in at the time of arrival of the car 12a (Yes in step S20), it is determined that a passenger or passengers waiting in the hall 20 have gotten into the car 12a. In this case, without registering a dummy call to be described later (step S21), the car controller 11a closes the door of the car 12a after the elapse of the predetermined period, and causes the car 12a to start to move to the next destination floor (step S24).

On the other hand, if the number of passengers who stay waiting is equal to or greater than that at the time of arrival of the car 12a (No in step S20), it is determined that a passenger or passengers still stay in the hall 20. In this case, the car controller 11a registers a dummy call before the car 12a starts to move (step S22).

"Dummy call" is a hall call which is registered automatically, not by a passenger, and which includes information on a registration floor and a destination direction as well as an ordinary hall call. The above registered dummy call includes information on the same registration floor (the first floor) and destination direction (up direction) as the hall call to which the car 12a currently responds.

The information of the dummy call is sent from the car controller 11a to the group management controller 10. The group management controller 10 receives the information of the dummy call as information of a newly registered hall call, and selects an optimal one of elevators (elevators B and C) other than elevator A, and causes the car of the selected elevator to move to the registration floor. This enables a passenger or passengers who did not get into the car 12a of elevator A to earlier get into the car of another elevator. It is therefore possible to shorten time for which a

passenger or passengers wait for a car of an elevator.

The following explanation is given with respect to the case where a dummy call is registered and elevator B is selected.

5 The group management controller 10 outputs an assignment signal for assignment of the dummy call to the car controller 11b for elevator B, and the car 12b of elevator B is caused to move to a registration floor. When the car 12b moves close to the
10 registration floor, the car controller 11b for elevator B lights a lantern 22b for elevator B, which is installed at the registration floor, to thereby indicate that the car 12b will arrive (step S23).

15 It should be noted that in order to indicate that the car 12b will arrive, if the lantern 22b is lit too early, there is a possibility that a passenger or passengers waiting in the hall 20 will get into the car 12b of elevator B without getting into the car 12a of elevator A. This is referred to as "divided riding",
20 and causes lowering of the occupancy ratio per car. That is, in the case where a dummy call is registered, although it can shorten the time for which a passenger waits for a car, it may cause divided riding. Therefore, it is preferable that a notification
25 indicating that the car of another elevator which responds to a dummy call will arrive at a hall should be made at time when the car moves as close as possible to the hall. The same is true of the case where a sound indicating that the car will arrive at the hall
30 is made in accordance with lighting of a lantern.

 Furthermore, in order that a greater number of passengers at a floor get into the car 12a of elevator A, which has already arrived at the floor, the timing at which a dummy call is registered may be delayed as
35 shown in FIG. 5.

FIG. 5 is a flowchart showing a registration processing for registering a dummy call.

In the above step S22, in the case of registering a dummy call, the car controller 11a first determines the number of persons who can get into the car 12a of elevator A which has already arrived at the hall (step S31). To be more specific, the car controller 11a determines the number P_b of passengers who are currently present in the car 12a on the basis of the live load of the car 12a which is obtained by the load detector 13a, and calculates the number P_c of persons which can get into the car 12a on the basis of the difference between the rated number P_a of persons and the number P_b of the above passengers.

For example, suppose the live load of the car 12a is 1,000 kg. If the average weight of passengers (which includes the weight of a load) is 70 kg, the number P_b of passengers is determined as follows:

$$P_b = 1,000/70 \div 14$$

If the rated number P_a of persons is 20, the number P_c of persons who can get into the car is determined as follows:

$$P_c = P_a - P_b = 6$$

When the number P_c of persons who can get into the car is determined, the car controller 11a sets in stages the timing at which a dummy call is registered, in accordance with the number P_c (step S32). In this case, the timing at which the dummy call is registered is further delayed as the number P_c increases. More specifically, for example, in the case where the number P_c is set to 2 as a reference number, time T at which the dummy call is registered is set under the following conditions:

$P_c = 2$ or less : $T = t_0$ (dummy call is registered without delay)

$P_c = 3$ to 5 : $T = T_1$ (dummy call is registered after the elapse of 5 seconds from t_0)

$P_c = 6$ or more : $T = T_2$ (dummy call is registered after the elapse of 10 seconds from T_0)

When the above set time T is reached (Yes in step S33), the car controller 11a registers the dummy call (step S34). The dummy call includes information on the same registration floor (the first floor) and destination direction (up direction) as the hall call to which the car 12a currently responds.

