[0009]

In order to solve the aforementioned problem, aspects of the present invention employ the following configurations, respectively.

[0010]

A first aspect relates to a gate apparatus.

A gate apparatus according to the first aspect includes:

an acquisition means for acquiring an image captured by an image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

a processing means for causing an authentication means to execute authentication processing on a predetermined region in the acquired image.

[0011]

A second aspect relates to a gate apparatus image processing method executed by at least one computer.

A gate apparatus image processing method according to the second aspect includes, by a gate apparatus:

acquiring an image captured by an image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

causing an authentication means to execute authentication processing on a predetermined region in the acquired image.

[0012]

A third aspect relates to a gate system.

A gate system according to the third aspect includes:

a camera being provided at a side of an aisle through which a person whose personal identification is required passes;

an authentication apparatus; and

a gate apparatus, wherein

the gate apparatus includes:

an acquisition means for acquiring an image captured by the image capture means; and

a processing means for causing the authentication apparatus to execute authentication processing on a predetermined region in the acquired image.

[0013]

Note that another aspect of the present invention may be a program causing at least one

[0019]

The present invention enables improvement in precision and efficiency of authentication processing performed by using an image captured by a camera installed at a location where personal identification is required.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

The aforementioned object, other objects, features, and advantages will become more apparent by use of the following preferred example embodiments and accompanying drawings.

[0021]

Fig. 1 is a diagram illustrating a conceptual configuration example of a gate system according to an example embodiment.

Fig. 2 is a plan view of the gate system 1 viewed from above.

Figs. 3A and 3B are diagrams each illustrating an example of an image captured by a camera.

Fig. 4 is a functional block diagram illustrating a functional configuration example of a gate apparatus according to the example embodiment.

Fig. 5 is a block diagram illustrating a hardware configuration of a computer providing the gate apparatus.

Fig. 6 is a flowchart illustrating an operation example of the gate apparatus according to the example embodiment.

Fig. 7 is a flowchart illustrating details of the authentication processing in the flowchart in Fig. 6.

Fig. 8 is a functional block diagram illustrating a functional configuration example of a gate apparatus according to an example embodiment.

Fig. 9 is a flowchart illustrating part of an operation example of the gate apparatus according to the example embodiment.

Figs. 10A and 10B are diagrams for each illustrating a processing example of an image captured by a camera.

Fig. 11 is a front view of a camera unit.

Figs 12A to 12C are diagrams for each illustrating processing examples of images captured by cameras.

Figs. 13A to 13C are diagrams for each illustrating processing examples of an image captured by a camera.

Figs. 14A to 14C are diagrams for each illustrating processing examples of an image captured by a camera.

predetermined time. Images captured by the camera 5 may be temporarily stored in a separate storage apparatus (unillustrated) and may be read from the storage apparatus by the authentication apparatus 50 sequentially or at predetermined intervals. Furthermore, images transmitted to the authentication apparatus 50 are preferably dynamic images but may be frame images captured at predetermined intervals or static images.

[0034]

Figs. 3A and 3B are diagrams each illustrating an example of an image 30 captured by the camera 5. Three persons P1, P2, and P3 in Fig. 2 are captured in the image 30 in Fig. 3A. The person P1 is an authentication target person. The two persons P2 and P3 other than the person P1 are persons other than the authentication target person in this case. In other words, persons other than the authentication target person are captured in the image 30. While the image 30 according to the present example embodiment is a full high-definition image with a resolution of 1080 by 1920 pixels, the image is not limited thereto.

[0035]

<Functional Configuration Example>

Fig. 4 is a functional block diagram illustrating a functional configuration example of the gate apparatus 10 according to the present example embodiment.

In each of the following diagrams, a configuration of a part not related to the essence of the present invention is omitted and is not illustrated.

The gate apparatus 10 includes an acquisition unit 102 and a processing unit 104.

The acquisition unit 102 acquires an image 30 (in Fig. 3A) captured by the camera 5 (image capture means) provided at a side of the aisle 12. The processing unit 104 causes the authentication apparatus 50 (authentication means) to execute the authentication processing on a predetermined region 34 (in Fig. 3B) in the acquired image 30.

