

DESCRIPTION

TITLE OF INVENTION

PERSON VERIFYING SYSTEM, INFORMATION PROCESSING DEVICE,
5 PERSON VERIFYING METHOD, AND PERSON VERIFYING PROGRAM

TECHNICAL FIELD

[0001] The present disclosure relates to a person collation system, an information processing device, a person collation method, and a person collation program.

10 BACKGROUND ART

[0002] Patent Literature 1 discloses a method of capturing an image of a face of a person moving through a passage with an image capturing device, determining whether the pedestrian is a pre-registered person based on an image acquired from the image capturing device until the pedestrian reaches a door that permits entry of only a person who has succeeded in authentication, unlocking the door when it is determined that the pedestrian is the pre-registered person, and making the person to input a user ID and a password when it is determined that the pedestrian is not the pre-registered person.

CITATION LIST

PATENT LITERATURE

20 [0003] Patent Literature 1: JP2006-236244A

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] In a system for authenticating a person moving in a passage, when a person to be authenticated using a facial image and a person (for example, a guest who is only there for the day) to be authenticated using a method other than the facial image (for example, using a QR code (registered trademark) or an IC card) can be mixed, the method disclosed in Patent Literature 1 has the following problem. That is, since a facial image of the person to be authenticated using the method other than the facial image is not pre-registered, the system displays an authentication failure message for the person before the person is authenticated using the method other than the facial image. This may give the person to be authenticated using the method other than the facial image unpleasant feeling.

[0005] Further, it is conceivable that by setting a passage in which a plurality of persons can

pass side by side, performing authentication of the plurality of persons collectively, and displaying authentication results collectively, stay in front of a door that permits entry of only a person who has been successfully authenticated is prevented. However, in the method disclosed in Patent Literature 1, in a case where there are a plurality of persons, a face of a person closest to the door is preferentially authenticated, and authentication results are displayed one by one in the order of the authenticated persons, so that the stay occurs in front of the door.

[0006] An object of the present disclosure is to provide a technique capable of mixing, in a passage through which a plurality of persons can pass side by side, a person to be collated by a facial image and a person to be collated by a method other than the facial image, and preventing a person to be collated by the method other than the facial image from feeling unpleasant due to displaying of an erroneous collation result using the facial image.

SOLUTION TO PROBLEM

[0007] A person collation system according to an aspect includes: an image capturing device configured to capture an image of a plurality of persons moving in a predetermined passage; an information processing device configured to execute a first collation process of collating the person using a facial image of the person captured by the image capturing device and a second collation process of collating the person by another collation method different from the collation using the facial image; and a display device configured to display information on a collation result of the person, in which

the information processing device displays, on the display device, the information on the collation result of the person estimated as a target of the second collation process in a different manner to that used when collation is performed in the first collation process.

[0008] An information processing device according to an aspect includes: a processor configured to execute a first collation process of collating a person using a facial image of the person captured by an image capturing device that captures an image of a plurality of the persons moving in a predetermined passage and a second collation process of collating the person by another collation method different from collation using the facial image; and an output device configured to cause a display device to display information on a collation result of the person estimated as a target of the second collation process in a different manner to that used when the collation is performed in the first collation process.

[0009] A person collation method according to an aspect includes: executing a first collation process of collating a person using a facial image of the person captured by an image capturing

device that captures an image of a plurality of the persons moving in a predetermined passage and a second collation process of collating the person by another collation method different from collation using the facial image; and causing a display device to display information on a collation result of the person estimated as a target of the second collation process in a different manner to that used when the collation is performed in the first collation process.

[0010] A person collation program according to an aspect causes a computer to execute the person collation method described above.

[0011] These comprehensive or specific aspects may be implemented by a system, a device, a method, an integrated circuit, a computer program, a recording medium, or any combination of the system, the device, the method, the integrated circuit, the computer program, and the recording medium.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] According to the present disclosure, in a passage through which a plurality of persons can pass side by side, it is possible to mix a person to be collated by a facial image and a person to be collated by a method other than the facial image can be mixed, and it is possible to prevent a person to be collated by the method other than the facial image from feeling unpleasant due to displaying of an erroneous collation result using the facial image.

BRIEF DESCRIPTION OF DRAWINGS

[0013] FIG. 1 is a diagram for illustrating an overview of a gate system according to Embodiment 1.

FIG. 2 is a diagram illustrating a display example of collation results on a first display device or a second display device according to Embodiment 1.

FIG. 3 is a block diagram illustrating a configuration example of the gate system according to Embodiment 1.

FIGS. 4A and 4B illustrate diagrams of a facial image and a body image according to Embodiment 1.

FIG. 5 is a flowchart illustrating an example of a detection process performed by a first edge device according to Embodiment 1.

FIG. 6 is view illustrating a configuration example of person information according to Embodiment 1.

FIG. 7 is a flowchart illustrating an example of an overall process performed by a management device according to Embodiment 1.

FIG. 8 is a flowchart illustrating an example of a face detection information process (S202) illustrated in FIG. 7.

FIG. 9 is a flowchart illustrating an example of a body detection information process (S204) illustrated in FIG. 7.

5 FIG. 10 is a flowchart illustrating an example of a post-movement process (S210) illustrated in FIG. 7.

FIG. 11 is a flowchart illustrating an example of a face collation result information process (S206) illustrated in FIG. 7.

10 FIG. 12 is a flowchart illustrating an example of a display process performed by the first edge device according to Embodiment 1.

FIG. 13 is a diagram illustrating a face collation zone and a passage determination zone in a detection area according to Embodiment 1.

FIG. 14 is a diagram for illustrating examples of a display pattern on the first display device according to Embodiment 1.

15 FIG. 15A is a first view for illustrating a method of detecting, from a person information table, the person information by which a person is estimated to be the same person as a person indicated by body detection information according to Embodiment 1.

FIG. 15B is a second view for illustrating the method of detecting, from the person information table, the person information by which the person is estimated to be the same person as the person indicated by the body detection information according to Embodiment 1.

20 FIG. 16 is a diagram for illustrating a method of detecting a movement direction of a person according to Embodiment 1.

FIG. 17 is a block diagram illustrating a configuration example of a gate system according to Embodiment 2.

25 FIG. 18 is a diagram illustrating an example of a case where an ID reader is installed in the passage determination zone.

FIG. 19 is a diagram illustrating an example of setting a face collation zone, an ID collation zone, and the passage determination zone in a detection area according to Embodiment 2.

30 FIG. 20 is a flowchart illustrating an example of a process performed by a management device when the face collation zone, the ID collation zone, and the passage determination zone are set in the detection area according to Embodiment 2.

FIG. 21 is a flowchart illustrating an example of a face collation process according to

Embodiment 2.

FIG. 22 is a flowchart illustrating an example of an ID collation process according to Embodiment 2.

5 FIG. 23 is a flowchart illustrating an example of a passage determination process according to Embodiment 2.

FIG. 24 is a diagram illustrating a first example of setting the ID collation zone and the passage determination zone in the detection area according to Embodiment 2.

FIG. 25 is a diagram illustrating a second example of setting the ID collation zone and the passage determination zone in the detection area according to Embodiment 2.

10 FIG. 26 is a flowchart illustrating an example of the passage determination process when the ID collation zone and the passage determination zone are set in the detection area according to Embodiment 2.