In such a manner, the timing at which the dummy call is registered is further delayed as the number of persons who can get into the car 12a increases (as the available space of the car increases), to thereby prevent divided riding, i.e., prevent a passenger or passengers from getting into the car of another elevator; and cause the car 12a of elevator A which has already arrived at the hall to start to move after causing a greater number of passengers to get into the car 12a.

In such a manner, according to the first embodiment, based on the relationship between the state of a passenger or passengers waiting in a hall and the occupancy ratio of a car, it is determined whether a passenger or passengers can get into the car or not; and if it is determined that a passenger or passengers can get into the car, a notification prompting a passenger or passengers to get into a car is made, as a result of which the car can be operated at a higher occupancy ratio. Thereby, it can be expected that the number of passengers waiting in the hall at each of the floors can be decreased, and as a result the time for which passengers wait for a car can be shortened.

Furthermore, if it is determined that a passenger or passengers who did not get into a car arriving at the hall are present, a dummy call is registered before the car starts to move, to thereby cause the car of another elevator to move earlier to the floor at which the dummy call earlier, and shorten the time for which the passenger or passengers wait.

(Second embodiment)

The second embodiment will be described.

In the first embodiment, a notification prompting a passenger or passengers to get into a car is issued
5 regardless of the state of a passenger or passengers who are in the car. However, in general, in many cases, if a number of passengers stand in the vicinity of the car door in the car, another passenger or passengers hesitate to get into the car. In addition,
10 even in the case where sufficient space is available in the vicinity of the car door in the car, if such a notification as shown in FIG. 6 is made to prompt a passenger or passengers to get into the car, in some cases, a passenger or passengers present in the car
15 feel uncomfortable. In view of this point, in the second embodiment, it is determined whether or not to make a notification prompting a passenger or passengers to get into a car, in accordance with the state of a passenger or passengers present in the car.

20 A processing operation of the second embodiment will be explained. It should be noted that a basic flow of the processing of the second embodiment is the same as that of the first embodiment. Accordingly, only part of the second embodiment which differs from
25 the first embodiment will be explained.

FIG. 7 is a flowchart showing a processing operation of each of the car controllers in the second embodiment.

Suppose for example, a hall call for upward
30 movement is registered in the hall 20 at the first floor, and is assigned to the car 12a of elevator A.

As in the first embodiment, when the car 12a arrives at the first floor (the registration floor at which the hall call is registered), on the basis of the
35 relationship between the state of a passenger or passengers waiting in the floor and the occupancy ratio of the car, it is determined whether a further

passenger or passengers can get into the car or not (steps S11 to S16).

5 In this case, in the second embodiment, when it is determined that a further passenger or passengers can get into the car (Yes in step S16), the car controller 11a detects a state of a passenger or passengers present in the vicinity of the car door 14a in the car 12a on the basis of the result of an analysis of an image of the car 12a which is obtained by imaging (step 10 A11). In this case, the ratio of a passenger or passengers in the imaging range L2 shown in FIG. 2 to the imaging range L2 is detected; and as the ratio increases, it is determined that a greater number of passengers are present in the vicinity of the car door 15 14a in the car. It may be set that using a precision image analysis technique, the number of passengers who are present in the vicinity of the car door 14a in the car is accurately detected, and it is determined whether the number of the above passengers is greater 20 than or equal to a predetermined number (for example, 2) or not.

If a large number of passengers are present in the vicinity of the car door 14a, i.e., a large number of passengers in the imaging range L2 are detected (Yes in 25 step A11), the car controller 11a issues such a notification as shown in FIG. 6 to prompt a further passenger or passengers to get into the car (step S17).

On the other hand, if it is not detected that a large number of passengers are present in the vicinity 30 of the car door 14a; that is, it is not detected that a large number of passengers are present in the imaging range L2 (No in step A11), the car controller 11a monitors the occupancy ratio of the car 12a to check a variation of the occupancy ratio (step S18), without 35 issuing a notification prompting a further passenger or passengers to get into a car. If the occupancy ratio of the car 12a is increased higher than that at the

time of arrival of the car 12a (Yes in step S18), the car controller 11a closes the door of the car 12a after the elapse of a predetermined period, and causes the car 12a to move to a next destination floor (step S24).