[0036]

As illustrated in in Fig. 3A, the image 30 includes not only the person P1 being the authentication target but also two persons being the person P2 and the person P3. When being directly caused to perform the authentication processing on the image 30, the authentication apparatus 50 extracts a face region for a person other than the authentication target and executes the authentication processing on the person and therefore performs originally unnecessary processing, leading to an increased load.

[0037]

Therefore, the processing unit 104 extracts a predetermined region 34 from the image 30 and causes the authentication apparatus 50 to perform the authentication processing on the

region 34 in such a way that the region 34 includes the person P1 being the authentication processing target. As illustrated in Fig. 3B, the region 34 is extracted by removing (masking or trimming) an upper region 32 of the image 30. Note that, as a processing method for extracting the region 34 from the image 30, the region 32 may be trimmed from the image 30, or the region 34 may be extracted by temporarily masking the region 32.

[0038]

For example, the region 34 (and/or the masked region 32) is preset based on the width of the aisle 12, the length of the aisle 12 (the distance from a person in a surrounding area), the installation position of the camera 5 (the distance between the camera 5 and the authentication target person, and the height), the orientation of the optical axis of the camera 5 (the angle formed by the optical axis relative to the traveling direction of the person), and the angle of view of the camera 5. For example, in a case of the resolution of the image 30 being 1080 by 1920 pixels, the region 34 is set to a region acquired by removing the region 32 being a range of 500 pixels from the upper end of the image 30 (around 25% of the image 30 in a height direction in the diagram), according to the present example embodiment. The range of the region 34 or the region 32 may be changed through accepting an input operation by a manager.

[0039]

A setting may be accepted from a setting screen by using a terminal (unillustrated) used by a manager managing the gate apparatus 10; or a computer providing the gate apparatus 10 may be connected to a display, and a setting operation may be accepted by causing the display to display a setting screen.

[0040]

While a range including the upper end of the image 30 is set to the masked region 32 in the example in Fig. 3B, a range including the lower end of the image 30 may be removed or both regions may be removed. Furthermore, a range including at least one of the left and right ends of the image 30 may be removed.

[0041]

The processing unit 104 causes the authentication apparatus 50 to execute the authentication processing on the thus extracted region 34.

[0042]

<Hardware Configuration Example>

Fig. 5 is a block diagram illustrating a hardware configuration of a computer 1000 providing the gate apparatus 10.

The computer 1000 includes a bus 1010, a processor 1020, a memory 1030, a storage

In an example in Fig. 12B, a range 34a in the first image 30 including the face of a person with a height of 110 cm is set to a target region of the authentication processing. In this example, a range (region 32) including the lower end of the first image 30 up to below the face (below the chin) of a person with a height of 110 cm is removed. For example, in a full high-definition image with a resolution of 1080 by 1920 pixels, a range (region 32) of 130 pixels from the lower end of the first image 30 is removed.

[0081]

In another example, a region above the face of a person with a height of 190 cm may be set to a masked region.

[0082]

Furthermore, the acquisition unit 102 acquires a second image 40 captured by the camera 5b capturing an image of a person from below. The processing unit 104 causes the authentication apparatus 50 to execute the authentication processing on a region in the second image 40 acquired by removing a range of at least 10% from the upper end in a downward direction.

[0083]

In an example in Fig. 13B, a region 44a in a second image 40 acquired by removing a range (region 42) of at least 10% from the upper end of the second image 40 in the downward direction is set to a target region of the authentication processing. For example, in a full high-definition image with a resolution of 1080 by 1920 pixels, a range of 192 pixels from the upper end of the second image 40 is removed. The reason is that when an image of a face is captured from below, the face included in the upper side of the image 30 is distorted and therefore is removed from the authentication processing target region.

[0084]

Alternatively, the processing unit 104 may cause the authentication apparatus 50 to execute the authentication processing on a region in the first image 30 acquired by removing a part including at least the upper end. Furthermore, the processing unit 104 may cause the authentication apparatus 50 to execute the authentication processing on a region in the second image 40 acquired by removing a a part including at least the lower end.

[0085]

Further, the processing unit 104 may cause the authentication apparatus 50 to execute the authentication processing on at least an overlapping region of the first image 30 and the second image 40.