FIG. 27 is a diagram illustrating a first example in which an ID collation person moves toward the ID collation zone according to Embodiment 2.

15 FIG. 28 is a diagram illustrating a second example in which the ID collation person moves toward the ID collation zone according to Embodiment 2.

FIG. 29 is a diagram illustrating a third example in which the ID collation person moves toward the ID collation zone according to Embodiment 2.

20 FIG. 30 is a flowchart of the face collation process including a process of estimating whether a person is heading for the ID collation zone.

FIG. 31 is a flowchart of the passage determination process including a process of estimating whether the person is heading for the ID collation zone according to Embodiment 2.

FIG. 32 is a diagram illustrating a method of estimating whether the person is heading for the ID collation zone according to Embodiment 2.

25 FIGS. 33A to 33D illustrate diagrams of a display example of collation result images according to Embodiment 2.

FIG. 34 is a diagram illustrating a first modification of the gate system according to the present disclosure.

30 FIG. 35 is a diagram illustrating a second modification of the gate system according to the present disclosure.

FIG. 36 is a diagram illustrating a third modification of the gate system according to the present disclosure.

FIG. 37 is a diagram illustrating an example of a hardware configuration of a

computer according to the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0014] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings as appropriate. However, unnecessarily detailed description may be omitted. For example, detailed description of already well-known matters and redundant description of substantially the same configuration may be omitted. This is to avoid unnecessary redundancy of the following description and to facilitate understanding of those skilled in the art. The accompanying drawings and the following description are provided for those skilled in the art to sufficiently understand the present disclosure, which are not intended to limit the subject matter described in the claims.

[0015] (Embodiment 1)

<Overview of Gate System>

FIG. 1 is a diagram for illustrating an overview of a gate system 9 according to Embodiment 1. FIG. 2 is a diagram illustrating a display example of collation results on a first display device 31 or a second display device 32 according to Embodiment 1.

[0016] The gate system 9 is a system that collates a facial image of a person 1 and determines whether the person 1 has a right to pass through a gate. The gate system 9 includes a first gate 11 and a second gate 12. The first gate 11 and the second gate 12 are installed at a predetermined distance in a passage 2 through which the persons 1 move. In the present embodiment, a direction from the second gate 12 to the first gate 11 is defined as a first direction, and a direction from the first gate 11 to the second gate 12 is defined as a second direction. In the present embodiment, an area between the first gate 11 and the second gate 12 in the passage 2 is referred to as a person detection area 3. The gate system 9 does not necessarily need to include the first gate 11 and the second gate 12 through which the persons pass downward as illustrated in FIG. 1, and may have a configuration illustrated in FIG. 36 to be described later. In this case, the gate system 9 may set a virtual first line instead of the first gate 11, set a virtual second line instead of the second gate 12, and set an area between the first line and the second line as the detection area 3. Further, a direction from the first line to the second line may be defined as the first direction, and a direction from the second line to the first line may be defined as the second direction. Therefore, in the following description, the first gate 11 may be interpreted as the first line, and the second gate 12 may be interpreted as the second line.

[0017] In the present embodiment, for convenience of description, an axis along the first

direction or the second direction is referred to as an X axis, an axis orthogonal to the X axis and extending in a height direction is referred to as a Z axis, and an axis orthogonal to the X axis and the Z axis is referred to as a Y axis. An X-axis direction may be referred to as a gate width direction.

5 [0018] The first gate 11 includes first image capturing devices 21 each capable of capturing an image of at least a part of the detection area 3, and the first display device 31 having a screen facing in a direction of the second gate 12. Although the first gate 11 includes three first image capturing devices 21 in FIG. 1, the first gate 11 may include one or two first image capturing devices 21 or may include four or more first image capturing devices 21. Although the first gate
10 11 includes one first display device 31 in FIG. 1, the first gate 11 may include two or more first display devices 31.

[0019] The second gate 12 includes second image capturing devices 22 each capable of capturing an image of at least a part of the detection area 3, and the second display device 32 having a screen facing in a direction of the first gate 11. Although the second gate 12 includes
15 three second image capturing devices 22 in FIG. 1, the second gate 12 may include one or two second image capturing devices 22 or may include four or more second image capturing devices 22. Although the second gate 12 includes one second display device 32 in FIG. 1, the second gate 12 may include two or more second display devices 32.

[0020] In the present embodiment, it is assumed that the first direction is an entrance
20 direction to a facility or the like having a right to control entry and exit and the second direction is an exit direction from the facility or the like. However, the first direction may be the exit direction from the facility or the like, and the second direction may be the entry direction to the facility or the like.

[0021] The gate system 9 collates the facial images of the persons 1 moving in the first
25 direction, which are captured by the first image capturing devices 21 of the first gate 11, with collation facial images registered in advance, and displays collation results on the first display device 31 as illustrated in FIG. 2.

[0022] The gate system 9 collates the facial images of the persons 1 moving in the second
30 direction, which are captured by the second image capturing devices 22 of the second gate 12, with the collation facial images registered in advance, and displays collation results on the second display device 32 as illustrated in FIG. 2.

[0023] A gate width of each of the first gate 11 and the second gate 12 or a width of the detection area 3 in a X direction may be a width by which the plurality of persons 1 can pass

side by side. Accordingly, the gate system 9 according to the present embodiment can allow the plurality of persons 1 to enter and exit smoothly compared to a gate system having a gate width by which only one person can pass. For example, in the case of the gate system having the gate width for one person, when the collation of the person 1 in front fails, a large number of subsequent persons 1 stop to wait. However, in the case of the gate system 9 having the gate width by which the plurality of persons 1 can pass side by side as in the present embodiment, even when the collation of the person 1 in front fails, a large number of subsequent persons 1 only need to move while avoiding the person 1 in front who fails in the collation, and thus the persons 1 can pass through the gate smoothly without stopping to wait. That is, the gate system 9 according to the present embodiment can restrain occurrence of congestion at the time of entering and exiting the facility or the like. Hereinafter, the gate system 9 according to the present embodiment will be described in detail.

[0024] <Configuration of Gate System>

FIG. 3 is a block diagram illustrating a configuration example of the gate system 9 according to Embodiment 1. FIG. 4 illustrates diagrams of the facial image and a body image according to Embodiment 1.

[0025] The gate system 9 includes the first gate 11 and the second gate 12. The first gate 11 includes the first image capturing devices 21 and the first display device 31. The second gate 12 includes the second image capturing devices 22 and the second display device 32. The first gate 11, the first image capturing devices 21, the first display device 31, the second gate 12, the second image capturing devices 22, and the second display device 32 may be collectively referred to as a gate device 10.

[0026] The gate system 9 further includes a first edge device 41, a second edge device 42, a management device 50, and a face collation device 60. Each first image capturing device 21 is connected to the first edge device 41 via an electrical cable (for example, a USB cable or an Ethernet (registered trademark) cable). The first display device 31 is connected to the first edge device 41 via an electrical cable (for example, an HDMI (registered trademark) cable). Each second image capturing device 22 is connected to the second edge device 42 via an electrical cable (for example, a USB cable or an Ethernet cable). The second display device 32 is connected to the second edge device 42 via an electrical cable (for example, an HDMI cable). The first edge device 41 and the second edge device 42 are connected to the management device 50 via a communication network 4. The management device 50 is connected to the face collation device 60 via the communication network 4. Examples of the communication network

4 include a wired LAN, a wireless LAN, a mobile communication network (for example, LTE, 4G, 5G), the Internet, and/or a VPN.

