

TITLE OF THE INVENTION

ELEVATOR OPERATION STATE VISUALIZATION APPARATUS, ELEVATOR
CONTROL SYSTEM, AND ELEVATOR OPERATION STATE VISUALIZATION
METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to an elevator operation state visualization apparatus, an elevator control system, and an elevator operation state visualization method.

2. Description of the Related Art

[0002]

JP 2007-91354 A discloses a technique for grasping the operation states of a plurality of elevators and performing operation with high customer satisfaction. JP 2007-91354 A states, "In order to grasp the actual elevator operation status at a glance, at least the measured values of the landing duration, the number of passengers, and the number of operating cars are displayed together in the form of a graph on one screen. This makes it easy even for beginners to understand the process of current and past operation statuses and the setting status of usability

specifications in an "at-a-glance form" without using any dedicated equipment."

SUMMARY OF THE INVENTION

[0004]

However, in the technique described in JP 2007-91354 A, when the operation state of the elevator deteriorates, it is not possible to know how to change the setting of which item among many items of usability specifications prepared for the factors that have deteriorated the operation state.

[0005]

Accordingly, the present invention aims at providing an elevator operation state visualization apparatus, an elevator control system, and an elevator operation state visualization method, which allow to easily know an improvement plan when the operation state of an elevator deteriorates.

[0006]

In order to solve the above problems, for example, the configuration described in the claims is adopted.

The present application includes a plurality of means for solving the above-described problems. For example, an elevator operation state visualization apparatus includes a visualization processing unit

configured to visualize an operation state of an elevator based on elevator operation information. The apparatus includes a storage device holding an analysis condition database that registers an analysis condition for analyzing the operation state of the elevator from the elevator operation information and an improvement method database that registers an improvement method for each cause of deterioration that deteriorates the operation state of the elevator, an operation state analysis processing unit configured to analyze the operation information based on the analysis condition registered in the analysis condition database and specify the cause of deterioration when determining that the operation state of the elevator has deteriorated, and a totalization processing unit configured to acquire an improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit from the improvement method database. The visualization processing unit creates visualization data for visualizing the cause of deterioration specified by the operation state analysis processing unit and the improvement method acquired by the totalization processing unit.

[0007]

According to the present invention, it is possible to easily know an improvement plan when the operation state of an elevator deteriorates.

Problems, configurations, and effects other than those described above will be clarified by the following description of an embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a diagram showing a schematic configuration of an elevator according to an embodiment;

Fig. 2 is a block diagram of an elevator control system according to the embodiment;

Fig. 3 is a diagram illustrating an example of a data configuration of a user DB stored in a storage device;

Fig. 4 is a diagram showing an example of a data configuration of an analysis condition DB stored in the storage device;

Fig. 5 is a diagram illustrating an example of a data configuration of an improvement method DB stored in the storage device;

Fig. 6 is a diagram illustrating an example of a data configuration of an operation information DB stored in the storage device;

Fig. 7 is a diagram illustrating an example of a data configuration of an analysis result DB stored in the storage device;

Fig. 8 is a display example (part 1) of a building information screen according to the embodiment;

Fig. 9 is a display example (part 2) of the building information screen according to the embodiment;

Fig. 10 is a flowchart (part 1) showing an elevator operation state visualization method and an elevator control method according to the embodiment; and

Fig. 11 is a flowchart (part 2) showing the elevator operation state visualization method and the elevator control method according to the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009]

Prior to describing an embodiment of an elevator operation state visualization apparatus, an elevator control system, and an elevator operation state visualization method of the present invention, the configuration of an elevator to which the present invention is applied will be described first.

[0010]

Fig. 1 is a diagram showing the schematic configuration of an elevator 1 according to an embodiment

of the present invention. The elevator 1 according to this embodiment mainly includes a car 2, a tail cord 3, and an elevator controller 10. Because the mechanical configuration of the elevator 1 is the same as before, a detailed description is omitted.

[0011]

The car 2 has an internal space in which a user gets on and a car door 4 for entering and exiting the internal space. The car 2 is connected to a counterweight (not shown) through a main rope (not shown) in a hoistway 5 extending in the vertical direction along the building (construction). The car 2 travels in the vertical direction in the hoistway 5 when the main rope is wound up or fed out by a hoisting machine (not shown).

[0012]

An operation panel 2a is installed inside the car 2. The operation panel 2a includes a destination floor registration button for designating a destination floor. The elevator controller 10 receives information indicating that a destination floor is designated by the destination floor registration button on the operation panel 2a via a signal line (not shown).

[0013]

The elevator controller 10 is installed in, for example, a machine room 6 provided in the upper part of the

hoistway 5. The elevator controller 10 is connected to the car 2 through the tail cord 3. The elevator controller 10 transmits a control signal for operating the car 2 via the tail cord 3, and receives operation information of the elevator 1 including operation information of the car 2 via the tail cord 3. Such an elevator controller 10 is also a constituent element of a building management device in an elevator control system described below. The operation information received by the elevator controller 10 will be described in detail later.

[0014]

On each floor of the building, landings 7a and 7b are provided at positions adjacent to the hoistway 5. When the car 2 stops at a position facing the landings 7a and 7b and the car door 4 opens, passengers H on the landings 7a and 7b get on the car 2, and a passenger H in the car 2 gets off the elevator 1.

[0015]

On each of the landings 7a and 7b, landing operation panels 8a and 8b are installed. The landing operation panels 8a and 8b each include at least one of an up call button for calling the car 2 moving upward from the floor and a down call button for calling the car 2 moving downward from the floor. More specifically, the landing operation panel 8a on the lowest floor includes only the up

call button, the landing operation panel 8b on the uppermost floor includes only the down call button, and a landing operation panel on an intermediate floor (not shown) Includes both up call and down call buttons. The elevator controller 10 receives information indicating that the landing operation panels 8a and 8b have been pressed via a signal line (not shown).

[0016]

<<Elevator Control System 100>>

Fig. 2 is a block diagram of an elevator control system 100 according to the embodiment. The elevator control system 100 shown in this drawing is a system for performing group management control of a plurality of elevators, and includes an elevator operation state visualization apparatus 30. The elevator control system 100 includes a building management device 20, the elevator operation state visualization apparatus 30, and a terminal device 40 connected via communication networks 13 and 14. These are configured as follows.

[0017]

<Communication Networks 13 and 14>

The communication networks 13 and 14 may be, for example, the Internet, a mobile communication network, a wired LAN, a wireless LAN, a dedicated line, or a combination thereof. Further, the communication networks

13 and 14 may be one communication network (for example, the Internet). Further, the numbers of building management devices 20 and terminal devices 40 connected to the visualization apparatus 30 via the communication networks 13 and 14 each are not limited to one and may be plural. The building management device 20 and the terminal device 40 need not correspond one to one.

[0018]

<Building Management Device 20>

The building management device 20 includes a portion that manages the operation of a plurality of elevators installed in a customer building, and is provided for, for example, each customer building. Each of the building management devices 20 includes the plurality of elevator controllers 10 that the elevators of each customer building have. Each building management device 20 includes a bank management device 21 that manages the plurality of elevator controllers 10 in groups for each bank.

