

TITLE OF THE INVENTION

CONTROLLING APPARATUS OF ESCALATOR

BACKGROUND OF THE INVENTION

5 The present invention relates to an escalator
controlling apparatus and, more particularly, to an
escalator controlling apparatus which is able to judge
abnormal condition on the basis of images taken of the
escalator and a region in the vicinity thereof and effect an
10 operation control, etc. of the escalator on the basis of the
judgment result.

As prior arts of this kind, there is a prior art
which is disclosed in JP A 4-286596 in which vehicles such
as wheelchairs are detected by a camera for detection set at
15 the landing place of the escalator, the escalator comes into
a specific operation mode such as transfer of vehicles.
Further, there is another prior art which is disclosed in JP
A 5-319762. In the prior art, a flow of passengers in a
passenger conveyor is taken picture as image data, and when
20 some disturbance occurs in the passenger flow and an
accident that the passenger or passengers tumble or a fear
that the tumbling of the passenger or passengers may result
in an accident is detected, an alarm is given to an observer
or the speed of the passenger conveyor is controlled to
25 prevent the accident from expanding.

According to the above-mentioned prior arts, the
wheel chairs, etc. can be detected and it is possible to

effect automatically a specific operation to cope with the detection result. Further, a tumbling accident of a passenger or passengers and an event which may result in a tumbling accident is detected from the disturbance in the travelling operation of the escalator, and it is possible to prevent the accident from expanding. However, those are realized by individual apparatus, and it is not considered to detect other events or objects. Further, when other functions are added, additional devices and apparatus are needed, whereby there are such problems that the whole apparatus becomes complicated and high in cost and an additional setting space is needed. For example, in the former of the above-mentioned prior arts, two cameras are set at each of outlet and inlet to detect the vehicles, and the detection of vehicles is effected by image information therefrom.

Further, in the latter of the above-mentioned prior arts, since features of passengers, etc. extracted by image processing are arranged in time-series and detected by an inclination angle at which a passenger or passengers inclined against a moving direction, an event similar to the tumbling, etc. can be detected, but it is not considered to detect an event which is not related to the moving direction of the feature. Further, since judgment of an accident is effected by the inclination angle against the moving direction, the passage of time for a certain time is necessary for the judgment, and it is not considered to

take an action by rapidly responding to a rapid change.

SUMMARY OF THE INVENTION

The present invention is made in view of the above-mentioned various problems, and an object of the present invention is to provide an escalator controlling apparatus which is able to detect and control a plurality of kinds of objects or events relating to the escalator by one set of apparatus and to detect an object or objects which are not related to a traveling direction of the escalator and an event or events rapidly changing.

An escalator controlling apparatus for detecting the abnormal condition of an object or objects getting on, getting off or approaching an escalator and controlling the escalator, according to the present invention, comprises

picture taking means for taking pictures of the above-mentioned escalator and a region in the vicinity thereof to obtain pickup data;

feature extraction means for specifying the object and extracting feature data of the object, from the pickup data;

feature time-series storing means for storing the feature data in time-series; and

event judging means for processing the stored feature time-series data according to the passage of time, comparing a processing result with a judgment reference and outputting a judgment result; and

wherein operation control of the escalator, guidance and notice are effected according to the judgment result.

Further, in the above-mentioned event judgment
5 means, the processing of the stored feature time-series data is time differential operation and time integration operation.

Further, the above-mentioned event judging means processes the feature data extracted in the feature
10 extraction data according to the passage of time, compares the result with a prescribed judgment reference and outputs a judgment result.

Further, the above-mentioned judgment result is transmitted by wireless to effect an operation control of
15 the escalator, guidance and notice.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the whole construction of an escalator controlling apparatus of an embodiment of
20 the present invention;

Fig. 2 is a table of an example of the content of feature time-series data memory 33 shown in Fig. 1;

Fig. 3 is a view of an example of a content of an event judgment data base 35 in Fig. 1;

25 Fig. 4 is a flow chart showing processing sequence in the image sensor processing unit 3 shown in Fig. 1; and

Fig. 5 is a view for explaining judging conditions

on the basis of taken images in the image sensor processing unit 3 shown in Fig. 1.

DESCRIPTION OF EMBODIMENT OF THE INVENTION

5 An embodiment of the present invention will be described hereunder, referring to Figs. 1 to 5.

 In Fig. 1, a whole construction of an escalator controlling apparatus of an embodiment of the present invention is shown.