[0027] Each first image capturing device 21 captures the detection area 3 to generate a captured image, and transmits the captured image to the first edge device 41. Each second image capturing device 22 captures the detection area 3 to generate a captured image, and transmits the captured image to the second edge device 42. The captured image may be a still image or a moving image.

[0028] As illustrated in FIGS. 4A and 4B, the first edge device 41 detects the entire body of the person 1 from the captured images received from the first image capturing devices 21. In the present embodiment, an image of the entire body of the person 1 detected from the captured images is referred to as a body image 200. The first edge device 41 transmits the detected body image 200 to the management device 50. As illustrated in FIG. 4A, the first edge device 41 detects a face portion of the person 1 from the captured images received from the first image capturing devices 21. In the present embodiment, an image of the face portion of the person 1 detected from the captured images is referred to as a facial image 220. The first edge device 41 transmits the detected facial image 220 to the management device 50.

[0029] As illustrated in FIGS. 4A and 4B, the second edge device 42 detects the entire body of the person 1 from the captured images received from the second image capturing devices 22. The second edge device 42 transmits the body image 200 detected from the captured images to the management device 50. As illustrated in FIG. 4A, the second edge device 42 detects the face portion of the person 1 from the captured images received from the second image capturing devices 22. The second edge device 42 transmits the facial image 220 detected from the captured images to the management device 50. The details of processes performed by the first edge device 41 and the second edge device 42 will be described later.

[0030] The management device 50 generates person information 100 (see FIG. 6) corresponding to the person 1 located in the detection area 3 based on the body image 200 or the facial image 220 received from the first edge device 41, or the body image 200 or the facial image 220 received from the second edge device 42. The management device 50 may generate the person information 100 for each person 1 detected in the detection area 3. Details of the person information 100 will be described later (see FIG. 6). The management device 50 transmits a face collation request including the facial image 220 to the face collation device 60.

[0031] The face collation device 60 stores the collation facial image of the person 1 who has the right to pass through (for example, enter or exit through) the gate in advance. For example,

the face collation device 60 stores the collation facial image of the person 1 who has registered in advance to enter the facility. The face collation device 60 may manage the collation facial image in association with name, age, gender, credit card information, and the like of the person 1.

5 [0032] The face collation device 60 collates the facial image 220 received from the management device 50 with each collation facial image. When the face collation device 60 succeeds in the collation with any one of the registered collation facial images, the face collation device 60 generates face collation result information including a result "collation successful" and transmits the face collation result information to the management device 50. At this time,
 10 the face collation device 60 may perform charging in real time by using the credit card information associated with the collation facial image that is successfully collated. When the face collation device 60 fails in the collation with all of the registered collation facial images, the face collation device 60 generates face collation result information including a result "collation failed" and transmits the face collation result information to the management device
 15 50. The collation between the facial image 220 and the collation facial image may be achieved by a known facial image matching technique. In addition, the "collation" may be interpreted as "authentication".

[0033] The management device 50 receives the face collation result information from the face collation device 60. The management device 50 transmits, to the first edge device 41,
 20 person collation information including the face collation result information on the facial image 220 of the person 1 moving in the first direction, and transmits, to the second edge device 42, person collation information including the face collation result information on the facial image 220 of the person 1 moving in the second direction.

[0034] When receiving the person collation information from the management device 50,
 25 the first edge device 41 displays the face collation result information provided in the person collation information on the first display device 31 as illustrated in FIG. 2. Accordingly, the person 1 who is located in the detection area 3 and is moving in the first direction can know his or her collation result by viewing the screen of the first display device 31 located ahead of a movement direction. That is, the first edge device 41 can cause the person 1 moving in the first
 30 direction to visually confirm the collation result of the person 1.

[0035] When receiving the person collation information from the management device 50, the second edge device 42 displays the face collation result information provided in the person collation information on the second display device 32 as illustrated in FIG. 2. Accordingly, the

person 1 who is located in the detection area 3 and is moving in the second direction can know his or her collation result by viewing the screen of the second display device 32 located ahead of the movement direction. That is, the second edge device 42 can cause the person 1 moving in the second direction to visually confirm the collation result of the person 1. Hereinafter, the processes performed by the first edge device 41, the second edge device 42, and the management device 50 will be described in detail.

[0036] <Detection Process in First Edge Device>

FIG. 5 is a flowchart illustrating an example of a detection process performed by the first edge device 41 according to Embodiment 1. Regarding a detection process performed by the second edge device 42 according to Embodiment 1, the "first image capturing devices 21" may be interpreted as the "second image capturing devices 22" in the following description with reference to FIG. 5.

[0037] The first edge device 41 receives the captured images from the first image capturing devices 21 (S101).

[0038] The first edge device 41 receives a distance image from each first image capturing device 21 (S102). In this manner, each first image capturing device 21 may be able to generate the distance image indicating a distance to the person 1 or the like present in the detection area 3. The same applies to each second image capturing device 22. The generation of the distance image may be achieved by using any known technique such as a stereo camera or a distance measuring sensor (for example, a light detection and ranging (LiDAR)). In the present embodiment, the process in step S102 is performed after the process in step S101, but the present invention is not limited thereto, and the order may be switched.

[0039] As illustrated in FIG. 4A, the first edge device 41 detects the facial image 220 of the person 1 from the captured images (S103). The detection of the facial image 220 of the person may be achieved by using any known technique such as pattern matching or artificial intelligence (AI). Further, the AI may be an image recognition technique using deep learning (for example, a convolutional neural network (CNN)) or the like.

[0040] The first edge device 41 determines whether the facial image 220 can be detected from the captured images in step S103 (S104). When the facial image 220 cannot be detected (S104: NO), the first edge device 41 proceeds the process to step S108.

[0041] When the facial image 220 can be detected (S104: YES), the first edge device 41 calculates three-dimensional coordinates (hereinafter, referred to as a face coordinate 221 (see (a) and (b) of FIG. 4)) related to the detected facial image 220 by using the distance image

(S105). For example, as illustrated in FIG. 4A, the first edge device 41 calculates a center point of the facial image 220 as the face coordinate 221.

[0042] The first edge device 41 generates face detection information (S106). For example, the first edge device 41 generates the face detection information that includes an ID (hereinafter, referred to as an image capturing device ID) for identifying each first image capturing device 21 as a transmission source of the captured image, the facial image 220, a size of the facial image 220 (hereinafter, referred to as a facial image size), the face coordinate 221, and an image capturing time point of the captured image.

[0043] The first edge device 41 transmits the generated face detection information to the management device 50 (S107), and proceeds the process to the next step S108.

[0044] As illustrated in FIG. 4A or 4B, the first edge device 41 detects the body image 200 of the person 1 from the captured images (S108). The detection of the body image 200 of the person 1 may be achieved by using any known technique such as the pattern matching or the AI. Further, the AI may be the image recognition technique using deep learning (for example, CNN) or the like.

[0045] The first edge device 41 determines whether the body image 200 can be detected from the captured images in step S108 (S109). When the body image 200 cannot be detected (S109: NO), the first edge device 41 returns the process to step S101.

