

ELEVATOR CONTROL DEVICE AND ELEVATOR INSPECTION PROCESSING METHOD

TECHNICAL FIELD

[0001]

Embodiments of the present invention relate to an elevator control device and an elevator inspection processing method.

BACKGROUND

[0002]

There is a monitoring system in which a remote monitoring device installed at a place remote from an elevator monitors the elevator. In this monitoring system, the elevator acquires inspection data for each inspection item and transmits the inspection data to the remote monitoring device on the basis of an instruction periodically transmitted by the remote monitoring device.

[0003]

As a result, the remote monitoring device can monitor a state of each place in the elevator from a remote place on the basis of the inspection data transmitted from the elevator.

CITATION LIST

PATENT LITERATURE

[0004]

Patent Literature 1: JP 2015-20900 A

SUMMARY

[0005]

In remote monitoring of an elevator, an inspection process of the elevator can be accurately executed by using not only sensor data acquired by a sensor but also video data captured by a camera device as the inspection data.

[0006]

On the other hand, an upper limit of a data communication amount is set between the elevator and the remote monitoring device every prescribed period, for example, every month. When the data communication amount exceeds this upper limit, an additional communication usage fee is generated. Therefore, the elevator desirably transmits the inspection data to the remote monitoring device with a data amount not exceeding the set upper limit.

[0007]

However, when the amount of video data included in the inspection data is large, the data communication amount at the time of transmitting the inspection data may increase to exceed the set upper limit.

[0008]

An object of the present invention is to provide an elevator control device and an elevator inspection processing method capable of efficiently acquiring elevator inspection data and transmitting the elevator inspection data to a remote monitoring device while considering a data communication amount with the remote monitoring device.

[0009]

An elevator control device in accordance with some embodiments is communicably connected to a remote monitoring device configured to transmit an inspection instruction for causing an elevator to execute an inspection process every prescribed period from a remote place, and includes a data amount storage, a specification unit, an inspection execution unit, and an inspection result processor. The data amount storage is configured to store information on a previous inspection data amount that is a data amount of inspection data acquired by an inspection process executed previously. The specification unit is configured to specify a type of inspection data to be acquired in a current inspection process on a basis of the previous inspection data amount stored in the data amount storage upon acquiring the inspection instruction transmitted from the remote monitoring device. The inspection execution unit is configured to acquire the type of inspection data specified by the specification unit, execute the current inspection process, and acquire inspection data related to the current inspection process. The inspection result processor is configured to transmit the acquired inspection data related to the current inspection process to the remote monitoring device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a block diagram illustrating a configuration of a monitoring system using an elevator control device according to an embodiment.

FIG. 2A is a flowchart illustrating a first inspection process executed by the elevator control device during an operation of the monitoring system according to the embodiment.

FIG. 2B is a flowchart illustrating second and subsequent inspection processes executed by the elevator control device during the operation of the monitoring system according to the embodiment.

DETAILED DESCRIPTION

[0011]

Hereinafter, a monitoring system 1 using an elevator control device 14 according to an embodiment of the present invention will be described with reference to the drawings.

[0012]

(Configuration of Monitoring System 1 of Embodiment)

FIG. 1 is an overall diagram illustrating a configuration of the monitoring system 1 according to the embodiment. The monitoring system 1 is configured by connecting an elevator 10 and a remote monitoring device 20 installed in a remote center located at a place remote from the elevator 10 to each other via a wide area communication network 30.

[0013]

The elevator 10 includes a hoisting machine 11 installed in an upper portion of a hoistway in a building, a rope 12 stretched over the hoisting machine 11, a car 13 suspended from one end of the rope 12, and the elevator control device 14 installed in an upper portion of the hoistway. The car 13 and the elevator control device 14 are connected to each other via a tail cord 15. The car 13 has a car door 131.

[0014]

The elevator control device 14 includes a first storage 141, a first communication unit 142, and a first CPU 143.

[0015]

The first storage 141 includes a threshold storage 141a, a data amount storage 141b, and an abnormal sign item storage 141c. Regarding communication with the remote monitoring device 20, the threshold storage 141a stores a threshold D_{max} of a data communication amount set based on an upper limit value of the data communication amount per prescribed period, for example, per month, during which the communication can be used at a prescribed communication fee.