[0019]

Assume a case in which six elevators are installed in a customer building with 15 floors from second basement B2 to 13th floor 13F, and the six elevators are classified into high-rise bank A low-rise bank A according to the respective destination floors. For example, an elevator belonging to high-rise bank A has second basement B2, first

floor 1F, and eighth floor 8F to 13th floor 13F as stop floors. In addition, an elevator belonging to low-rise bank B has first basement B1 and first floor 1F to seventh floor 7F as stop floors.

[0020]

In a building management device 20a of such a customer building, elevator controllers 10a, 10b, and 10c belonging to bank A are connected to one bank management device 21a, and elevator controllers 10d, 10e, and 10f belonging to bank B are connected to another bank management device 21b.

[0021]

Similarly, in a building management device 20b of another customer building, a plurality of elevator controllers 10 are grouped for each bank and connected to each bank management device 21. The configurations of the elevator controller 10 and the bank management device 21 connected in this way are as follows.

[0022]

[Elevator Controller 10]

The elevator controller 10 is provided in each elevator as described above, and controls the operation of each elevator according to an instruction from the bank management device 21 to which each elevator controller 10 is connected. Further, the elevator controller 10 receives

operation information from constituent elements of the elevator and transmits the received operation information to the bank management device 21.

[0023]

The elevator operation information received by the elevator controller 10 includes (a) number of passengers, (b) average waiting time, (c) landing call registration count, (d) car call registration count, and (e) boarding times, (f) packed car passage count, and other information. These will be described next with reference to Fig. 1.

[0024]

-(a) Number of Passengers-

The number of passengers is the cumulative value of the values obtained by dividing the differences between the values detected by a weight sensor (not shown) provided in the elevator 1 by a predetermined average body weight (for example, 50 kg) when the car 2 stops at the landings 7a and 7b. That is, if the detection value of the weight sensor decreases by 200 kg between the time when the car door 4 is opened and the time when the car door 4 is closed, it means that four people have got off the car 2 (the number of passengers has decreased by four). On the other hand, if the detection value of the weight sensor increases by 150 kg between the time when the car door 4 is opened and the time when the car door 4 is closed, it means that three

people have been on the car 2 (the number of passengers has increased by three). The number of passengers is counted as a cumulative value during the transmission of operation information to the bank management device 21.

[0025]

-(b) Average Waiting Time-

The average waiting time is the elapsed time from when the up call button or the down call button of the landing operation panel 8a or 8b is pressed until the car 2 arrives at the corresponding landing 7a or 7b, and is also the average waiting time when the up call button or the down call button is pressed once. The average waiting time is, for example, the difference between the time when the landing operation panel 8a or 8b is operated and the time when the car 2 stops at the corresponding landing 7a or 7b. In addition, the waiting time on a midway floor may be counted separately when the up call button is pressed and when the down call button is pressed.

[0026]

-(c) Landing Call Registration Count-

The numbers of landing calls registered are the numbers of times the up call button and the down call button of the landing operation panels 8a and 8b are pressed, and are counted as, for example, cumulative values during the transmission of operation information to the

bank management device 21. Note that a landing call registration count on a midway floor may be counted separately when the up call button is pressed and when the down call button is pressed.

[0027]

-(d) Car Call Registration Count-

A car call registration count is the number of times the destination floor registration button on the operation panel 2a in the car 2 is pressed, and is counted as, for example, a cumulative value during the transmission of operation information to the bank management device 21.

[0028]

-(e) Boarding Time-

The boarding time is, for example, the average value of the times required for boarding the car 2 at the platform 7a and moving to the landing 7b. The boarding time is, for example, the time between when the passenger presses the destination floor button (the button on the floor of the landing 7b) in car 2 upon getting on the car 2 at the landing 7a and the car door 4 closes and when the car 2 moves to the landing 7b and the car door 4 opens.

[0029]

-(f) Packed Car Passage Count-

For example, a packed car passage count is the number of times, when the up call button or the down call

button of the landing operation panel 8a or 8b is pressed, the car 2 carrying the full passengers H passes through the corresponding landing 7a or 7b without stopping. The number times of packed car passage is counted as a cumulative value during the transmission of operation information to the bank management device 21.

[0030]

-Other-

Other examples of elevator operation information received by the elevator controller 10 include the number of times the car door 4 is opened and closed, the number of times the car door 4 is reversed, or the number of times of activation. These pieces of operation information are collected by a collecting device (not shown) provided in the elevator 1 and transmitted to each elevator controller 10.

[0031]

[Bank Management Device 21]

Returning back to Fig. 2, the bank management device 21 collects (receives) and stores operation information for each predetermined time of the elevator managed by the bank management device 21 from each elevator controller 10. The predetermined time is a preset time, and is set to, for example, any one of 5 minutes, 10 minutes, and 15 minutes. In addition, the bank management device 21 adds a

corresponding building ID, bank ID, elevator ID, date and time information, and floor name to the operation information for each predetermined time collected in a predetermined cycle (for example, one day), and transmits the data to the visualization apparatus 30 via the communication network 13.

[0032]

Note that the operation information collection method by the bank management device 21 and the transmission timing of the operation information to the visualization apparatus 30 are not limited to the above example. As an example, the information collected by the elevator controllers 10a to 10f may be transmitted to the visualization apparatus 30 in real time via the bank management device 21 and totalized by the visualization apparatus 30. As another example, the information collected by the bank management device 21 may be copied by the maintenance staff to a maintenance terminal and registered in the visualization apparatus 30.

[0033]

<Visualization Apparatus 30>

The visualization apparatus 30 is an apparatus that visualizes the operation state of the elevator managed by each bank management device 21 on the basis of the information transmitted from each bank management device

21. The visualization apparatus 30 mainly includes a storage device 31, a totalization processing unit 32, an operation state analysis processing unit 33, a visualization processing unit 34, and a usability specification data transmission unit 35. The visualization apparatus 30 includes, for example, a central processing unit (CPU), a read only memory (ROM), a random access memory (RAM), and a communication interface, and may further include a hard disk drive (HDD).

[0034]

The visualization apparatus 30 as described above functions as the totalization processing unit 32, the operation state analysis processing unit 33, the visualization processing unit 34, and the usability specification data transmission unit 35 by causing the CPU to read out and execute the program codes stored in the ROM so as to implement cooperation between software and hardware. That is, the totalization processing unit 32, the operation state analysis processing unit 33, the visualization processing unit 34, and the usability specification data transmission unit 35 correspond to algorithms executed by the controller. The details of the functions of the respective units of the visualization apparatus 30 will be described below.

[0035]

[Storage Device 31]

The storage device 31 is constituted by a ROM, RAM, or HDD, and stores a database in which information necessary for visualizing the operation state of each elevator is organized. The database (DB) stored in the storage device 31 includes a user database (user DB 31a), an analysis condition database (analysis condition DB 31b), an improvement method database (improvement method DB 31c), an operation information database (operation information DB 31d), and an analysis result database (analysis result DB 31e), which are shown in Figs. 3 to 7.

[0036]

The data structure of each database will be described with reference to Fig. 2. In each database, data associated with each other is registered for each record. However, in order to explain these databases, Figs. 3 to 7 each show common data in one group.

[0037]

-User DB 31a-

Fig. 3 is a diagram illustrating an example of the data configuration of the user DB 31a stored in the storage device 31. The user DB 31a is a database configured by information registered in advance by a system administrator. As shown in this drawing, the user DB 31a stores, for example, (1) user ID, (2) password, (3)

attribute information, and (4) building ID in association with each other. These are as follows.