[0046] When the body image 200 can be detected (S109: YES), the first edge device 41 calculates three-dimensional coordinates (hereinafter, referred to as a body coordinate 201 (see FIGS. 4A and 4B) related to the detected body image 200 by using the distance image (S110). For example, as illustrated in FIGS. 4A and 4B, the first edge device 41 calculates a center point of the body image 200 as the body coordinate 201.

[0047] The first edge device 41 generates body detection information (S111). For example, the first edge device 41 generates the body detection information including the image capturing device ID, a body ID for identifying the body image 200, the body image 200, the body coordinate 201, and an image capturing time point of the captured image.

[0048] The first edge device 41 transmits the generated body detection information to the management device 50 (S112), and returns the process to step S101. In the present embodiment, after the process of detecting the facial image from the captured images (S103 to S107) is performed, the process of detecting the body image from the captured images (S108 to S112) is performed, but the present invention is not limited thereto, and the order may be switched.

[0049] As described above, by performing the process of detecting the facial image 220

and/or the body image 200 of the person 1 from the captured images and the process of calculating the face coordinate 221 and/or the body coordinate 201 in the first edge device 41 or the second edge device 42, it is possible to distribute a processing load compared to a case where these processes are performed in the management device 50. When the distribution of the processing load is not considered, the gate system 9 may not include the first edge device 41 and the second edge device 42. In this case, the first image capturing devices 21, the first display device 31, the second image capturing devices 22, and the second display device 32 may be directly connected to the management device 50. Then, the management device 50 may perform the process of detecting the facial image 220 and/or the body image 200 of the person 1 from the captured images and the process of calculating the face coordinate 221 and/or the body coordinate 201.

[0050] <Person Information>

FIG. 6 illustrates a configuration example of the person information 100 according to Embodiment 1.

[0051] The person information 100 is generated for each person 1 detected in the detection area 3. The person information 100 includes, as information or data, a tracking ID 101, a first image capturing time point 102, an image update time point 103, a body image 104, a body image update time point 105, a body coordinate 106, a facial image 107, a facial image update time point 108, a face coordinate 109, a face collation ID 110, a collation state 111, and a movement direction 112.

[0052] An ID used for tracking the same person in the detection area 3 is set as the tracking ID 101. The tracking ID 101 can also be referred to as an ID for identifying the person information 100.

[0053] A time point at which the body image 104 or the facial image 107 provided in the person information 100 is captured for the first time is set as the first image capturing time point 102. The first image capturing time point can also be referred to as a time point at which the person information 100 is generated for the first time.

[0054] A time point at which the body image 104 or the facial image 107 provided in the person information 100 is last updated is set as the image update time point 103. The image update time point 103 can also be referred to as a time point at which the person information 100 is last updated.

[0055] The body image 200 detected from the captured images of the person 1 indicated by the person information 100 is set as the body image 104. The body image 104 may be

dynamically updated to the body image 200 detected from the latest captured images.

[0056] A time point at which the body image 104 provided in the person information 100 is last updated is set as the body image update time point 105.

[0057] The body coordinate 201 calculated based on the body image 104 is set as the body coordinate 106. The body coordinate 106 may be represented as three-dimensional coordinates (an X-coordinate, a Y-coordinate, and a Z-coordinate) in the detection area 3.

[0058] The facial image 220 detected from the captured images of the person 1 indicated by the person information 100 is set as the facial image 107. The facial image 107 may be dynamically updated to the facial image 220 detected from the latest captured images.

10 [0059] A time point at which the facial image 107 provided in the person information 100 is last updated is set as the facial image update time point 108.

[0060] The face coordinate 221 calculated based on the facial image 107 is set as the face coordinate 109. The face coordinate 109 may be represented as three-dimensional coordinates (an X-coordinate, a Y-coordinate, and a Z-coordinate) in the detection area 3.

15 [0061] An ID assigned to the collation facial image that is successfully collated is set as the face collation ID 110. That is, the face collation ID 110 can also be referred to as an ID for certifying the person 1 corresponding to the facial image 107. When there is no collation facial image that is successfully collated (that is, face collation fails), NULL may be set as the face collation ID 110.

20 [0062] A state of collation with the facial image 107 is set as the collation state 111. For example, any one of "before collation request", "during collation", "collation successful", and "collation failed" is set as the collation state 111.

[0063] A movement direction of the person 1 indicated by the person information 100 is set as the movement direction 112. For example, either the first direction or the second direction is set as the movement direction.

[0064] The management device 50 manages a plurality of pieces of person information 100 as a person information table (not illustrated). The person information table may be stored in a memory 1002 or a storage 1003 (see FIG. 37) provided in the management device 50, or may be stored in a device different from the management device 50.

30 [0065] <Overall Process in Management Device>

FIG. 7 is a flowchart illustrating an example of an overall process performed by the management device 50 according to Embodiment 1.

[0066] The management device 50 determines whether the face detection information (see

step S107 in FIG. 5) is received from the first edge device 41 or the second edge device 42 (S201).

[0067] When the face detection information is received (S201: YES), the management device 50 executes a face detection information process (S202). Details of the face detection information process will be described later (see FIG. 8).

[0068] When the face detection information is not received (S202: NO), the management device 50 determines whether the body detection information (see step S112 in FIG. 5) is received from the first edge device 41 or the second edge device 42 (S203).

[0069] When the body detection information is received (S203: YES), the management device 50 executes a body detection information process (S204). Details of the body detection information process will be described later (see FIG. 9).

[0070] When the body detection information is not received (S203: NO), the management device 50 determines whether the face collation result information is received (S205). The face collation result information refers to information returned from the face collation device 60 in response to the face collation request transmitted from the management device 50 to the face collation device 60 in FIG. 8 to be described later, and refers to information that includes a result of the face collation (for example, a result "collation successful" or a result "collation failed").

[0071] When the face collation result information is received (S205: YES), the management device 50 executes a face collation result information process (S206). Details of the face collation result information process will be described later (see FIG. 11).

[0072] When the face collation result information is not received (S205: NO), the management device 50 returns the process to step S201.

[0073] After executing the face detection information process (S202) or the body detection information process (S204), the management device 50 executes a post-movement process (S210) and returns the process to step S201. Details of the post-movement process will be described later (see FIG. 10). In the present embodiment, the processes in steps S201, S203, and S205 are performed in a stepwise manner, but the present invention is not limited thereto, and the processes in steps S201, S203, and S205 may be switched or may be performed in parallel.

[0074] <Face Detection Information Process in Management Device>

FIG. 8 is a flowchart illustrating an example of the face detection information process (S202) illustrated in FIG. 7.

[0075] The management device 50 detects, from the person information table, the person information 100 corresponding to the face detection information received from the first edge device 41 or the second edge device 42 (S301). In the present embodiment, the person information 100 corresponding to the face detection information refers to the person information 100 by which a person is estimated to be the same person as the person 1 indicated by the face detection information. Details of a method of detecting, from the person information table, the person information 100 by which the person is estimated to be the same person as the person 1 indicated by the face detection information will be described later (see FIGS. 15A and 15B).

[0076] The management device 50 determines whether the person information 100 can be detected from the person information table in step S301 (S302).

[0077] Next, a case where it is determined in step S302 that the person information 100 cannot be detected from the person information table (S302: NO) will be described.