[0016]

The data amount storage 141b stores information on a previous inspection data amount D_0 which is a data amount of inspection data acquired by an inspection process executed previously among inspection processes of the elevator 10 executed every prescribed period as described later. The abnormal sign item storage 141c stores information on an inspection item for which it is determined that there is an abnormality sign in the previous inspection process.

[0017]

The first communication unit 142 communicates with the remote monitoring device 20 via the wide area communication network 30.

[0018]

The first CPU 143 is, for example, a central processing unit (CPU) included in a general-purpose microcomputer, and constitutes one or more information processors described below by installing and executing a prescribed elevator control program. The first CPU 143 includes an operation controller 143a, an inspection instruction acquisition unit 143b, a specification unit 143c, an inspection execution unit 143d, and an inspection result processor 143e.

[0019]

The operation controller 143a controls devices in the elevator 10 including the hoisting machine 11. The inspection instruction acquisition unit 143b acquires an inspection instruction transmitted from the remote monitoring device 20 as described later. When the inspection instruction acquisition unit 143b acquires the inspection instruction, the specification unit 143c specifies the type of inspection data to be acquired in the current inspection process for each inspection item on the basis of information stored in the threshold storage 141a, the data amount storage 141b, and the abnormal sign item storage 141c. Examples of the type of inspection data include measurement data by a sensor, ON/OFF operation data of a switch, and video data captured by a camera device.

[0020]

Specifically, when a previous inspection data amount D0 stored in the data amount storage 141b does not exceed the threshold Dmax stored in the threshold storage 141a, the specification unit 143c specifies the type of inspection data including video data for all of a plurality of inspection items set in advance as an acquisition target in the current inspection process.

[0021]

When the previous inspection data amount D0 stored in the data amount storage 141b exceeds the threshold Dmax stored in the threshold storage 141a, the specification unit 143c specifies the type of inspection data not including video data for some or all of the plurality of inspection items set in advance as an acquisition target in the current inspection process. The “some of the plurality of inspection items set in advance” refers to, for example, an inspection item corresponding to information stored in the abnormal sign item storage 141c.

[0022]

The inspection execution unit 143d acquires the type of inspection data specified

by the specification unit 143c and executes an inspection process regarding each inspection item.

[0023]

The inspection result processor 143e stores information on a data amount of inspection data acquired regarding the current inspection process (hereinafter, referred to as “current inspection data amount”) D1 in the data amount storage 141b.

[0024]

The inspection result processor 143e calculates a severity indicating an abnormality degree for each inspection item on the basis of the inspection data acquired in the executed inspection process, recognizes an item whose calculated severity is a prescribed value or more as an item having an abnormal sign (hereinafter, referred to as “abnormal sign item”), and stores information on the recognized abnormal sign item in the abnormal sign item storage 141c. In addition, the inspection result processor 143e transmits the acquired inspection data to the remote monitoring device 20.

[0025]

In the elevator 10, a plurality of camera devices (not illustrated) for photographing a place corresponding to an inspection item, a plurality of sensors (not illustrated) for acquiring state information of a place corresponding to an inspection item, and the like are installed.

[0026]

The remote monitoring device 20 includes a second storage 21, a second communication unit 22, and a second CPU 23. The second storage 21 includes an inspection data storage 211 that stores inspection data of the elevator 10 transmitted from the elevator control device 14. The second communication unit 22 communicates with the elevator control device 14 via the wide area communication network 30.

[0027]

The second CPU 23 is, for example, a central processing unit (CPU) included in a general-purpose microcomputer, and constitutes one or more information processors described below by installing and executing a prescribed remote monitoring program.

[0028]

The second CPU 23 includes a remote monitoring unit 231 that monitors the elevator 10 from a remote place by transmitting an inspection instruction for causing the elevator control device 14 to execute an inspection process every prescribed period and acquiring inspection data transmitted from the elevator control device 14 in response to the inspection instruction.

[0029]

(Operation of Monitoring System 1 of Embodiment)

An operation of the monitoring system 1 according to the present embodiment will be described. During an operation of the monitoring system 1, the remote monitoring device 20 transmits an inspection instruction to the elevator control device 14 every prescribed period (for example, once a month).