10 In Fig. 1, a reference number 1 denotes an escalator body; 11, a transmission unit which receives a judgment result from an image sensor processing unit 3 and transmits it to an escalator apparatus 12; 12, the escalator apparatus for controlling the escalator to be in a prescribed
15 operational condition on the basis of the above-mentioned judgment result; 2, a camera mounted on the escalator body 1 to take pictures of the escalator body 1 and a prescribed region in the vicinity of the escalator body 1; 3, the image sensor processing unit which inputs the image data
20 taken by the camera 2 and outputs a result of event judgment; 31, a temporary memory which temporarily stores image data input from the camera 2; 32, a feature extraction unit which reads image data in, specifies an object of the event judgment by image processing, and extracts features
25 thereof; 33, a feature time-series data memory which memorizes features of the specified object in time-series; 34, an event judgment unit which reads in both the feature

time-series data memorized in the feature time-series data memory 33 and feature data from the feature extraction unit 32, extracts time information, that is, information relating to time such as time differential, time integration, etc., compares the extracted time information with a judgment reference stored in an event judgment data base 35 and judges the event; 35, the event judgment data base storing a judgment reference; 36, a wireless transmission unit which transmits a judgment result to the transmission unit 11, a manager room 4 and a maintenance apparatus 5; 4, the manager room; and 5, the maintenance apparatus which is installed by a maintenance company and through which communication with the maintenance company is effected, for example.

Further, in the above-mentioned event judgment unit 34, time differential of the feature time-series data is for serving to judge a tumbling accident of a passenger or passengers, etc. by detecting a rapid change in features according to the passage of time, and time integration of the feature time-series data is for serving to judge stay of a passenger or passengers at an inconvenient position by a long stay of the features.

Further, in the event judgment unit 34, the reason that the feature data read out from the feature extraction unit 32 other than the feature time-series data are used for judgment of time processing is for improving judgment precision by retrieving the newest feature data read out

from the feature extraction unit 32.

Further, the transmission of the above-mentioned judgment result was explained, taking wireless transmission such as wireless and optical communication as an example, however, transmission lines can be employed, and signal transmission using power source lines also can be employed. Further, a case where one camera 2 is employed is explained, however, a plurality of cameras can be used so that pictures can be taken of necessary portions of the escalator body 1 according to the setting positions.

Fig. 2 shows an example of the content of the feature time-series data memory 33.

In Fig. 2, time 1 and time 2 each denote the time at which the camera 2 takes a picture, the feature content of the figure expresses object features extracted, the area is an area of each of the extracted features changing at each time, and the coordinate expresses coordinates in which the extracted features change at each time.

In this feature time-series data memory 33, the feature data extracted by the feature extraction unit 32 and individually classified in each object are memorized, and renewed at each time when new data are input. Further, as for the feature time-series data, when any of the feature content is released, the content of an item corresponding to the content is cleared. For example, in the case of "an object existing within the step", the content is released when the object gets off to be out of the step. However, in

a case where the escalator stopped due to possibility of tumbling, the feature time-series data can be kept without being cleared until a maintenance man or a manager releases.

5 Fig. 3 shows an example of the content of the event judgment data base 35.

 The event judgment data base 35 provides a judgment reference on which time information of the feature time-series data judges whether or not a prescribed event occurs,
10 and decides, when the time information satisfies the prescribed premise conditions shown in the premise, a conclusion and an action according thereto, as shown in Fig. 3.

 Next, an operation of the escalator controlling
15 apparatus is explained, referring to Figs. 1 to 3.

 The camera 2 always takes pictures of the escalator body 1 and a certain region in the vicinity of the escalator body 1. Taken images are sent to the image sensor processing unit 3, and stored in the temporary
20 memory 31. The memorized image data are read in the feature extraction unit 32 in turn, and an object or objects and their features are extracted by image processing. The extraction of object images is effected so that a background image such as the escalator body 1 was
25 taken in advance and the object image is taken by difference between the object image on the background image and the background image, so on. In this case, a

continuous region is processed as one object and regions separated from each other are extracted individual objects. Extracted objects and their features are sent to the feature time-series data memory 33 and the event judgment
5 unit 34.

Into the feature time-series data memory 33, features classified individually into each object are memorized each time of taking a pictures of the features, that is, in series of time.

10 In the event judgment unit 34, both feature time-series data from the feature time-series data memory 33 and newest feature data from the feature extraction unit 32 are read in, time information of time differential and time integration are processed to be extracted, and an event is
15 judged referring to the judgement reference of the event judgement data base 35 on the basis of the extracted time information.

As a result of the judgment, in a case where it is necessary to change an operation of the escalator, a
20 judgment signal is transmitted from the wireless transmission unit 36 to the transmission unit 11 of the escalator body 1, or it is noticed to a guide apparatus not shown and the manager room 4, etc., further, if it is necessary to communicate with a maintenance company, the
25 judgment signal is sent to the manager room 4 and the maintenance apparatus 5, thereby to communicate with the maintenance company.

Next, processing sequence in the image sensor processing unit 3 is explained referring to the flow chart in Fig. 4.

In a step 101, the camera 2 takes pictures of the escalator body 1 and a region roundabout, the result is transmitted to the temporary memory 31 in a step 102.

Next, in a step 103, the content of the temporary memory 31 is sent to the feature extraction unit 32, and in a step 104, image features are extracted. In a step 105, the extracted feature data are sent to the feature time-series data memory 33 and the event judgment unit 34.