[0078] The management device 50 generates new person information 100 based on the face detection information (S303). At this time, the management device 50 sets the following contents for the new person information 100.

- set a new tracking ID as the tracking ID 101 of the person information 100
- set the facial image 220 provided in the face detection information as the facial image 107 of the person information 100
- set the face coordinate 221 provided in the face detection information as the face coordinate 109 of the person information 100
- set an image capturing time point provided in earliest face detection information (that is, an image capturing time point acquired earliest) as the first image capturing time point 102 of the person information 100

- set the "before collation request" as the collation state 111 of the person information 100

[0079] The management device 50 detects the movement direction of the person 1 corresponding to the face detection information, and sets the detected movement direction as the movement direction 112 of the person information 100 generated in step S303 (S304). Details of a method of detecting the movement direction of the person will be described later (see FIG. 16).

[0080] The management device 50 newly registers the person information 100 generated and set in step S303 and step S304 in the person information table (S305).

[0081] The management device 50 transmits a face collation request including the facial

image 107 and the tracking ID 101 to the face collation device 60, and updates the collation state 111 of the person information 100 to the "during collation" (S306).

Then, the management device 50 completes this process.

[0082] Next, a case where it is determined in step S302 that the person information 100 can be detected from the person information table (S302: YES) will be described.

[0083] The management device 50 updates the contents of the person information 100 detected in step S301 based on the face detection information (S310). For example, the management device 50 updates the detected person information 100 as follows.

- update the face coordinate 109 of the person information 100 to the face coordinate 221 provided in the face detection information

- update the image update time point 103 and the facial image update time point 108 of the person information 100 to the image capturing time point provided in the face detection information

[0084] The management device 50 determines whether the collation state 111 of the detected person information 100 is the "before collation request" or the "collation failed" (S311). When the collation state 111 is neither the "before collation request" nor the "collation failed" (S311: NO), the management device 50 completes this process.

[0085] When the collation state 111 is the "before collation request" or the "collation failed" (S311: YES), the management device 50 transmits the face collation request including the facial image 107 and the tracking ID 101 to the face collation device 60, and updates the collation state 111 of the person information 100 to the "during collation" (S312). Then, the management device 50 completes this process.

[0086] <Body Detection Information Process in Control Device>

FIG. 9 is a flowchart illustrating an example of the body detection information process (S204) illustrated in FIG. 7.

[0087] The management device 50 detects, from the person information table, the person information 100 corresponding to the body detection information received from the first edge device 41 or the second edge device 42 (S401). In the present embodiment, the person information 100 corresponding to the body detection information refers to the person information 100 by which the person is estimated to be the same person as the person 1 indicated by the body detection information. Details of a method of detecting, from the person information table, the person information 100 by which the person is estimated to be the same person as the person 1 indicated by the body detection information will be described later (see

FIGS. 15A and 15B).

[0088] The management device 50 determines whether the person information 100 can be detected from the person information table in step S401 (S402).

[0089] Next, a case where it is determined in step S402 that the person information 100 cannot be detected from the person information table (S402: NO) will be described.

[0090] The management device 50 generates new person information 100 based on the received body detection information (S403). At this time, the management device 50 sets the following contents for the new person information 100.

- set a new tracking ID as the tracking ID 101 of the person information 100

- set the body image 200 provided in the body detection information as the body image 104 of the person information 100

- set a body coordinate 202 provided in the body detection information as the body coordinate 106 of the person information 100

- set an image capturing time point provided in earliest body detection information (that is, an image capturing time point acquired earliest) as the first image capturing time point 102 of the person information 100

[0091] The management device 50 detects the movement direction of the person 1 corresponding to the body detection information, and sets the detected movement direction as the movement direction 112 of the person information 100 generated in step S403 (S404).

Details of the method of detecting the movement direction of the person 1 will be described later (see FIG. 16).

[0092] The management device 50 newly registers the person information 100 generated and set in step S403 and step S404 in the person information table (S405). Then, the management device 50 completes this process.

[0093] Next, a case where it is determined in step S402 that the person information 100 can be detected from the person information table (S402: YES) will be described.

[0094] The management device 50 updates the contents of the person information 100 detected in step S401 based on the body detection information (S410). For example, the management device 50 updates the detected person information 100 as follows.

- update the body coordinate 106 of the person information 100 as the body coordinate 202 provided in the body detection information

- update the image update time point 103 and the body image update time point 105 of the person information 100 to a body image capturing time point provided in the body

detection information

[0095] Then, the management device 50 completes this process.

[0096] <Post-Movement Process in Management Device>

FIG. 10 is a flowchart illustrating an example of the post-movement process (S210) illustrated in FIG. 7.

[0097] The management device 50 generates person movement information based on target person information (S501). In the present embodiment, the target person information refers to the person information 100 detected from the person information table or the newly generated person information 100 in the face detection information process illustrated in FIG. 8, or the person information 100 detected from the person information table or the newly generated person information 100 in the body detection information process illustrated in FIG. 9. At this time, the management device 50 sets the following contents for the person movement information.

- tracking ID
- zone information
- facial image (body image when there is no facial image)
- collation state
- face collation ID

[0098] Here, the zone information refers to information indicating that the person 1 corresponding to the target person information is located in a face collation zone 301 or a passage determination zone 302 in the detection area 3. Details of the face collation zone 301 and the passage determination zone 302 will be described later (see FIG. 13).

[0099] The management device 50 determines whether the movement direction of the target person information is the first direction or the second direction (S502).

[0100] When the movement direction is the first direction (S502: the first direction), the management device 50 transmits the person movement information generated in step S501 to the first edge device 41 (S503), and completes this process.

[0101] When the movement direction is the second direction (S502: the second direction), the management device 50 transmits the person movement information generated in step S501 to the second edge device 42 (S504), and completes this process.

[0102] <Face Collation Result Information Process in Control Device>

FIG. 11 is a flowchart illustrating an example of the face collation result information process (S206) illustrated in FIG. 7.

[0103] The management device 50 sets contents of the face collation result information received from the face collation device 60 as the person information 100 corresponding to the face collation result information in the person information table (S601). For example, the management device 50 sets the contents of the face collation result information as the person information 100 as follows.

- set the face collation ID of the face collation result information as the face collation ID 110 of the person information 100

- set the collation result (the result "collation successful" or the result "collation failed") of the face collation result information as the collation state 111 of the person information 100

[0104] The management device 50 generates the person collation information based on the person information 100 set in step S601 (S602).

At this time, the management device 50 sets the following contents for the person collation information.

- tracking ID
- zone information
- facial image
- collation state
- face collation ID

[0105] The management device 50 determines whether the movement direction 112 of the person information 100 set in step S601 is the first direction or the second direction (S603).

[0106] When the movement direction 112 is the first direction (S602: the first direction), the management device 50 transmits the person collation information generated in step S602 to the first edge device 41 (S604), and completes this process.

[0107] When the movement direction 112 is the second direction (S602: the second direction), the management device 50 transmits the person collation information generated in step S602 to the second edge device 42 (S605), and completes this process.

[0108] <Display Process in First Edge Device>

FIG. 12 is a flowchart illustrating an example of a display process performed by the first edge device 41 according to Embodiment 1. Regarding a display process performed by the second edge device 42 according to Embodiment 1, in the following description with reference to FIG. 12, the "first edge device 41" may be interpreted as the "second edge device 42", the "first display device 31" may be interpreted as the "second display device 32", and the "first

direction" may be interpreted as the "second direction".