[0030]

FIGS. 2A and 2B are flowcharts illustrating processes executed by the elevator control device 14 during an operation of the monitoring system 1. While the operation controller 143a of the elevator control device 14 performs a normal operation of the elevator 10 (step S1), when the remote monitoring unit 231 of the remote monitoring device 20 transmits a first inspection instruction, the inspection instruction acquisition unit 143b acquires this instruction via the first communication unit 142 (step S2: YES).

[0031]

When the inspection instruction acquisition unit 143b acquires the first inspection instruction, the specification unit 143c specifies the type of inspection data for each inspection item to be acquired in a first inspection process (step S3). In the first inspection process, for example, the specification unit 143c specifies the type of inspection data to be acquired, including video data for all inspection items.

[0032]

When the specification unit 143c specifies the type of inspection data to be acquired for each inspection item, the inspection execution unit 143d stops the normal operation by the operation controller 143a and executes an inspection process regarding each inspection item (step S4). The inspection execution unit 143d acquires data to be acquired regarding each inspection item as inspection data by appropriately moving the car 13 by the operation controller 143a or switching ON/OFF of a prescribed switch, and performs an inspection process.

[0033]

The inspection result processor 143e acquires the inspection data acquired regarding the executed inspection process, and stores information on the current inspection data amount D1 of the acquired inspection data in the data amount storage 141b. The information stored in the data amount storage 141b is used as the previous inspection data amount D0 in a next inspection process.

[0034]

The inspection result processor 143e calculates a severity indicating an abnormality degree for each inspection item on the basis of the acquired inspection data for each inspection item, and stores information on an abnormal sign item whose

calculated severity is a prescribed value or more in the abnormal sign item storage 141c (step S5).

[0035]

The inspection result processor 143e transmits the acquired inspection data to the remote monitoring device 20 (step S6). The inspection result processor 143e may transmit the inspection data including information on the abnormal sign item. Thereafter, the operation controller 143a restarts the normal operation (step S7).

[0036]

In the remote monitoring device 20, the remote monitoring unit 231 acquires the inspection data and the information on the severity of each item transmitted from the elevator control device 14 via the second communication unit 22, and stores the inspection data and the information in the inspection data storage 211. As a result, the first inspection process ends.

[0037]

Thereafter, when an execution timing of a next inspection process arrives and the remote monitoring unit 231 of the remote monitoring device 20 transmits a second inspection instruction to the elevator control device 14, the inspection instruction acquisition unit 143b acquires this instruction (step S8: YES).

[0038]

When the inspection instruction acquisition unit 143b acquires the second inspection instruction, the specification unit 143c specifies the type of inspection data for each inspection item to be acquired in the current inspection process on the basis of information stored in the threshold storage 141a, the data amount storage 141b, and the abnormal sign item storage 141c.

[0039]

Specifically, the specification unit 143c predicts that the current inspection data amount D1 acquired in the current inspection process will be substantially the same as the previous inspection data amount D0 acquired in the previous inspection process, and determines whether or not the previous inspection data amount D0 stored in the data amount storage 141b exceeds the threshold Dmax stored in the threshold storage 141a (step S9).

[0040]

When determining that the previous inspection data amount D0 exceeds the threshold Dmax (step S9: YES), the specification unit 143c further determines whether or not information on the abnormal sign item is stored in the abnormal sign item storage 141c (step S10).

[0041]

When determining that the information on the abnormal sign item is stored (step S10: YES), the specification unit 143c specifies the type of inspection data to be acquired in the current inspection process, including video data for the abnormal sign item and not including video data for items other than the abnormal sign item among the inspection items (step S11).

[0042]

Here, the specification unit 143c allows the data amount of the inspection data to exceed the threshold D_{max} when the inspection data is transmitted to the remote monitoring device 20 in a subsequent stage by including video data related to the abnormal sign item in the acquisition target of the current inspection process in preference to enhancing accuracy of a monitoring process of the abnormal sign item rather than suppressing occurrence of an additional communication fee.

[0043]

On the other hand, when determining that the information on the abnormal sign item is not stored in step S10 (step S10: NO), the specification unit 143c specifies the type of inspection data to be acquired in the current inspection process, not including video data for all inspection items (step S12).

[0044]

When determining that the previous inspection data amount D_0 does not exceed the threshold D_{max} in step S9 (step S9: NO), the specification unit 143c specifies the type of inspection data to be acquired in the current inspection process, including video data for all inspection items (step S13).