[0038]

(1) user ID and (2) password are user identifiers for identifying users who can access the visualization apparatus 30. (3) attribute information is information indicating an attribute of the user. For example, "building management company" that manages a plurality of buildings, "building owner" that owns a building, or the like is set. (4) building ID is a building identifier that identifies the building where the elevator managed by each bank management device is installed.

[0039]

That is, (4) building ID "building A" or "building B" corresponding to (3) attribute information "building management company" identifies the building managed by the user with (1) user ID "001". In addition, (4) building ID "building C" corresponding to (3) attribute information "building owner" identifies the building owned by (1) user ID "002".

[0040]

-Analysis Condition DB 31b-

Fig. 4 is a diagram showing an example of the data configuration of the analysis condition DB 31b stored in the storage device 31. The analysis condition DB is a

database configured by information registered in advance by the system administrator, and analysis conditions for analyzing the operation state of the elevator from the elevator operation information are registered. As shown in this drawing, the analysis condition DB 31b stores (5) cause of deterioration, (6) evaluation level, (7) evaluation item, (8) evaluation threshold, and (9) estimated factor in association with each other. These are as follows.

[0041]

(5) cause of deterioration is a cause of deteriorating the operation state of the elevator described below, and is either one of pieces of elevator operation information described above or calculated item based on the elevator operation information. The cause of such deterioration is, for example, "average waiting time" and "packed car passage occurrence ratio". Of these, the "average waiting time" is one of the pieces of operation information described above. In addition, the "packed car passage occurrence ratio" is the value obtained by dividing (e) packed car passage occurrence count by (c) landing call registration count in the operation information described above, and is the ratio at which packed car passage occurs when a landing call is registered.

[0042]

(6) evaluation level is information for classifying evaluation items for evaluating the operation state of the elevator described below according to evaluation levels, and is information assigned to each evaluation item. That is, as will be described later, evaluation items are classified into cause items that directly evaluate the satisfaction levels of elevator operation states and factor items that indirectly influence the numerical values of cause items and indirectly evaluate the satisfaction levels of elevator operation states. A cause item is also (5) cause of deterioration. A factor item is a factor causing a cause of deterioration. Note that evaluation level 1 can be sometimes assigned to and evaluation level 2 can be other times assigned to the same evaluation item.

[0043]

(7) evaluation items are items for evaluating the operation state of the elevator, and as described above, are classified into cause items associated with evaluation level 1 and factor items associated with evaluation level 2. These evaluation items are items selected from the elevator operation information described above or items calculated based on the elevator operation information. These evaluation items are registered in the analysis condition DB 31b in association with the above-described deterioration causes, and a plurality of evaluation items

registered in association with the same deterioration cause are collectively managed as one evaluation group.

[0044]

Among the evaluation items as described above, a cause item (evaluation item of evaluation level 1) matches the cause of deterioration, and one cause item is associated with the cause of deterioration. In addition, a factor item (evaluation item of evaluation level 2) is associated with one of the previous causes of deterioration, and one factor item is sometimes associated with a plurality of causes of deterioration. For example, the cause of deterioration "average waiting time" is assigned with "landing call registration ratio", "car call registration ratio", and "average car door opening duration" as factor items (evaluation items of evaluation level 2).

[0045]

Among these, "landing call registration ratio" and "car call registration ratio" are the ratios of the respective registration counts to the total counts of "landing call registration counts" and "car call registration counts". In addition, "average car door opening duration" is an average duration when the car door is opened once. These are values calculated from the operation information described above.

[0046]

(8) evaluation threshold is a threshold set for the values of evaluation items. That is, if the value of an evaluation item exceeds the evaluation threshold, it is determined that the evaluation item is problematic. For example, if an evaluation item is "average waiting time", the threshold for "average waiting time" until the car arrives in one landing call registration is set to 50 sec. When "average waiting time" exceeds 50 sec, it is determined that there is a problem.

[0047]

(9) estimated factor is a factor of deterioration that is estimated when a factor item to which evaluation level 2 is given among the evaluation items deteriorates beyond the evaluation threshold. This estimated factor is set only for the factor item (evaluation item of evaluation level 2). For example, as an estimated factor when the landing call registration ratio exceeds the evaluation threshold (80%), "the number of stops of the car due to landing calls per unit time is large" is registered.

[0048]

-Improvement Method DB 31c-

Fig. 5 is a diagram illustrating an example of the data configuration of the improvement method DB 31c stored in the storage device 31. The improvement method DB 31c is

a database configured by information registered in advance by the system administrator. An improvement method for each cause of deterioration that deteriorates the operation state of the elevator is registered in this database. As shown in this drawing, the improvement method DB 31c stores (5) cause of deterioration, (7) evaluation item, (9) estimated factor, (10) improvement category, and (11) improvement method in association with each other. Among these, (5) cause of deterioration, (7) evaluation item, and (9) estimated factor are as described above. However, (7) evaluation item is associated only with factor items (evaluation items of evaluation level 2) for indirectly evaluating the satisfaction level of the elevator operation state. In addition, (10) improvement category and (11) improvement method are as follows.

[0049]

(10) improvement category is information for classifying improvement methods used when the evaluation items for each cause of deterioration deteriorate into system improvement methods and elevator operation improvement methods, and is information assigned to (11) improvement method (to be described next). That is, improvement methods used when evaluation items deteriorate are classified into system improvement methods based on

elevator control and operation improvement methods related to elevator usage methods.

[0050]

Among these, the system improvement methods are improvement methods related to elevator control and correspond to improvements by adjusting so-called usability. An operation improvement method is equivalent to improvement by encouragement related to the use of the elevator for tenants, offices, or users who move into a customer building.

[0051]

(11) improvement method is a method for improving each estimated factor, and one or a plurality of methods are associated with each estimated factor and each improvement category. For example, when an estimated factor is "the number of stops of the car due to landing calls per unit time is large", the method "reduce the number of stops of the car due to landing calls by adjusting a congestion threshold" is associated as a system improvement method, that is, as a usability adjustment method. In addition, as an operation improvement method, the method "provide encouragement to make passengers get on to the full capacity (to increase the boarding ratio)" is associated.

[0052]

-Operation Information DB 31d-

Fig. 6 is a diagram illustrating an example of the data configuration of the operation information DB 31d stored in the storage device 31. The operation information DB 31d is a database composed of information transmitted from the bank management device 21 every predetermined cycle (for example, one day). As shown in this drawing, the operation information DB 31d includes, for example, (4) building ID, (21) bank ID, and (22) elevator.

The operation information DB 31 stores IDs, (23) date and time information, (24) floor name, and (25) operation information in association with each other. The operation information DB 31d also stores these pieces of information in association with each (21) bank ID and (23) date and time information.

[0053]

Among these, (4) building ID is a building identifier for identifying a building in which an elevator managed by the bank management device 21 is installed, as described concerning the user DB 31a (see Fig. 3). (21) bank ID is a bank identifier that identifies the bank to which the elevator managed by the bank management device 21 belongs. (22) elevator ID is an elevator identifier that identifies the elevator managed by the bank management device 21. (23) date and time information is information

indicating a predetermined time range (start time to end time) for collecting operation information. (24) floor name is a floor identifier for identifying the floor on which the elevator managed by the bank management device 21 lands.