[0086]

For example, the overlapping region of the first image 30 and the second image 40 is a region 34b in the first image 30 in Fig. 12C and a region 44b in the second image 40 in Fig. 13C.

[0087]

Specifically, the processing unit 104 may extract the region 34b in Fig. 12C and set the region to a target region of the authentication processing for the first image 30 and may extract the region 44b in Fig. 13C and set the region to a target region of the authentication processing for the second image 40.

[0088]

The authentication apparatus 50 may perform the authentication processing on the regions extracted from the first image 30 and the second image 40, respectively, or may perform the authentication processing on at least one of the regions.

[0089]

Furthermore, Fig. 14A illustrates a scene in which two images of a person are captured by using the camera 5a (first image capture unit) and the camera 5b (second image capture unit). As illustrated in Fig. 14C, a region 34c acquired by further removing the region 32 related to the height restriction (110 cm) from the region 34b being an overlapping region of the first image 30 and the second image 40 extracted from the first image 30 as illustrated in Fig. 14B may be set to an authentication target region. Furthermore, as illustrated in Fig. 14C, a region 44c acquired by further removing the region 42 being 10% from the upper end in the downward direction from the region 44b being an overlapping region of the first image 30 and the second image 40 extracted from the second image 40 as illustrated in Fig. 14B may be set to an authentication target region.

[0090]

Further, a configuration including the selection unit 106 according to the second example embodiment may be employed in the present example embodiment. Specifically, the interpupillary distance of a person included in each of the region 34c and the region 44c narrowed down by the processing unit 104 may be further computed, and a person being an authentication target may be selected based on the computed interpupillary distance.

[0091]

According to the present example embodiment, a predetermined region can be set to a target region of the authentication processing by removing predetermined regions from images captured by using the two cameras 5, respectively, by the processing unit 104.

[0092]

Thus, an authentication target person can be narrowed down by simple processing of narrowing an image 30 to a predetermined region without performing complex processing, and therefore authentication efficiency can be improved with a reduced processing load.

target person in the image 30 out of the plurality of persons P1 to P4.

[0097]

According to the example embodiment, an authentication target region is narrowed for each of images transmitted from a plurality of camera units 20 and an authentication target person is narrowed down; and therefore a processing load on the authentication apparatus 50 performing the authentication processing on a plurality of images is reduced.

[0098]

Furthermore, a terminal used by a manager or the gate apparatus 10 may further include a region setting means (unillustrated) implemented by an application for region setting. The region setting means may include a display processing unit (unillustrated) acquiring an image from a camera 5 and causing a display on the terminal or the gate apparatus 10 to display the image on a screen, and an acceptance unit (unillustrated) accepting, by using a graphical user interface (GUI) on the screen, specification of a region 34 in which the face of a person in an image displayed on the screen and biometric information being an authentication target can be acquired in a state of causing the person to stand at a standing position for an authentication target person in front of the camera 5, or a region 32 that can be removed.

[0099]

The configuration enables suitable and easy specification of a region varying with the installation position (the height and the orientation) of the camera 5, the width and the distance of the aisle 12, or the like, according to an actual use environment.

[0100]

When a terminal is used, setting information of a region specified by the region setting means in the terminal may be input to a gate apparatus 10 and be stored in a memory 1030 or a storage device 1040 in a computer 1000 providing the gate apparatus 10. Alternatively, when the gate apparatus 10 is used, a region accepted by the acceptance unit in the region setting means may be stored in the memory 1030 or the storage device 1040 in the computer 1000, to be described later, providing the gate apparatus 10.

[0101]

Specification of a region may be indicated by a trimming position relative to an image 30. The trimming position may specify at least one of a downward distance (a pixel count or a percentage) from the upper end of the image 30, an upward distance (a pixel count or a percentage) from the lower end of the image 30, a rightward distance (a pixel count or a percentage) from the left end of the image 30, and a leftward distance (a pixel count or a percentage) from the right end of the image 30.

in the gate apparatus,

the acquisition means acquires a first image captured by a first camera that captures an image of a person from above, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

12. The gate system according to any one of 9. to 11., wherein,

in the gate apparatus,

the acquisition means acquires a second image captured by a second camera that captures an image of a person from below, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

13. The gate system according to any one of 9. to 12., wherein,

in the gate apparatus,

the acquisition means acquires a first image captured by a first camera that captures an image of a person from above, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

14. The gate system according to any one of 9. to 13., wherein,

in the gate apparatus,

the acquisition means acquires a second image captured by a second camera that captures an image of a person from below, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the second image acquired by removing a part including at least a lower end.