5 In such a manner, according to the second embodiment, if a large number of passengers are in the vicinity of the car door in the car, such a prompt as described above is given, thereby causing a passenger or passengers who hesitated to get into the car in
10 consideration of the state of the passengers in the car to positively get into the car. In this case, in the case where sufficient space is present in the vicinity of the car door in the car, such a prompt as described above is not given, and the passenger or passengers in
15 the car thus do not feel uncomfortable.

(Third embodiment)

The third embodiment will be described.

If the occupancy ratio of a car is increased by issuing a notification prompting a further passenger or
20 passengers to get into the car, there is a case where the car is substantially crowded with passengers, and starts to move in such a crowded state. When the car substantially crowded is moved to another floor at which another hall call is made, it does not enable a
25 passenger or passengers waiting in the hall in the other floor to get into the car, and its operation efficiency remarkably reduces. In view of this point, according to the third embodiment, in the case where a car departs from a floor in a substantially crowded
30 state, it passes through a floor at which no car call is registered (which will be hereinafter referred to as a car-call-unregistered floor), and another car is caused to move to the floor.

35 A processing operation of the third embodiment will be explained. It should be noted that a basic flow of the processing of the third embodiment is the same as that of the first embodiment. Accordingly,

only part of the third embodiment which differs from the first embodiment will be explained.

FIG. 8 is a flowchart showing a processing operation of each of the car controllers in the third embodiment.

Suppose for example, a hall call for upward movement is registered in the hall 20 at the first floor, and is assigned to the car 12a of elevator A.

As in the first embodiment, when the car 12a arrives at the first floor (the registration floor at which the hall call is registered), on the basis of the relationship between the state of a passenger or passengers waiting in the floor and the occupancy ratio of the car, it is determined whether a further passenger or passengers can get into the car or not (steps S11 to S16). If it is determined that a further passenger or passengers can get into the car, such a prompt as shown in FIG. 2 can be given, and it is determined whether the occupancy ratio of the car 12a is increased higher than that at the time of arrival of the car 12a or not (step S18).

In this case, in the third embodiment, if the occupancy ratio of the car 12a is increased higher than that at the time of arrival of the car 12a (Yes in step S18), the car controller 11a determines whether or not the occupancy ratio of the car 12a before the departure thereof exceeds a predetermined reference value (for example, 80%) for determining whether a car is crowded (step B11). If the occupancy ratio of the car 12a before the departure thereof does not exceed the reference value (No in step B11), the car controller 11a closes the door of the car 12a after the elapse of a predetermined period, and causes the car 12a to move to the next destination floor (step S24).

On the other hand, if the occupancy ratio of the car 12a before the departure thereof exceeds the reference value (Yes in step B11), the car controller

11a controls the car 12a to pass through a car-call-unregistered floor (step B12). To be more specific, if a floor where a hall call to which the car 12a should subsequently respond is registered is a car-call-unregistered floor (a floor at which no passenger will get off the car), the hall call is canceled. For example, suppose a hall call for upward movement is made at the second floor, and assigned to the car 12a. In this case, if a car call for movement to the second floor is not registered in the car 12a, which will depart from the first floor upwards, the hall call is canceled, and the car 12a is operated to pass through the second floor.

In this case, the car controller 11a registers a dummy call for a car-call-unregistered floor, through which the car 12a passes, and causes the car of another elevator to respond to the dummy call, i.e., move to the car-call-unregistered floor (step B13). As described above, "dummy call" is a hall call which is registered automatically, not by a passenger, and includes information on a registration floor and a destination direction as well as an ordinary hall call. In this case, a dummy call including information on destination direction (up direction and the car-call-unregistered floor (the second floor) through which the car passes is registered.

The information of the dummy call is sent from the car controller 11a to the group management controller 10. The group management controller 10 receives the information of the dummy call as information of a newly registered hall call, and selects an optimal one of elevators (elevators B and C) other than elevator A, and causes the car of the selected elevator to move to the registration floor. By virtue of this feature, the car of an elevator which is other than the car 12a of elevator A can be caused to earlier move to a floor at which the car 12a of elevator A does not stop, thus

shortening the time for which a passenger or passengers wait for a car.

Furthermore, in the case where a dummy call is registered and elevator B is selected, when the car 12b thereof is moved close to a registration floor for which the dummy call is registered, the car controller 11b for elevator B lights a lantern 22b for elevator B, which is installed at the registration floor, to indicate that the car 12b will arrive at the floor (step B14).