[0054]

(25) operation information is the operation information that the elevator controller 10 transmits to the bank management device 21 as described above, and includes (a) number of passengers, (b) average waiting time, (c) landing call registration count, (d) car call registration count, (e) packed car passage count, and others.

[0055]

Note that (25) operation information in the operation information DB 31d is not limited to the information transmitted from the constituent elements of the elevator to the elevator controller 10, and may be, for example, the information created by a simulator that simulates the operation of the elevator. Such operation information is input to the visualization apparatus 30 from, for example, an external terminal device, and stored in the operation information DB 31d of the storage device 31.

[0056]

In addition, (25) operation information in the operation information DB 31d may include, in addition to the information transmitted from each elevator controller 10 described above to the bank management device 21, other information that influences the operation state of the elevator. The other information is building usage information, and for example, any numerical information indicating the usage status of each floor of the building where the elevator is installed. Such building usage information may be received from the collection device (not shown) provided in the customer building via each elevator controller 10 or directly by the corresponding bank management device 21, and may be transmitted as (25) operation information to the storage device 31 of the visualization apparatus 30.

[0057]

-Analysis Result DB 31e-

Fig. 7 is a diagram illustrating an example of the data configuration of the analysis result DB 31e stored in the storage device 31. The analysis result DB is a database configured by information registered when a deterioration in operation state is detected in the analysis process performed by the operation state analysis processing unit 33 (to be described below). As shown in this drawing, the analysis result DB stores, for example,

(4) building ID, (21) bank ID, (23) date and time information, (31) deterioration detection date and time, (5) cause of deterioration, (7) evaluation item in association with each other.

[0058]

These pieces of information are registered according to the result obtained by the operation state analysis processing unit 33 by analyzing information in the operation information DB 31d described above based on information in the analysis condition DB 31b. A procedure for an analysis process by the operation state analysis processing unit 33 will be described in detail concerning the subsequent elevator operation state analysis method.

[0059]

[Totalization Processing Unit 32]

The totalization processing unit 32 shown in Fig. 2 is a unit for totalizing (25) operation information (see Fig. 6) in the operation information DB 31d according to designated conditions set by the system administrator in advance so as to allow the operation state analysis processing unit 33 (to be described next) to easily use the information for the detection of a deterioration in operation state. For example, the totalization processing unit 32 totalizes (for example, accumulates and averages) a plurality pieces of building usage information associated

with the same bank ID for each totalization cycle (for example, 5 min, 15 min, or 30 min) designated by the system administrator. Accordingly, (8) evaluation threshold (see Fig. 4) in the analysis condition DB 31b is registered in a unit that can be handled for each totalization cycle designated by the system administrator. Note that this totalization cycle is a cycle in which a predetermined time during which the bank management device 21 collects operation information is a minimum unit.

[0060]

The totalization processing unit 32 collects, from each database, information necessary for visualization processing of the analysis result in the operation state analysis processing unit 33 (to be described next) by the visualization processing unit 34 (to be described next).

[0061]

The totalization processing unit 32 also acquires, from the improvement method DB 31c, an improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit 33 and registered in the analysis result DB 31e. Note that a procedure for the visualization process executed by the totalization processing unit 32 will be described in detail concerning the subsequent elevator operation state analysis method.

[0062]

[Operation State Analysis Processing Unit 33]

Based on information in the analysis condition DB 31b, the operation state analysis processing unit 33 detects a deterioration in the operation state of the elevator by analyzing the elevator operation information which is registered in the operation information DB 31d. The operation state analysis processing unit 33 executes analysis processing of operation information for each date and time information. When the totalization processing unit 32 totalizes the operation information (see Fig. 6) in the operation information DB 31d, a deterioration in operation state is detected based on the totalized operation information.

[0063]

Upon detecting a deterioration, the operation state analysis processing unit 33 specifies the cause of the deterioration and the evaluation item causing the deterioration, and registers, in the analysis result DB 31e (see Fig. 7), (4) building ID, (21) bank ID, (23) date and time information, (31) deterioration detection date and time, (5) cause of deterioration, and (7) evaluation item in association with each other. The operation state analysis processing unit 33 also specifies (9) estimated factor registered in the improvement method DB 31c by

specifying (7) evaluation item. The detection of a deterioration in the operation state by the operation state analysis processing unit 33 will be described concerning the subsequent elevator operation state visualization method and elevator control method.

[0064]

[Visualization Processing Unit 34]

The visualization processing unit 34 performs processing for visualizing the operation state of the elevator based on the analysis processing by the operation state analysis processing unit 33. Visualization processing by the visualization processing unit 34 makes it possible to display the operation state of the elevator on the terminal device 40 (to be described below). In particular, the visualization processing unit 34 creates visualization data for visualizing a cause of deterioration, an estimated factor, an improvement method, and the classification of the improvement method based on analysis processing by the operation state analysis processing unit 33.

[0065]

The data format of the visualization data created by the visualization processing unit 34 is not particularly limited. For example, an image format, HTML format, XML format, CSV format, or the like can be adopted. Details of

the operation state of the elevator displayed by a visualization process by the visualization processing unit 34 will be described in detail concerning the terminal device 40 and the elevator operation state visualization method (to be described later).

[0066]

[Usability Specification Data Transmission Unit 35]

When the totalization processing unit 32 acquiring a system improvement method related to elevator control, the usability specification data transmission unit 35 creates usability specification change data from the improvement method based on the analysis result obtained by the operation state analysis processing unit 33. Further, the usability specification data transmission unit 35 is a unit that transmits the created usability specification change data to the bank management device 21 of the corresponding building. Details of the processing performed by the usability specification data transmission unit 35 will be described in detail concerning the following elevator control method.

[0067]

<Terminal Device 40>

The terminal device 40 is an information processing terminal possessed by a customer, and includes a display unit, an operation unit, and a communication interface.

The operation unit may be a touch panel provided on the front surface of the display unit in addition to the keyboard and the mouse. Although the specific example of the terminal device 40 is not specifically limited, the terminal device corresponds to, for example, a personal computer, a tablet, a smart phone, or the like.

[0068]

The operation state of the elevator is displayed on the display unit of the terminal device 40 based on the visualization data created by a visualization process by the visualization processing unit 34. The operation state of the elevator is displayed as a part of a building information screen. Fig. 8 is a display example (part 1) of the building information screen 301 according to the embodiment. Fig. 9 is a display example (part 2) of the building information screen 301 according to the embodiment.

[0069]

As shown in these drawings, the building information screen 301 displayed on the display unit of the terminal device 40 by the processing by the visualization processing unit 34 includes a building information display selection area 3011, an operation state display column 3012, a date and time information selection column 3013, a [display] button 3014, a deterioration information display column

3015, an improvement method display column 3016, an [execute] button 3017, and an operation state graph display column 3018.

[0070]

The building information display selection area 3011 includes a "building name" column, a "bank name" column, and radio buttons for selecting a bank to be visualized. The radio buttons enable the selection of all the banks displayed in the "bank name" column.