15. The gate system according to 14., wherein,

in the gate apparatus,

the processing means causes the authentication apparatus to execute the authentication processing on at least an overlapping region of the first image and the second image.

16. The gate system according to any one of 9. to 15., including

a plurality of the gate apparatuses being placed in parallel.

[0107]

the second image acquired by removing a part including at least a lower end.

23. The gate apparatus image processing method according to 22., further including, by the gate apparatus,

causing the authentication means to execute the authentication processing on at least an overlapping region of the first image and the second image.

[0108]

24. A program for causing a computer to execute:

a procedure for acquiring an image captured by an image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

a procedure for causing an authentication means to execute authentication processing on a predetermined region in the acquired image.

25. The program according to 24., further causing a computer to execute

a procedure for selecting, out of one or more persons in the image, a person whose interpupillary distance satisfies a criterion as an authentication target.

26. The program according to 24. or 25., further causing a computer to execute:

a procedure for acquiring a first image captured by a first image capture means for capturing an image of a person from above; and

a procedure for causing the authentication means to execute the authentication processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

27. The program according to any one of 24. to 26., further causing a computer to execute:

a procedure for acquiring a second image captured by a second image capture means for capturing an image of a person from below; and

a procedure for causing the authentication means to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

28. The program according to any one of 24. to 27., further causing a computer to execute:

a procedure for acquiring a first image captured by a first image capture means for capturing an image of a person from above; and

a procedure for causing the authentication means to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

29. The program according to any one of 24. to 28., further causing a computer to execute:

a procedure for acquiring a second image captured by a second image capture means for capturing an

Claims

1. A gate apparatus comprising:

acquisition means for acquiring an image captured by image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

processing means for causing authentication means to execute authentication processing on a predetermined region in the acquired image.

2. The gate apparatus according to claim 1, further comprising

selection means for selecting, out of one or more persons in the image, a person whose interpupillary distance satisfies a criterion as an authentication target.

3. The gate apparatus according to claim 1 or 2, wherein

the acquisition means acquires a first image captured by first image capture means for capturing an image of a person from above, and

the processing means causes the authentication means to execute the authentication processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

4. The gate apparatus according to any one of claims 1 to 3, wherein

the acquisition means acquires a second image captured by second image capture means for capturing an image of a person from below, and

the processing means causes the authentication means to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

5. The gate apparatus according to any one of claims 1 to 4, wherein

the acquisition means acquires a first image captured by first image capture means for capturing an image of a person from above, and

the processing means causes the authentication means to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

6. The gate apparatus according to any one of claims 1 to 5, wherein

the acquisition means acquires a second image captured by second image capture means for capturing an image of a person from below, and

the processing means causes the authentication means to execute the authentication processing on a region in the second image acquired by removing a part including at least a lower end.

7. The gate apparatus according to claim 6, wherein

the processing means causes the authentication means to execute the authentication processing on at least an overlapping region of the first image and the second image.

8. A gate apparatus arrangement method comprising

placing a plurality of the gate apparatuses according to any one of claims 1 to 7 in parallel.

9. A gate system comprising:

a camera being provided at a side of an aisle through which a person whose personal identification is required passes;

an authentication apparatus; and

a gate apparatus, wherein

the gate apparatus includes:

acquisition means for acquiring an image captured by the camera; and

processing means for causing the authentication apparatus to execute authentication processing on a predetermined region in the acquired image.

10. The gate system according to claim 9, wherein

the gate apparatus further includes selection means for selecting, out of one or more persons in the image, a person whose interpupillary distance satisfies a criterion as an authentication target.