[0109] The first edge device 41 determines whether the person movement information or the person collation information is received from the management device 50 (S701). When neither the person movement information nor the person collation information is received (S701: NO),
 5 the first edge device 41 returns the process to step S701. When the person movement information or the person collation information is received (S701: YES), the first edge device 41 performs the following process.

[0110] The first edge device 41 determines whether the facial image or the body image corresponding to the tracking ID provided in the received person movement information or
 10 person collation information is displayed on the first display device 31 (S702).

[0111] When the facial image or the body image corresponding to the tracking ID is not displayed on the first display device 31 (S702: NO), the first edge device 41 newly displays the facial image or the body image and the collation state provided in the person movement information or the person collation information on the first display device 31 (S703). Then, the
 15 first edge device 41 returns the process to step S701.

[0112] When the facial image or the body image corresponding to the tracking ID is displayed on the first display device 31 (S702: YES), the first edge device 41 updates the displayed facial image or body image and collation state to the facial image or the body image and the collation state provided in the person movement information or the person collation
 20 information, and displays the facial image or the body image and the collation state (S704). Then, the first edge device 41 returns the process to step S701.

[0113] Accordingly, as illustrated in FIG. 2, the first display device 31 displays collation result images indicating the facial image or the body image and the collation state (for example, the result "collation successful", the result "collation failed", or the like) of each person 1
 25 moving in the first direction. Therefore, each person 1 moving in the first direction can visually confirm his or her collation result from the first display device 31 installed ahead of the movement direction.

[0114] Similarly, as illustrated in FIG. 2, the second display device 32 displays the collation result images indicating the facial image or the body image and the collation state (for example, the result "collation successful", the result "collation failed", or the like) of each person 1
 30 moving in the second direction. Therefore, each person 1 moving in the second direction can visually confirm his or her collation result from the second display device 32 installed ahead of the movement direction.

[0115] The contents related to the display process described above can be described as follows. That is, the management device 50 detects the movement direction of each person 1 moving between the first gate 11 and the second gate 12, displays the collation result of the facial image 220 of the person 1 moving in the first direction on the first display device 31 but not on the second display device 32, and displays the collation result of the facial image 220 of the person 1 moving in the second direction on the second display device 32 but not on the first display device 31.

[0116] Accordingly, the collation result of the person 1 is displayed on the display device installed in the movement direction of the person 1, and the collation result of the person is not displayed on the display device installed in a direction opposite to the movement direction of the person 1. Therefore, the management device 50 can appropriately show the collation result for each of the persons 1 moving in the first direction and the persons 1 moving in the second direction through the passage 2.

[0117] <Display Pattern>

FIG. 13 is a diagram illustrating the face collation zone 301 and the passage determination zone 302 in the detection area 3 according to Embodiment 1. Although the first gate 11 and the first direction are described below as an example, the same applies to the second gate 12 and the second direction.

[0118] The captured images captured by the first image capturing devices 21 of the first gate 11 are used for the face collation of the person 1 moving in the first direction. In the detection area 3, a predetermined area close to the second gate 12 is set as the face collation zone 301, and a predetermined area close to the first gate 11 is set as the passage determination zone 302. The first edge device 41 may change a display pattern on the first display device 31 depending on whether the person 1 is located in the face collation zone 301 or the passage determination zone 302. Next, the display pattern will be described.

[0119] FIG. 14 is a diagram for illustrating examples of the display pattern on the first display device 31 according to Embodiment 1. Regarding a display pattern on the second display device 32, in the following description with reference to FIG. 14, the "first edge device 41" may be interpreted as the "second edge device 42", and the "first display device 31" may be interpreted as the "second display device 32".

[0120] When the person 1 is located outside the detection area 3 (outside the zones), the first edge device 41 does not display the collation result image of the person 1 on the first display device 31.

[0121] When the person 1 is located in the face collation zone 301, the first edge device 41 controls the display of the first display device 31 as the following patterns (A0) to (A3).

(A0) When the facial image 220 of the person 1 is present and the collation state 111 is the "during collation", the first edge device 41 displays a collation result image including the facial image 220 of the person 1 and a message "during collation" on the first display device 31.

(A1) When the facial image 220 of the person 1 is present and the collation state 111 is the "collation successful", the first edge device 41 displays a collation result image including the facial image 220 of the person 1 and a message "collation successful" on the first display device 31. At this time, the first edge device 41 may output a collation success sound from a speaker provided in the first display device 31.

(A2) When the facial image 220 of the person 1 is present and the collation state 111 is the "collation failed", the first edge device 41 displays a collation result image including the facial image 220 of the person 1 and a message "collation failed" on the first display device 31. At this time, the first edge device 41 may output a collation failure sound from the speaker provided in the first display device 31.

(A3) When the facial image 220 of the person 1 is not present and the body image 200 is present, the first edge device 41 displays a collation result image including the body image 200 of the person 1 and a message "warning" on the first display device 31. At this time, the first edge device 41 may output a warning sound from the speaker provided in the first display device 31.

[0122] When the person 1 is located in the passage determination zone 302, the first edge device 41 controls the display of the first display device 31 as the following patterns (A4) to (A7).

(A4) When the facial image 220 of the person 1 is present and the collation state 111 is the "during collation", the first edge device 41 displays the collation result image including the facial image 220 of the person 1 and the message "during collation" on the first display device 31.

(A5) When the facial image 220 of the person 1 is present and the collation state 111 is the "collation successful", the first edge device 41 displays a collation result image including the facial image 220 of the person 1 and a message "passing" on the first display device 31. At this time, the first edge device 41 may output a passing sound from the speaker provided in the first display device 31.

(A6) When the facial image 220 of the person 1 is present and the collation state 111 is the "collation failed", the first edge device 41 displays a collation result image including the facial image 220 of the person 1 and a message "unauthorized passing" on the first display device 31. At this time, the first edge device 41 may output an unauthorized passing sound from the speaker provided in the first display device 31.

(A7) When the facial image 220 of the person 1 is not present and the body image 200 is present, the first edge device 41 displays a collation result image including the body image 200 of the person 1 and the message "unauthorized passing" on the first display device 31. At this time, the first edge device 41 may output the unauthorized passing sound from the speaker provided in the first display device 31.

[0123] Display priorities may be set as follows.

- The passage determination zone 302 has a higher display priority than the face collation zone 301.

- The message "passing" has the highest display priority, and the message "collation successful" has the next highest display priority.

- When there is the facial image 220, the message "during collation" has the lowest display priority.

- A case where the facial image 220 is present has a higher display priority than a case where only the body image 200 is present.

[0124] For example, display priorities of the patterns (A0) to (A7) described above may be set as follows in ascending order.

$$(A3) < (A7) < (A0) < (A4) < (A2) < (A6) < (A1) < (A5)$$

[0125] <Method of Detecting Person Information of Same Person>

FIGS. 15A and 15B are views for illustrating the method of detecting, from the person information table, the person information 100 by which the person is estimated to be the same person as the person 1 indicated by the body detection information according to Embodiment 1. In FIGS. 15A and 15B, it is assumed that the person 1 moves in the first direction. Regarding a case where the person 1 moves in the second direction, in the following description with reference to FIGS. 15A and 15B, the "first image capturing devices 21" may be interpreted as the "second image capturing devices 22", and the "second image capturing devices 22" may be interpreted as the "first image capturing devices 21".