[0071]

Based on the analysis result obtained by the operation state analysis processing unit 33 concerning the bank selected by the radio button in the building information display selection area 3011, the operation state display column 3012 displays, for example, "Operation state has deteriorated" or "Operation state is good".

[0072]

When a deterioration in operation state is detected by analysis by the operation state analysis processing unit 33 concerning the bank selected by the radio button in the building information display selection area 3011, the date and time information selection column 3013 performs display that allows the selection of all date and time information corresponding to the detection of deteriorations in operation state.

[0073]

The [display] button 3014 is displayed when a deterioration in operation state is detected by analysis by the operation state analysis processing unit 33 concerning the bank selected by the radio button in the building information display selection area 3011.

[0074]

The deterioration information display column 3015 displays the cause of deterioration and the estimated factor extracted by the visualization processing unit 34. The improvement method display column 3016 displays the improvement methods extracted by the visualization processing unit 34 separately as a method related to the operation of the elevator and a method related to the elevator system (usability specifications). Furthermore, the [execute] button 3017 is displayed in conjunction with the display of a method related to the elevator system (usability specifications).

[0075]

The operation state graph display column 3018 displays, one above the other, at least an evaluation graph 3018a corresponding to normal times (or good times) when no deterioration in operation state is detected and an evaluation graph 3018b corresponding to bad times when a deterioration in operation state is detected. This makes

it possible to check the degree of deterioration at a glance.

[0076]

The evaluation graphs 3018a and 3018b are data about the bank in which a deterioration in operation state is detected by analysis processing by the operation state analysis processing unit 33, and are created based on the data of a specified deterioration cause group. The evaluation graphs 3018a, 3018b each are, for example, a two-dimensional graph, with the first axis representing the value of the cause of deterioration (cause item) corresponding to the detection of a deterioration in operation state such as the average waiting time, and the second axis orthogonal to the first axis representing the time. The second axis is, for example, a 24-hour time scale so as to include data on the date and time of detection of a deterioration in operation state. The evaluation graphs 3018a and 3018b each include an evaluation threshold 3018c.

[0077]

The first axis may represents the value of a factor item. In addition, as each of the evaluation graphs 3018a and 3018b, two types of graphs may be displayed: a graph with the first axis representing the cause of deterioration

(cause item) and a graph with the first axis representing a factor item.

[0078]

Figs. 8 and 9 each show an example in which the average waiting time is detected as the cause of a deterioration in operation state, and displays two-dimensional graph data with the vertical axis representing "average waiting time (sec)" and the horizontal axis representing the time. As an example of graph data, the evaluation graph 3018a (graph data) corresponding to normal times shows the transition of the average waiting time at 2019/01/06 (24 hr), and the evaluation graph 3018b (graph data) corresponding to bad times shows the transition of average waiting time at 2019/01/07 (24 hr).

[0079]

A display procedure by the display unit of the terminal device 40 as described above will be described in detail concerning the elevator operation state visualization method and elevator control method described next.

[0080]

<<Elevator Operation State Visualization Method and Elevator Control Method>>

Fig. 10 is a flowchart (part 1) illustrating the elevator operation state visualization method and the

elevator control method according to the embodiment, showing an analysis process concerning the operation state of the elevator which is executed by the operation state analysis processing unit 33 of the visualization apparatus 30 shown in Fig. 2. Fig. 11 is a flowchart (part 2) illustrating the elevator operation state visualization method and the elevator control method according to the embodiment, showing an operation state visualization process and an elevator control process which are executed by the visualization apparatus 30 and the terminal device 40 shown in Fig. 2.

[0081]

The elevator operation state visualization method and the elevator control method according to the embodiment will be described in the order of the flowcharts shown in Figs. 10 and 11 with reference to necessary diagrams of Figs 2 to 9.

[0082]

<Analysis Process of Operation State>

An analysis process for the operation state of an elevator will be described first with reference to Fig. 10.

[Step S101]

In step S101, the operation state analysis processing unit 33 determines whether the time to execute an analysis process has been reached. Assume that the

operation state analysis processing unit 33 performs an operation state analysis process periodically, for example, once a day. In this case, the operation state analysis processing unit 33 may execute this determination based on the elapsed time since the previous execution of an analysis process. Further, this elapsed time may coincide with a predetermined cycle (for example, one day) during which operation information is collected by the bank management device 21. The analysis process time may be set in accordance with the time when collected operation information is transmitted from the bank management device 21 to the storage device 31 of the visualization apparatus 30. If the operation state analysis processing unit 33 determines that the analysis process time has been reached (YES), the process advances to the next step S102 and waits until it is determined that the analysis process time has been reached (YES).

[0083]

[Step S102]

In step S102, the operation state analysis processing unit 33 refers to the operation information DB 31d and determines whether there is data newly registered in the operation information DB 31d after the time when the previous analysis process was executed. If it is determined that there is such data (YES), the process

advances to step S103. On the other hand, if it is determined that there is no such data (NO), the processing is terminated.

[0084]

[Step S103]

In step S103, the operation state analysis processing unit 33 causes the totalization processing unit 32 to totalize (for example, accumulate or average) (25) operation information registered in the operation information DB 31d according to the totalization cycle (for example, 5 min, 15 min, or 30 min) designated in advance by the system administrator. If the totalization cycle specified by the system administrator is the same as the time range in (23) date and time information in the operation information DB 31d, the operation state analysis processing unit 33 skips this process and proceeds to the next step S104.

[0085]

[Step S104]

In step S104, the operation state analysis processing unit 33 executes determination processing for each evaluation item of evaluation level 1 registered in the analysis condition DB 31b based on (25) operation information registered in the operation information DB 31d. At this time, the operation state analysis processing unit

33 extracts information corresponding to the evaluation item of evaluation level 1 registered in the analysis condition DB 31b from all pieces of (25) operation information registered in the operation information DB 31d, or calculates information corresponding to the evaluation item of evaluation level 1 from the extracted operation information.

[0086]

The operation state analysis processing unit 33 compares the extracted or calculated value of each evaluation item with (8) evaluation threshold set for each evaluation item of evaluation level 1 registered in the analysis condition DB 31b. The operation state analysis processing unit 33 determines, for all the evaluation items extracted or calculated, whether (8) evaluation threshold is exceeded.

[0087]

[Step S105]

In step S105, the operation state analysis processing unit 33 determines that a deterioration in operation state is detected (YES), if there is at least one evaluation item of evaluation level 1 exceeding (8) evaluation threshold as a result of the comparison in step S104. If the operation state analysis processing unit 33 determines that such an evaluation items has been detected

(YES), the process advances to next step S106. The operation state analysis processing unit 33 determines that no deterioration in operation state is detected (NO), if there is no evaluation item of evaluation level 1 exceeding (8) evaluation threshold as a result of the comparison in step S104.

[0088]

In the example of the operation information DB 31d shown in Fig. 6, among (25) operation information stored in association with (4) building ID "building A", (21) bank ID "bank B", ..., (b) average waiting time "55 sec" exceeds (8) evaluation threshold "50 sec" registered in the analysis condition DB 31b in Fig. 4. For this reason, it is determined that a deterioration in operation state is detected (YES), and the process advances to step S106.