11. The gate system according to claim 9 or 10, wherein,

in the gate apparatus,

the acquisition means acquires a first image captured by a first camera that captures an image of a person from above, and

the processing means causes the authentication apparatus to execute the authentication

processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

12. The gate system according to any one of claims 9 to 11, wherein,

in the gate apparatus,

the acquisition means acquires a second image captured by a second camera that captures an image of a person from below, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

13. The gate system according to any one of claims 9 to 12, wherein,

in the gate apparatus,

the acquisition means acquires a first image captured by a first camera that captures an image of a person from above, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

14. The gate system according to any one of claims 9 to 13, wherein,

in the gate apparatus,

the acquisition means acquires a second image captured by a second camera that captures an image of a person from below, and

the processing means causes the authentication apparatus to execute the authentication processing on a region in the second image acquired by removing a part including at least a lower end.

15. The gate system according to claim 14, wherein,

in the gate apparatus,

the processing means causes the authentication apparatus to execute the authentication processing on at least an overlapping region of the first image and the second image.

16. The gate system according to any one of claims 9 to 15, comprising

a plurality of the gate apparatuses being placed in parallel.

17. A gate apparatus image processing method comprising, by a gate apparatus:

acquiring an image captured by image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

causing authentication means to execute authentication processing on a predetermined region in the acquired image.

18. The gate apparatus image processing method according to claim 17, further comprising, by the gate apparatus,

selecting, out of one or more persons in the image, a person whose interpupillary distance satisfies a criterion as an authentication target.

19. The gate apparatus image processing method according to claim 17 or 18, further comprising, by the gate apparatus:

acquiring a first image captured by first image capture means for capturing an image of a person from above; and

causing the authentication means to execute the authentication processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

20. The gate apparatus image processing method according to any one of claims 17 to 19, further comprising, by the gate apparatus:

acquiring a second image captured by second image capture means for capturing an image of a person from below; and

causing the authentication means to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

21. The gate apparatus image processing method according to any one of claims 17 to 20, further comprising, by the gate apparatus:

acquiring a first image captured by first image capture means for capturing an image of a person from above; and

causing the authentication means to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

22. The gate apparatus image processing method according to any one of claims 17 to 21, further comprising, by the gate apparatus:

acquiring a second image captured by second image capture means for capturing an image of a person from below; and

causing the authentication means to execute the authentication processing on a region in the second image acquired by removing a part including at least a lower end.

23. The gate apparatus image processing method according to claim 22, further comprising, by the gate apparatus,

causing the authentication means to execute the authentication processing on at least an overlapping region of the first image and the second image.

24. A computer-readable storage medium storing a program for causing a computer to execute:

a procedure for acquiring an image captured by image capture means provided at a side of an aisle through which a person whose personal identification is required passes; and

a procedure for causing authentication means to execute authentication processing on a predetermined region in the acquired image.

25. The computer-readable storage medium according to claim 24, wherein the program further causes a computer to execute

a procedure for selecting, out of one or more persons in the image, a person whose interpupillary distance satisfies a criterion as an authentication target.

26. The computer-readable storage medium according to claim 24 or 25, wherein the program further causes a computer to execute:

a procedure for acquiring a first image captured by first image capture means for capturing an image of a person from above; and

a procedure for causing the authentication means to execute the authentication processing on a region in the first image including at least a range including a face of a person with a height being a target of personal identification.

27. The computer-readable storage medium according to any one of claims 24 to 26, wherein the program further causes a computer to execute:

a procedure for acquiring a second image captured by second image capture means for capturing an image of a person from below; and

a procedure for causing the authentication means to execute the authentication processing on a region in the second image acquired by removing a range of at least 10% from an upper end in a downward direction.

28. The computer-readable storage medium according to any one of claims 24 to 27, wherein the program further causes a computer to execute:

a procedure for acquiring a first image captured by first image capture means for capturing an image of a person from above; and

a procedure for causing the authentication means to execute the authentication processing on a region in the first image acquired by removing a part including at least an upper end.

29. The computer-readable storage medium according to any one of claims 24 to 28, wherein the program further causes a computer to execute:

a procedure for acquiring a second image captured by second image capture means for capturing an image of a person from below; and

a procedure for causing the authentication means to execute the authentication processing on a region in the second image acquired by removing a part including at least a lower end.

30. The computer-readable storage medium according to claim 29, wherein the program further causes a computer to execute

a procedure for causing the authentication means to execute the authentication processing on at least an overlapping region of the first image and the second image.