[0126] The body image 200 of the person 1 moving in the first direction, which is captured by the first image capturing devices 21, shows a front view of the body of the person 1.

Hereinafter, an X-coordinate and a Y-coordinate of a body coordinate 201A calculated from the body image 200 as the front view are referred to as an X-coordinate 201Ax and a Y-coordinate 201Ay of the front view of the body, respectively. Further, the facial image 220 of the person 1 moving in the first direction, which is captured by the first image capturing devices 21, shows a front view of the face of the person 1. Hereinafter, an X-coordinate and a Y-coordinate of a face coordinate 221A calculated from the facial image 220 as the front view are referred to as an X-coordinate 221Ax and a Y-coordinate 221Ay of the front view of the face, respectively.

[0127] The body image 200 of the person 1 moving in the first direction, which is captured by the second image capturing devices 22, shows a rear view of the body of the person 1. Hereinafter, an X-coordinate and a Y-coordinate of a body coordinate 201B calculated from the body image 200 as the rear view are referred to as an X-coordinate 201Bx and a Y-coordinate 201By of the rear view of the body, respectively.

[0128] As illustrated in FIG. 15A, the Y-coordinate 201Ay of the front view of the body and the Y-coordinate 201By of the rear view of the body are separated by a thickness of the body of the person 1 in a front-rear direction. Therefore, when a position difference between the Y-coordinate 201Ay of the front view of the body and the Y-coordinate 201By of the rear view of the body is smaller than a predetermined threshold (hereinafter, referred to as a body thickness threshold) W based on a thickness of the body, the Y-coordinate 201Ay of the front view of the body and the Y-coordinate 201By of the rear view of the body can be estimated to correspond to the Y-coordinate of the same person. The body thickness threshold W may be a value slightly larger than an average body thickness. Similarly, when a position difference between the Y-coordinate 221Ay of the front view of the face and the Y-coordinate 201By of the rear view of the body is smaller than the body thickness threshold W, the Y-coordinate 221Ay of the front view of the face and the Y-coordinate 201By of the rear view of the body can be estimated to be the Y-coordinate of the same person.

[0129] Further, as illustrated in FIG. 15B, when an amount of change in an X component between the X-coordinate 201Ax (that is, the present X-coordinate) of the body coordinate 201A provided in the received body detection information and the X-coordinate 201Ax (that is, the past X-coordinate) of the body coordinate 201A provided in the person information 100 is equal to or less than a predetermined threshold (hereinafter, referred to as a body width threshold) W2, the X-coordinate 201Ax of the present body coordinate and the X-coordinate 201Ax of the past body coordinate can be estimated to be the X-coordinate of the same person. The face coordinate 221A may be used instead of the body coordinate 201A.

[0130] That is, when the management device 50 can detect, from the person information table, the person information 100 in which a position difference between the X-coordinate of the body coordinate 201 (or the face coordinate 221) provided in the received body detection information and the X-coordinate of the body coordinate 201 (or the face coordinate 221) provided in the person information 100 is equal to or smaller than the body width threshold W2 and a position difference between the Y-coordinate of the body coordinate 201 provided in the received body detection information and the Y-coordinate of the body coordinate 201 or the Y-coordinate of the face coordinate 221 provided in the person information 100 is smaller than the body thickness threshold W, the detected person information 100 may be the information by which the person is estimated to be the same person as the person 1 indicated by the body detection information.

[0131] Similarly, when the management device 50 can detect, from the person information table, the person information 100 in which the position difference between the X-coordinate of the body coordinate 201 (or the face coordinate 221) provided in the received body detection information and the X-coordinate of the body coordinate 201 (or the face coordinate 221) provided in the person information 100 is smaller than the body width threshold W2 and a position difference between the Y-coordinate of the face coordinate 221 provided in the received face detection information and the Y-coordinate of the body coordinate 201 or the Y-coordinate of the face coordinate 221 provided in the person information 100 is smaller than the body thickness threshold W, the detected person information 100 may be the information by which the person is estimated to be the same person as the person 1 indicated by the face detection information.

[0132] A condition related to the position difference in the X-coordinate and the body width threshold W2 and a condition related to the position difference in the Y-coordinate and the body thickness threshold W described above are satisfied when a time difference between a facial image capturing time point provided in the face detection information or the body image capturing time point provided in the body detection information and a facial image update time point 108 or a body image update time point 105 provided in the person information 100 is sufficiently small (that is, when the time difference is smaller than a predetermined time threshold T). This is because the person 1 is moving, and thus when the time difference is large, the person information 100, which satisfies the condition related to the position difference of the X-coordinate and the body width threshold W2 and the condition related to the position difference of the Y-coordinate and the body thickness threshold W described above, is more

likely to be information by which the person is estimated to be another person located at the position in the past.

[0133] That is, the following process may be performed in step S301 of FIG. 8. The management device 50 detects, from the person information table, the person information 100 for which a time difference between the facial image capturing time point provided in the face detection information and the facial image update time point 108 or the body image update time point 105 provided in the person information 100 is less than the predetermined time threshold T, a position difference between the X-coordinate of the face coordinate 221 provided in the face detection information and the X-coordinate of the face coordinate 109 provided in the person information 100 is less than the body width threshold W2, and a position difference between the Y-coordinate of the face coordinate 221 provided in the face detection information and the Y-coordinate of the face coordinate 109 or the Y-coordinate of the body coordinate 106 provided in the person information 100 is less than the body thickness threshold W.

[0134] Further, the following process may be performed in step S401 of FIG. 9. The management device 50 detects, from the person information table, the person information 100 in which a time difference between the body image capturing time point provided in the body detection information and the facial image update time point 108 or the body image update time point 105 provided in the person information 100 is less than the predetermined time threshold T, a position difference between the X-coordinate of the body coordinate 201 provided in the body detection information and the X-coordinate of the body coordinate 106 provided in the person information 100 is less than the body width threshold W2, and a position difference between the X-coordinate of the body coordinate 201 provided in the body detection information and the Y-coordinate of the face coordinate 109 or the Y-coordinate of the body coordinate 106 provided in the person information 100 is less than the body thickness threshold W.

[0135] The contents described above can be described as follows. That is, when a difference between a position (for example, the body coordinate 201 or the face coordinate 221) of the person 1 provided in a first image (for example, the body image 200 or the facial image 220) captured by the first image capturing devices 21 and a position (for example, the body coordinate 201 or the face coordinate 221) of the person 1 provided in a second image (for example, the body image 200 or the facial image 220) captured by the second image capturing devices 22 is smaller than the predetermined threshold W based on the body thickness of the person, the management device 50 estimates that the position of the person 1 provided in the

first image and the position of the person 1 provided in the second image indicate the position of the same person.

[0136] Accordingly, for example, the management device 50 can estimate whether the first image acquired by capturing the front side of the person 1 and the second image acquired by capturing the rear side of the person 1 belong to the same person.

[0137] <Method of Detecting Movement Direction of Person>

FIG. 16 is a diagram for illustrating the method of detecting the movement direction of the person 1 according to Embodiment 1.

[0138] The management device 50 detects the movement direction of the person 1 by, for example, any one of the following first method, second method, and third method.