[0089]

[Step S106]

In step S106, the operation state analysis processing unit 33 performs a determination process for each evaluation item of evaluation level 2 registered in the analysis condition DB 31b based on (25) operation information registered in the operation information DB 31d shown in Fig. 6. In this case, in the comparison in step S104, a determination process is executed for the evaluation item of evaluation level 2 associated with the

same cause of deterioration as the evaluation item of evaluation level 1 exceeding the evaluation threshold.

[0090]

For example, in the example of the operation information DB 31d shown in Fig. 6, among (25) operation information stored in association with (4) building ID "building A", (21) bank ID "bank B",..., (b) average waiting time "55 sec" exceeds the evaluation threshold. Therefore, the information corresponding to the evaluation item of evaluation level 2 associated with (5) deterioration cause "average waiting time" registered in the analysis condition DB 31b in Fig. 4 is extracted or calculated from the operation information DB 31d.

[0091]

The operation state analysis processing unit 33 compares the extracted or calculated value of each evaluation item with (8) evaluation threshold set for each evaluation item of evaluation level 2 registered in the analysis condition DB 31b in Fig. 4. The operation state analysis processing unit 33 then determines whether each evaluation item exceeds (8) evaluation item, and extracts any evaluation item that exceeds (8) evaluation value as a factor that has deteriorated the operation state.

[0092]

[Step S107]

In step S107, the operation state analysis processing unit 33 registers, in the analysis result DB 31e shown in Fig. 7, (7) evaluation item extracted as a factor that deteriorated the operation state in association with (4) building ID, (21) bank ID, (23) date and time information, (31) date and time of deterioration detection, and (5) cause of deterioration. Note that the (31) deterioration detection time is the time when the analysis process shown in the flowchart in Fig. 10 is executed.

[0093]

<Operation State Visualization Process and Elevator Control Process>

An elevator operation state visualization process and an elevator control process will be described based on Fig. 11 with reference to other drawings as necessary. The procedure shown in Fig. 11 is a procedure executed in the visualization apparatus 30 and the terminal device 40 shown in Fig. 2. In the following description, it is assumed that the visualization apparatus 30 functions as a Web server and a Web browser is installed in the terminal device 40. However, it is assumed that the visualization apparatus 30 and the terminal device 40 constitute a client & server type system, and a dedicated program may be installed in the terminal device 40.

[0094]

Referring to Fig. 11, steps S301 to S309 show processing performed by each unit of the visualization apparatus 30. Steps S401 to S406 show processing performed by the terminal device 40. Further, steps S41 to S43 show the operation processing of the terminal device 40 by the customer.

[0095]

[Step S41]

First of all, in step S41, the customer having the terminal device 40 executes a login operation using the terminal device 40. In this case, the customer enters the user ID and password assigned to him/her on the login page of the terminal device 40. At this time, for example, the customer inputs the user ID "001" and the password "abc" via the terminal device 40. In the following description, it is assumed that the terminal device 40 is the terminal device 40 of the customer who has executed a login operation in step S41.

[0096]

[Step S401]

In step S401, the terminal device 40 on which a login operation has been performed transmits the user ID and password input in step S41 to the visualization apparatus 30 as login information.

[0097]

[Step S301]

In step 301, upon receiving login information, the visualization processing unit 34 of the visualization apparatus 30 reads out the building ID associated with the received user ID and password from the user DB 31a (see Fig. 3). The visualization apparatus 30 creates visualization data for a building information screen based on the read building ID.

[0098]

At this time, for example, when the visualization apparatus 30 receives the user ID "001" and the password "abc", the visualization processing unit 34 reads out the building IDs "building A" and "building B" registered in correspondence with the user ID "001" from the user DB 31a (see Fig. 3).

[0099]

The visualization processing unit 34 also extracts information registered in correspondence with the building IDs "building A" and "building B" from the analysis result DB 31e (see Fig. 7), and creates a building information screen based on these pieces of information.

Note that there the building IDs "building A" and "building B" may not be registered in the analysis result DB 31e (see Fig. 7).

[0100]

[Step S302]

Thereafter, in step S302, the visualization processing unit 34 transmits the visualization data of the building information screen created in step S301 to the terminal device 40 that is the transmission source of the user ID and password received in step S301.

[0101]

[Step S402]

In step S402, the terminal device 40 that has received the visualization data of the building information screen displays the building information screen on the display unit based on the received building information screen data. In this case, as shown in Fig. 8, the information read in step S301 is displayed in the "building name" column, the "bank name" column, and the operation state display column 3012 in the building information display selection area 3011 on the building information screen 301.

[0102]

For example, in the "building name" column, the information of the building IDs "building A" and "building B" read in step S301 is displayed. In the "bank name" column, the bank IDs "bank A", "bank B", and "central bank" of the building management device 20 provided for the

building IDs "building A" and "building B" are displayed in association with the building IDs.

[0103]

In this state, selection of all displayed banks can be switched by checking radio buttons in the building information display selection area 3011. In the example of Fig. 8, "bank B" of "building A" is selected.

[0104]

The operation state display column 3012 displays the operation state of the elevator in "bank B" selected in the building information display selection area 3011. In this case, if there is information corresponding to selected "bank B" in the information extracted from the analysis result DB 31e (see Fig. 7) in step S301, the operation state display column 3012 displays "deteriorating".

[0105]

In this case, if there is no information corresponding to "bank B" selected in the building information display selection area 3011 in the information extracted from the analysis result DB 31e (see Fig. 7) in step S301, the operation state display column 3012 displays "operating state is good".

[0106]

When the operation state display column 3012 displays "operation state has deteriorated", the date and

time information selection column 3013 displays all the date and time information corresponding to the detection of a deterioration in operation state concerning "bank B" selected in the building information display selection area 3011. In the example shown in Fig. 8, the date and time information "2019/01/07 12:00 to 12:15" is selected.

[0107]

The [display] button 3014 is displayed when the operation state display column 3012 displays "operation state has deteriorated", and is hidden when the operation state display column 3012 displays "operation state is good".

[0108]

In this state, the deterioration information display column 3015, the improvement method display column 3016, the [execute] button 3017, and the operation state graph display column 3018 are hidden.

However, the operation state graph display column 3018 may display only the evaluation graph 3018a in normal times as a default display, and may display only a graph axis in the display column of the evaluation graph 3018b in bad times.

[0109]

If there is no information about all the banks displayed in the building information display selection

area 3011 in the information extracted from the analysis result DB 31e (see Fig. 7) in step S301, the [display] button 3014 is hidden. In this case, all the subsequent steps are skipped.

[0110]

[Step S42]

In the above display state, when the customer clicks the [display] button 3014 of the building information screen 301 displayed on the display unit of the terminal device 40 in step S42, this operation is the input of a display instruction by the customer.

[0111]

[Step S403]

In step S403, the terminal device 40 requests the visualization apparatus 30 for visualization data for displaying deterioration information, an improvement method, and an operation state graph in response to a click operation on the [display] button 3014. At this time, the terminal device 40 transmits, to the visualization apparatus 30, as a request for visualization data, the information selected upon display in step S402, that is, the building ID and bank ID selected in the building information display selection area 3011 and the date and time information selected in the date and time information selection column 3013, as selected information.

[0112]

In this case, as an example, the terminal device 40 transmits the building ID "building A", the bank ID "bank B", and the date and time information "2019/01/07 12:00 to 12:15" as the selected information to the visualization apparatus 30.