In such a manner, according to the third embodiment, in the case where a car substantially crowded departs from a floor, it is controlled to pass through a car-call-unregistered floor. Because of this control, the car is prevented from stopping when it can carry no further passenger; that is, useless stopping of the car can be avoided. In this case, a dummy call is registered, and the car of another elevator is made to respond to the dummy call, to thereby shorten the time for which a passenger or passengers wait for a car.

According to at least one of the above embodiments, it is possible to provide an elevator group management system which increases the occupancy ratio of each of cars, decreases the number of passengers who stay at a hall to wait for a car, and shortens the time for which a passenger or passengers wait for a car.

It should be noted that in each of the above embodiments, an image obtained by imaging performed by a single camera installed in the vicinity of the car door in a car is analyzed to detect the state of a hall and that of the vicinity of the car door in the car; however, it may be set that for example, two cameras are installed in the car, and images respectively obtained by the cameras are analyzed to detect the state of the hall and that of the vicinity of the car

door in the car.

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
5 inventions. Indeed, the novel embodiments described
herein may be embodied in a variety of other forms;
furthermore, various omissions, substitutions and
changes in the form of the embodiments described herein
may be made without departing from the spirit of the
10 inventions. The accompanying claims and their
equivalents are intended to cover such forms or
modifications as would fall within the scope and spirit
of the inventions.

CLAIMS

1. An elevator group management system which includes plural cars, and causes, in response to a hall call registered at an arbitrary floor, a selected one of the cars to move to the floor
5 at which the hall call is registered, the elevator group management system comprising:

door-opening time detection means for detecting a state of a passenger or passengers waiting at a hall within a first range from a door of the car toward the hall, and a state of a
10 passenger or passengers present in the vicinity of the door in the car within a second range from the door of the car toward a back side of the car, when the selected car arrives at the floor and the door of the car is opened;

occupancy detection means for detecting an occupancy ratio
15 of the car;

ridable/unridable-state determination means for determining, when the door-opening time detection means detects the state of the passenger or passengers waiting at the hall, whether or not the passenger or passengers waiting at the hall
20 are allowed to get into the car, based on the occupancy ratio of the car at a point of time at which the car arrives at the floor, which is detected by the occupancy detection means;

notification control means for issuing, when the ridable/unridable-state determination means determines that the
25 passenger or passengers are allowed to get into the car, a notification prompting the passenger or passengers to get into the car in consideration of the state of the passenger or

passengers present in the vicinity of the door of the car, which is detected by the door-opening time detection means; and

operation control means for closing the door of the car and causing the car to move to a next destination floor, when the
5 occupancy ratio of the car is increased by the notification issued by the notification control means so that the occupancy ratio of the car is higher than that at the point of time at which the car arrives at the floor.

10 2. The elevator group management system of Claim 1, further comprising dummy-call registration means for registering a dummy call before departure of the car, when the rideable/unrideable-state determination means determines that the passenger or passengers are not allowed to get into the car, or when the
15 number of passengers waiting at the hall after the notification issued by the notification control means does not become smaller than that at the point of time at which the car arrives at the hall, the dummy call being registered as a call for causing another one of the cars to move to the floor at which the hall
20 call is registered.

3. The elevator group management system of Claim 2, wherein the dummy-call registration means further delays timing at which the dummy call is registered, as the number of persons allowed to
25 get into the car increases.

4. The elevator group management system of Claim 1, wherein

when the occupancy ratio of the car before departure thereof exceeds a predetermined occupancy ratio, the operation control means controls the car to pass through a floor for which no car call is registered.

5

5. The elevator group management system of Claim 4, further comprising dummy-call registration means for registering a dummy call for causing another one of the cars to move to a floor determined by the operation control means as a floor through
10 which the selected car will pass.

6. The elevator group management system of Claim 1, further comprising a load detector installed in the car,

wherein the occupancy detection means detects the occupancy
15 ratio of the car based on relationship between a rated load of the car and a live load detected by the load detector.

7. The elevator group management system of Claim 1, further comprising a monitoring camera installed in the vicinity of the
20 door in the car to image a state of the hall and a state of the vicinity of the door in the car,

wherein the door-opening time detection means performs an analytical processing on an image obtained by imaging performed by the camera to detect the state of the passenger or passengers
25 waiting in the hall, and detects the state of the passenger or passengers present in the vicinity of the door of the car based on a result of the analytical processing performed on the image.