[0045]

When the specification unit 143c specifies the type of inspection data to be acquired for each inspection item, the inspection execution unit 143d stops the normal operation by the operation controller 143a and executes an inspection process regarding each inspection item (step S14). The inspection result processor 143e acquires the inspection data acquired regarding the executed inspection process, and stores information on the current inspection data amount D_1 of the acquired inspection data in the data amount storage 141b.

[0046]

The inspection result processor 143e calculates a severity indicating an abnormality degree for each inspection item on the basis of the acquired inspection data for each inspection item, and stores information on an abnormal sign item whose calculated severity is a prescribed value or more in the abnormal sign item storage 141c

(step S15).

[0047]

The inspection result processor 143e transmits the acquired inspection data to the remote monitoring device 20 (step S16). As a result, the second inspection process ends. Thereafter, the operation controller 143a restarts the normal operation (step S17).

[0048]

The elevator control device 14 returns to step S8 when the second inspection process ends, and appropriately executes processes of steps S8 to S17 as described above when acquiring a next third inspection instruction (step S8: YES).

[0049]

By periodically repeating the above-described inspection processes, an administrator of a monitoring center detects a defect that occurs with a lapse of time after installation of the elevator 10, and can take measures such as part replacement or can detect a temporary defect and take measures to solve a cause of the defect.

[0050]

For example, in a case where an inspection item “door opening/closing time of the car door” is recognized as an abnormal sign item because a measurement value of the door opening/closing time by a sensor or the like exceeds a prescribed value, an administrator confirms that there is a foreign substance in a guide rail of the car door and an opening/closing operation is not smoothly performed by confirming video data obtained by photographing the car door, and can return the state to a normal state by removing the foreign substance.

[0051]

In a case where an inspection item “landing position” is recognized as an abnormal sign item because a step amount between a floor surface of the car 13 and a floor surface of a landing measured by a sensor or the like exceeds a prescribed value, an administrator recognizes that there is rust of a landing switch, deviation of an installation position, or the like by confirming video data obtained by photographing the landing switch, and can return the state to a normal state by replacing the landing switch or adjusting an installation position.

[0052]

As a result, this inspection item is not recognized as an abnormal sign item in a next inspection process, and the data amount of subsequent inspection data can be appropriately adjusted.

[0053]

In the embodiment described above, an administrator may manually set in

advance an item to be executed always using video data with respect to the specification unit 143c, and the specification unit 143c may specify an execution item of the current inspection process on the basis of the set information.

[0054]

(Effects of Embodiment)

According to the embodiment above, an elevator control device is communicably connected to a remote monitoring device configured to transmit an inspection instruction for causing an elevator to execute an inspection process every prescribed period from a remote place, and includes a data amount storage, a specification unit, an inspection execution unit, and an inspection result processor. The data amount storage is configured to store information on a previous inspection data amount that is a data amount of inspection data acquired by an inspection process executed previously. The specification unit is configured to specify a type of inspection data to be acquired in a current inspection process on a basis of the previous inspection data amount stored in the data amount storage upon acquiring the inspection instruction transmitted from the remote monitoring device. The inspection execution unit is configured to acquire the type of inspection data specified by the specification unit, execute the current inspection process, and acquire inspection data related to the current inspection process. The inspection result processor is configured to transmit the acquired inspection data related to the current inspection process to the remote monitoring device.

[0055]

As a result, the elevator control device can acquire inspection data of the elevator efficiently and transmit the inspection data to the remote monitoring device while considering a data communication amount.

[0056]

The specification unit may be configured to, as an acquisition target in the current inspection process: specify a type of the inspection data including video data for all of a plurality of inspection items set in advance upon the previous inspection data amount not exceeding a prescribed threshold; and specify a type of the inspection data not including video data for some or all of the plurality of inspection items set in advance upon the previous inspection data amount exceeding the threshold.

[0057]

As a result, it is possible to acquire the inspection data of the elevator more accurately and efficiently and to transmit the inspection data to the remote monitoring device while considering the data communication amount.

[0058]

The elevator control device above may further includes an abnormal sign item storage configured to store information on an abnormal sign item recognized as having an abnormality sign by the inspection process executed previously. Upon the previous inspection data amount exceeding the threshold and information on the abnormal sign item being stored in the abnormal sign item storage, the specification unit may be configured to, as the acquisition target in the current inspection process: specify a type of the inspection data including video data for the stored abnormal sign item; and specify a type of the inspection data not including video data for items other than the stored abnormal sign item.