[0113]

[Step S303]

In step S303, the totalization processing unit 32 of the visualization apparatus 30 acquires (9) estimated factor, (10) improvement category, and (11) improvement method registered in the improvement method DB 31c based on the selection information transmitted from the terminal device 40. In this case, first of all, the totalization processing unit 32 acquires information corresponding to the selection information transmitted from the terminal device 40 from the information registered in the analysis result DB 31e. The information acquired here includes (5) cause of deterioration "average waiting time" and (7) evaluation item "landing call registration ratio" registered in correspondence with the building ID "building A", the bank ID "bank B", and the date and time information "2019/01/07 12:00 to 12: 15" received as the selection information.

[0114]

The totalization processing unit 32 acquires (9) estimated factor, (10) improvement category, and (11) improvement method registered in correspondence with (5) cause of deterioration "average waiting time" and (7) evaluation item "landing call registration ratio" from the information registered in the improvement method DB 31c. .
[0115]

[Step S304]

In step S304, the totalization processing unit 32 of the visualization apparatus 30 collects data for creating an operation state graph from the information registered in the operation information DB 31d. In this case, the totalization processing unit 32 collects data corresponding to the building ID "building A" and the bank ID "bank B" of the selection information transmitted from the terminal device 40, which is (5) cause of deterioration "average waiting time" acquired in step S303, from (25) operation information registered in the operation information DB 31d.
[0116]

The data collected here is data at bad times for 24 hr in 2019/01/07 including the date and time information "2019/01/07 12:00 to 12:15" received as selection information. In addition, in this case, the totalization processing unit 32 may collect data in normal times in 24 hr during which no deterioration in operation state is

detected, for example, 24-hr data in the previous day,
2019/01/06.

[0117]

[Step S305]

In step S305, the visualization processing unit 34 of the visualization apparatus 30 creates two graph data based on the selection information transmitted from the terminal device 40 and the data collected by the totalization processing unit 32 in step S304. The visualization processing unit 34 creates graph data for displaying an evaluation graph in normal times based on the data in normal times totalized by the totalization processing unit 32. The visualization processing unit 34 creates graph data for displaying an evaluation graph in bad times based on the data in bad times totalized by the totalization processing unit 32. When an evaluation graph in normal times is displayed on the terminal device 40 as a default, it is not necessary to create graph data for displaying an evaluation graph in normal times.

[0118]

[Step S306]

In step S306, the visualization processing unit 34 of the visualization apparatus 30 transmits (5) cause of deterioration, (9) estimated factor, (10) improvement category, and (11) improvement method acquired in step S303

and two graph data created in step S305 to the terminal device 40.

[0119]

[Step S404]

In step S404, the terminal device 40 displays, on the building information screen 301 as shown in Fig. 9, (5) cause of deterioration, (9) estimated factor, (10) improvement category, (11) improvement method, and the two graph data received from the visualization apparatus 30.

[0120]

That is, the terminal device 40 displays (5) cause of deterioration "average waiting time" and (9) estimated factor received from the visualization apparatus 30 in the deterioration information display column 3015 of the building information screen 301. The improvement method display column 3016 displays (11) improvement methods associated with (10) improvement category "operation" as a method related to an elevator operation. In addition, as a method related to the elevator system (usability specifications), (11) improvement method associated with the (10) improvement category "system" is displayed (see the improvement method DB 31c in Fig. 5).

[0121]

The terminal device 40 displays the [execute] button 3017 in conjunction with the display of a method related to the elevator system (usability specifications).

[0122]

The terminal device 40 displays the evaluation graph 3018a in normal times and the evaluation graph 3018b in bad times one above the other in the operation state graph display column 3018 of the building information screen 301 based on the two graph data received from the visualization apparatus 30.

[0123]

[Step S43]

In step S43, when the customer clicks the [execute] button 3017 on the building information screen 301 displayed on the display unit of the terminal device 40, this operation is the input of an instruction to change the usability specifications (elevator system) by the customer.

[0124]

[Step S405]

In step S405, the terminal device 40 transmits an instruction to change usability specifications to the visualization apparatus 30 in response to a click operation of the [execute] button 3017.

[0125]

[Step S307]

In step S307, the usability specification data transmission unit 35 of the visualization apparatus 30 creates change data for changing the usability specifications in response to the instruction to change the usability specifications received from the terminal device 40. The change data created in this case is data for executing the improvement method displayed in the method column relating to the elevator system (usability specifications) in the improvement method display column 3016 shown in Fig. 9.

[0126]

[Step S308]

In step S308, the usability specification data transmission unit 35 of the visualization apparatus 30 transmits the created change data of the usability specifications to the corresponding bank management device 21, for example, the bank management device 21b that manages the elevator corresponding to "bank B" of "building A" (see Fig. 2). This makes the bank management device 21b transmit usability specification change data to the elevator controllers 10d, 10e, and 10f connected to the bank management device 21b.

[0127]

Note that the elevator controllers 10d, 10e, and 10f store the received change data of the usability

specifications without any change, or change the elevator system based on the change data.

[0128]

[Step S309]

In step S309, the usability specification data transmission unit 35 transmits the transmission result of the transmission of the usability specification change data to the bank management device 21b to the terminal device 40, and terminates the series of processes by the visualization apparatus 30.

[0129]

[Step S406]

On the other hand, in step S406, the terminal device 40 causes the display unit to display the completion of the transmission of the usability specification change data. The terminal device 40 displays the transmission result of the usability specification data received from the visualization apparatus 30. The transmission result of the usability specification data may be displayed on the building information screen 301 or may be displayed in a pop-up.

[0130]

<<Effects of Embodiment>>

According to the embodiment described above, when the operation state analysis processing unit 33 of the

visualization apparatus 30 detects a deterioration in the operation state of the elevator, the visualization processing unit 34 creates the cause of the deterioration in operation state , the estimated factor of the deterioration, and visualization data for visualizing an improvement method. This makes it possible to display these pieces of information on the display unit of the terminal device 40 of the customer. As a result, even a customer who does not have specialized knowledge regarding elevator control can easily know an improvement method used when the elevator operation state deteriorates and can also implement the improvement method.

[0131]

In particular, operation information is registered in the operation information DB 31d for each bank and date and time information, and the operation state analysis processing unit 33 analyzes the operation state based on the operation information registered in the operation information DB 31d. This makes it possible to detect a deterioration in the operation state of the elevator for each bank and acquire an improvement method for each cause of the deterioration. Therefore, it is possible to easily know an improvement method for a deterioration in the operating state of a group management elevator without specialized knowledge about elevator group management

control. This makes it possible even for customers such as building management companies and building owners who do not have specialized knowledge to easily improve the deterioration in the operation state.

[0132]

<<Modification>>

The above embodiment has exemplified the configuration in which the display unit of the terminal device 40 displays the [execute] button 3017 for requesting the transmission of the usability specification change data. However, the display unit may display an [invalid] button for invalidating any change in the usability specifications. In this case, when the [invalid] button is clicked by the customer, a change in the usability specifications is canceled and the usability specifications of the elevator is returned to a reference state.

[0133]

In this embodiment, the abscissas of the evaluation graph 3018a in normal times and the evaluation graph 3018b in bad times each represent a 24-hour scale. However, a variable scale may be used. The evaluation graph 3018a and the evaluation graph 3018b may have different display forms such as a bar graph.