In a step 106, in the event judgment unit 34, feature time-series data from the feature time-series data memory 33 and feature data from the feature extraction unit 32 are subjected to time differentiation and time integration to extract time information of the feature data. Further, in a step 107, an event is judged referring to the event judgment data base 35 on the basis of the extracted time information. The event judgment unit 34 judges whether or not a change of the operation is needed on the basis of the judgment result in a step 108, sends an operation change signal from the wireless transmission unit 36 to the transmission unit 11 in a case where the operation change is necessary in a step 109, and changes the operation of the escalator in a step 110. In a step 111, in a case where the operation is unnecessary to change, whether or not notice to the manager room 4 and the

maintenance apparatus 5 or guide are necessary is judged, if necessary, the guide is conducted and the notice to the maintenance company is effected through the manager room 4 and the maintenance apparatus 5. In a case where the
5 notice, etc. in the step 111 is not needed, or in a case where the processing in a step 112 is finished, the flow is returned to the step 101, and the above-mentioned processing is repeatedly effected.

Next, judgment conditions are explained on the basis
10 of pickup images in the image sensor processing unit 3, referring to Fig. 5.

In Fig. 5, a reference number 13 denotes a handrail of the escalator body 1, 14 denotes the steps of the escalator body 1, a to j each denote an object to be judged
15 such as a person and arrows each denote a travelling direction of the escalator.

At the time 1, objects a to j are detected by making a difference from the background image such as the escalator body 1. The objects d to g which are using the escalator
20 are being moved together with the steps 14 in the arrow direction, and the other objects a to c, h and j are not related to the travelling of the escalator because the objects are out of the escalator steps 14.

At the time 2, since the objects d to g on the steps
25 14 move with the steps 14, the coordinate positions of the objects can be judged by using a coordinate fixed to the steps 14 and effecting coordinate transformation, however,

the judgement can be effected by detecting the travelling movement of the steps 14.

At the time 3, since the object *j* has been out of the image screen and the object *h* is not on the escalator and moves by walk, etc., the objects each are not related to the movement of the escalator but have a time-differentiated moving amount and moving speed, so that it is possible to make a difference between "being still" and "being on the steps". Further, since the object *e* can be judged to be a condition leaning over the handrail 13 from the images at any time, an alarm guide that the object leans over the handrail 13 is issued at after the passage of a prescribed time, for example, at a time of the time 5. Further, the object *a* is staying around the handrail 13 for a prescribed time and the objects *b* and *c* stay around the inlet, whereby the object *a* is judged to be in a stay because of mischief, and the objects *b* and *c* are judged to be in a stay because of stand-talking, and the objects are guided.

Further, between the time 3 and the time 4, the object *g* takes a large movement, so that this is judged to be an abnormal condition such as tumbling, etc. and a guide is conducted and the escalator is rapidly stopped. In a case of normally getting off the escalator as the object *d* does, as one of the number of getting off persons, the object *d* is separately counted, whereby it also is possible to measure the traffic flow.

As mentioned above, according to the embodiment of the present invention, a plurality of events can be detected from one image data, and it is possible to effect a rapid response in a case where an object rapidly changes and
5 guidance to a person staying for a long time, by using the time-series data and extracting time information of time differential and time integration.

As mentioned above, the present invention can detect and control a plurality of kinds of objects and events
10 concerning the escalator by one set of apparatus, and detect a rapid change in an object and event not related to the traveling direction of the escalator and control the escalator.



WHAT IS CLAIMED IS

1. An escalator controlling apparatus for detecting the abnormal condition of an object or objects ascending
5 descending or approaching an escalator and controlling said escalator, said controlling apparatus comprising:
 picture taking means for taking pictures of said escalator and a region in the vicinity thereof to obtain pickup data;
10 feature extraction means for specifying said object and extracting feature data of said object, from said pickup data;
 feature time-series storing means for storing said feature data in time-series;
15 event judging means for processing said stored feature time-series data according to the passage of time, comparing a processing result with a judgment reference and outputting a judgment result; and
 wherein operation control of said escalator, guide
20 and notice are effected according to said judgment result.
2. An escalator controlling apparatus according to claim 1, wherein in said event judging means, the processing of the stored feature time-series data is time differential
25 operation and time integration operation.
3. An escalator controlling apparatus according to



claim 1 or 2, wherein said event judging means processes the
feature data extracted in said feature extraction data
according to the passage of time, compares the result with a
prescribed judgment reference and outputs a judgment
5 result.

4. An escalator controlling apparatus according to
claim 1 or 2, wherein said judgment result is transmitted
by wireless to effect an operation control of said
10 escalator, guide and notice.

5. An escalator controlling apparatus according to
claim 3, wherein said judgment result is transmitted by
wireless to effect an operation control of said escalator,
15 guide and notice.