[0059]

As a result, it is possible to acquire the inspection data of the elevator efficiently and to transmit the inspection data to the remote monitoring device while considering a data communication amount and an abnormal sign item.

[0060]

The specification unit may be configured to: specify a type of the inspection data not including video data for all of the plurality of inspection items set in advance upon the previous inspection data amount exceeding the threshold and information on the abnormal sign item being not stored in the abnormal sign item storage; and allow the data amount of the inspection data acquired in the current inspection process to exceed the threshold and specify a type of the inspection data upon the previous inspection data amount exceeding the threshold and the information on the abnormal sign item being stored in the abnormal sign item storage.

[0061]

As a result, the inspection process can be executed accurately by always acquiring video data for an abnormal sign item.

[0062]

The threshold may be set on a basis of an upper limit value of a data communication amount per prescribed period during which communication can be used at a prescribed communication fee. As a result, it is possible to acquire the inspection data of the elevator efficiently and to transmit the inspection data to the remote monitoring device while keeping the communication fee within a prescribed communication fee if possible.

[0063]

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a

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

CLAIMS

1. An elevator control device communicably connected to a remote monitoring device configured to transmit an inspection instruction for causing an elevator to execute an inspection process every prescribed period from a remote place, the elevator control device comprising:

- a data amount storage configured to store information on a previous inspection data amount that is a data amount of inspection data acquired by an inspection process executed previously;

- a specification unit configured to specify a type of inspection data to be acquired in a current inspection process on a basis of the previous inspection data amount stored in the data amount storage upon acquiring the inspection instruction transmitted from the remote monitoring device;

- an inspection execution unit configured to acquire the type of inspection data specified by the specification unit, execute the current inspection process, and acquire inspection data related to the current inspection process; and

- an inspection result processor configured to transmit the acquired inspection data related to the current inspection process to the remote monitoring device.

2. The elevator control device according to claim 1, wherein the specification unit is configured to, as an acquisition target in the current inspection process:

- specify a type of the inspection data including video data for all of a plurality of inspection items set in advance upon the previous inspection data amount not exceeding a prescribed threshold; and

- specify a type of the inspection data not including video data for some or all of the plurality of inspection items set in advance upon the previous inspection data amount exceeding the threshold.

3. The elevator control device according to claim 2, further comprising an abnormal sign item storage configured to store information on an abnormal sign item recognized as having an abnormality sign by the inspection process executed previously,

- wherein, upon the previous inspection data amount exceeding the threshold and information on the abnormal sign item being stored in the abnormal sign item storage, the specification unit is configured to, as the acquisition target in the current inspection process: specify a type of the inspection data including video data for the stored abnormal sign item; and specify a type of the inspection data not including video data for items

other than the stored abnormal sign item.

4. The elevator control device according to claim 3, wherein the specification unit is configured to:

specify a type of the inspection data not including video data for all of the plurality of inspection items set in advance upon the previous inspection data amount exceeding the threshold and information on the abnormal sign item being not stored in the abnormal sign item storage; and

allow the data amount of the inspection data acquired in the current inspection process to exceed the threshold and specify a type of the inspection data upon the previous inspection data amount exceeding the threshold and the information on the abnormal sign item being stored in the abnormal sign item storage.

5. The elevator control device according to claim 2, wherein the threshold is set on a basis of an upper limit value of a data communication amount per prescribed period during which communication can be used at a prescribed communication fee.

6. An elevator inspection processing method executed by an elevator control device communicably connected to a remote monitoring device configured to transmit an inspection instruction for causing an elevator to execute an inspection process every prescribed period from a remote place, the method comprising:

storing, in a data amount storage, information on a previous inspection data amount that is a data amount of inspection data acquired by an inspection process executed previously;

specifying a type of inspection data to be acquired in a current inspection process on a basis of the previous inspection data amount stored in the data amount storage upon acquiring the inspection instruction transmitted from the remote monitoring device;

acquiring the specified type of inspection data, executing the current inspection process, and acquiring inspection data related to the current inspection process; and

transmitting the acquired inspection data related to the current inspection process to the remote monitoring device.