[0134]

This embodiment has exemplified the case in which the bank management device 21 transmits operation information for each predetermined time collected at a predetermined interval of one day to the visualization apparatus 30, and the system administrator totalizes the data of the evaluation items for each totalization cycle (for example, 5 min, 15 min, or 30 min) designated by the system manager with one-day data being a parameter. However, evaluation item data may be totalized using data for five days from Monday to Friday as a parameter when the building is in operation.

[0135]

This embodiment has exemplified one evaluation threshold included in the evaluation graph 3018a and the evaluation graph 3018b. However, another evaluation threshold may be added for a caution alert. For example, a customer claim can be prevented by sending a caution alert to a maintenance company.

[0136]

In addition, the present invention is not limited to above-described embodiment and modification and includes various modifications. For example, the above-described embodiment has been described in detail for easy understanding of the present invention, and is not necessarily limited to one having all the configurations

described above. Further, part of the configuration of one embodiment can be replaced with the configuration of another embodiment, and the configuration of another embodiment can be added to the configuration of one embodiment. Moreover, it is possible to add, delete, and replace other configurations with respect to part of the configurations of each embodiments.

What is claimed is:

1. An elevator operation state visualization apparatus including a visualization processing unit configured to visualize an operation state of an elevator based on elevator operation information, the apparatus comprising:

a storage device holding an analysis condition database that registers an analysis condition for analyzing the operation state of the elevator from the elevator operation information and an improvement method database that registers an improvement method for each cause of deterioration that deteriorates the operation state of the elevator;

an operation state analysis processing unit configured to analyze the operation information based on the analysis condition registered in the analysis condition database and specify the cause of deterioration when determining that the operation state of the elevator has deteriorated; and

a totalization processing unit configured to acquire an improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit from the improvement method database, wherein

the visualization processing unit creates visualization data for visualizing the cause of deterioration specified by the operation state analysis processing unit and the improvement method acquired by the totalization processing unit.

2. The elevator operation state visualization apparatus according to claim 1, wherein

the improvement method database registers an estimated factor that causes the cause of deterioration and an improvement method for each of the estimated factors in association with the cause of deterioration,

the operation state analysis processing unit specifies an estimated factor that has caused the cause of deterioration based on the analysis condition registered in the analysis condition database,

the totalization processing unit acquires an improvement method corresponding to the estimated factor specified by the operation state analysis processing unit from the improvement method database, and

the visualization processing unit creates visualization data for visualizing the estimated factor specified by the operation state analysis processing unit and the improvement method acquired by the totalization processing unit.

3. The elevator operation state visualization apparatus according to claim 1, wherein

the operation information is information for each floor of the elevator,

the storage device stores an operation information database that registers date and time information related to date and time when the operation information has been detected in association with the operation information for each floor, and

the operation state analysis processing unit executes an analysis for specifying the cause of deterioration for each floor and each operation information associated with the date and time information.

4. The elevator operation state visualization apparatus according to claim 3, wherein

the visualization processing unit creates visualization data for visualizing a graph composed of the operation information and the date and time information.

5. The elevator operation state visualization apparatus according to claim 4, wherein

the visualization processing unit creates the visualization data so as to display an analysis result obtained by the operation state analysis processing unit, the cause of deterioration, the improvement method, and the graph on one screen.

6. The elevator operation state visualization apparatus according to claim 3, wherein

the storage device holds an analysis result database that registers the cause of deterioration specified by the operation state analysis processing unit and the date and time information registered in the operation information database in correspondence with the operation information, in which the cause of deterioration has been specified, in association with each other, and

the totalization processing unit acquires the improvement method registered in correspondence with the cause of deterioration from the improvement method database based on the cause of deterioration registered in the analysis result database.

7. The elevator operation state visualization apparatus according to claim 1, wherein

the improvement method database registers, as the improvement method, a method related to an operation of the elevator and a method related to control of the elevator upon classification, and

the visualization processing unit creates visualization data for visualizing the classification together with the improvement method.

8. The elevator operation state visualization apparatus according to claim 7, wherein

when the method related to the control of the elevator is acquired from the improvement method database as the improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit, the visualization processing unit creates visualization data to select whether to execute the improvement method for each acquired improvement method.

9. The elevator operation state visualization apparatus according to claim 1, wherein

the elevator operation information is information acquired from an elevator controller or a simulator that simulates an elevator operation.

10. The elevator operation state visualization apparatus according to any one of claims 1 to 9, wherein

the storage device stores an operation information database that registers operation information of a plurality of elevators provided in the same bank, for each bank, and

the operation state analysis processing unit analyzes the operation information of the plurality of elevators for each bank.

11. An elevator control system comprising:

an elevator controller configured to control an elevator operation;

an elevator operation state visualization apparatus configured to visualize an operation state of an elevator; and

a terminal device including a display unit and an operation unit that operates setting for control in the elevator controller,

the elevator operation state visualization apparatus including:

a visualization processing unit configured to visualize the operation state of the elevator and display the operation state on the display unit of the terminal device;

a storage device holding an analysis condition database that registers an analysis condition for analyzing the operation state of the elevator from the elevator operation information and an improvement method database that registers an improvement method for each cause of deterioration that deteriorates the operation state of the elevator;

an operation state analysis processing unit configured to analyze the operation information based on the analysis condition registered in the analysis condition database and specify the cause of deterioration when determining that the operation state of the elevator has deteriorated; and

a totalization processing unit configured to acquire an improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit from the improvement method database, wherein

the visualization processing unit visualizes and allows the display unit of the terminal device to display the cause of deterioration specified by the operation state analysis processing unit and the improvement method acquired by the totalization processing unit.

12. The elevator control system according to claim 11, wherein

the improvement method database registers, as the improvement method, a method related to an operation of the elevator and a method related to control of the elevator upon classification, and

the visualization processing unit creates visualization data for visualizing the classification together with the improvement method, and, when the method related to the control of the elevator is acquired from the improvement method database as the improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit, allows the display unit of the terminal device to perform display for

selecting whether to execute the improvement method for each acquired improvement method.

13. The elevator control system according to claim 12, wherein

the elevator operation state visualization apparatus comprises a usability specification data transmission unit configured to, when the terminal device performs an operation for selecting execution of the improvement method, causes the elevator controller to execute the improvement method based on the display for selecting whether to execute each improvement method.

14. The elevator control system according to any one of claims 11 to 13, wherein

the elevator operation information is information acquired from the elevator controller or a simulator configured to simulate the elevator operation.

15. An elevator operation state visualization method for visualizing an operation state of an elevator based on elevator operation information, the method comprising:

causing a storage device to hold an analysis condition database that registers an analysis condition for analyzing the operation state of the elevator from the elevator operation information and an improvement method database that registers an improvement method for each

cause of deterioration that deteriorates the operation state of the elevator;

causing an operation state analysis processing unit to analyze the operation information based on the analysis condition registered in the analysis condition database and specify the cause of deterioration when determining that the operation state of the elevator has deteriorated;

causing a totalization processing unit to acquire the improvement method corresponding to the cause of deterioration specified by the operation state analysis processing unit from the improvement method database; and

causing the visualization processing unit to create visualization data for visualizing the specified cause of deterioration and the acquired improvement method.