[0139] <<First Method>>

The management device 50 detects the movement direction 112 of the person information 100 based on a movement direction of the face coordinate 109 or the body coordinate 106 provided in the person information 100 over time. For example, when detecting that the Y-coordinate of the face coordinate 109 or the Y-coordinate of the body coordinate 106 provided in the person information 100 moves in a negative direction of the Y axis over time, the management device 50 detects the movement direction 112 of the person 1 as the first direction. When detecting that the Y-coordinate of the face coordinate 109 or the Y-coordinate of the body coordinate 106 provided in the person information 100 moves in a positive direction of the Y axis over time, the management device 50 detects the movement direction 112 of the person 1 as the second direction.

[0140] <<Second Method>>

The management device 50 determines, based on the image capturing device ID, whether the captured image of the person 1 detected for the first time is captured by the first image capturing devices 21 or is captured by the second image capturing devices 22. When the captured image of the person 1 detected for the first time is captured by the first image capturing devices 21, the management device 50 detects the movement direction 112 of the person 1 as the first direction. This is because the image of the person 1 entering the detection area 3 from the second gate 12 is first captured by the first image capturing devices 21 provided in the first gate 11. When the captured image of the person 1 detected for the first time is captured by the second image capturing devices 22, the management device 50 detects the movement direction 112 of the person 1 as the second direction. This is because the image of the person 1 entering the detection area 3 from the first gate 11 is first captured by the second image capturing devices

22 provided in the second gate 12.

[0141] <<Third Method>>

As illustrated in FIG. 16, when the face coordinate 109 or the body coordinate 106 of the person 1 detected for the first time is provided in a predetermined area 312 closer to the second gate 12 in the detection area 3, the management device 50 detects the movement direction 112 of the person 1 as the first direction. This is because the person 1 entering the detection area 3 from the second gate 12 first enters the predetermined area 312 closer to the second gate 12. When the face coordinate 109 or the body coordinate 106 of the person 1 detected for the first time is provided in a predetermined area 311 closer to the first gate 11 in the detection area 3, the management device 50 detects the movement direction 112 of the person 1 as the second direction. This is because the person 1 entering the detection area 3 from the first gate 11 first enters the predetermined area 311 closer to the first gate 11.

[0142] (Embodiment 2)

In Embodiment 2, a gate system by which ID collation can be performed in addition to face collation described in Embodiment 1 will be described. Examples of the ID collation include collation using an ID indicated by a barcode or a QR code, and collation using an ID stored in an IC card or an IC chip. The ID collation is an example of another collation method different from the face collation. Therefore, any other collation method may be used as long as it is different from the face collation.

[0143] In Embodiment 2, the same reference numerals are given to the components described in Embodiment 1, and a description thereof may be omitted. The contents of Embodiment 1 may be incorporated into Embodiment 2.

[0144] <Configuration of Gate System>

FIG. 17 is a block diagram illustrating a configuration example of the gate system 9 according to Embodiment 2.

[0145] The gate system 9 according to Embodiment 2 includes an ID collation device 70 and an ID reader 71 in addition to the components illustrated in FIG. 3. The gate system 9 according to Embodiment 2 may be interpreted as a person collation system. A process performed by the management device 50 according to Embodiment 2 may be interpreted as a person collation method. The computer program that implements the process performed by the management device 50 according to Embodiment 2 may be interpreted as a person collation program. The management device 50 according to Embodiment 2 may be interpreted as an information processing device.

[0146] The ID reader 71 is a device that reads an ID. For example, the ID reader 71 reads a barcode or a QR code printed on a ticket possessed by the person 1 or a barcode or a QR code displayed on a smartphone possessed by the person 1, and transmits an ID corresponding to the read barcode or QR code to the ID collation device 70. For example, the ID reader 71 reads an ID stored in an IC card possessed by the person 1 and transmits the read ID to the management device 50. The management device 50 transmits the ID received from the ID reader 71 to the ID collation device 70. The ID may be interpreted as identification information, and the ID reader 71 may be interpreted as an identification information reading device.

[0147] The ID collation device 70 collates the ID received from the management device 50 with an ID collation database, transmits information indicating the collation success to the management device 50 when the collation is successful, and transmits information indicating the collation failure to the management device 50 when the collation fails. In the ID collation database, an ID corresponding to the person 1 who is permitted to pass through the gate system is registered in advance.

[0148] When the management device 50 receives the information indicating the collation success from the ID collation device 70, the management device 50 may permit the person 1 who has succeeded in the collation to pass through the gate by the ID. When the management device 50 receives the information indicating the collation failure from the ID collation device 70, the management device 50 may not permit the person 1 who has failed in the collation to pass through the gate by the ID, and may display, for example, a message of unauthorized passing on the first display device 31. Details of the process performed by the management device 50 in Embodiment 2 will be described later.

[0149] FIG. 18 is a diagram illustrating an example of a case where the ID reader 71 is installed in the passage determination zone 302.

[0150] The person 1 (hereinafter, referred to as an ID collation person) who requests passage permission by the ID collation using the ID reader 71 instead of the face collation moves to the place of the ID reader 71 through the passage determination zone 302. When the facial image of the ID collation person is not registered in a face collation database, the management device 50 displays the message of unauthorized passing to the ID collation person who is passing through the passage determination zone 302. The display of the message of unauthorized passing may give the ID collation person who requests the passage permission by the ID collation unpleasant feeling.

[0151] Therefore, in the present embodiment, a technique for preventing the ID collation

person from feeling unpleasant in the gate system 9 by which the ID collation can be performed in addition to the face collation. Although the person 1 moving in the first direction is described in the present embodiment, the content described in the present embodiment can also be applied to the person 1 moving in the second direction.

5 [0152] <In Setting Face Collation Zone, ID Collation Zone, and Passage Determination Zone in Detection Area>

FIG. 19 is a diagram illustrating an example of setting the face collation zone 301, the ID collation zone 303, and the passage determination zone 302 in the detection area 3 according to Embodiment 2.

10 [0153] The management device 50 may set the face collation zone 301, the passage determination zone 302, and the ID collation zone 303 in the detection area 3. For example, as illustrated in FIG. 19, the management device 50 sets the face collation zone 301 and the ID collation zone 303 on an entrance side in the first direction, and sets the passage determination zone 302 on an exit side in the first direction. The ID reader 71 is installed in the ID collation zone 303. The face collation zone 301 and/or the passage determination zone 302 may be interpreted as a first collation area. The ID collation zone 303 may be interpreted as a second collation area.

[0154] The ID collation person may enter the ID collation zone 303 from the entrance side, perform the ID collation by the ID reader 71, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

20 [0155] A person (hereinafter, referred to as a face collation person) who requests the passage permission by the face collation may enter the face collation zone 301 from the entrance side, perform the face collation automatically by the method described in Embodiment 1, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

[0156] The management device 50 may also perform the face collation on the person 1 located in the ID collation zone 303. In this case, the face collation person may enter the ID collation zone 303 from the entrance side, automatically perform the face collation, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side. That is, the face collation person may pass through not only the face collation zone 301 but also the ID collation zone 303. Accordingly, a wide gate width in which the plurality of persons 1 can enter side by side can be more efficiently used, and the large number of persons 1 can pass through the gate smoothly.

[0157] For the person 1 located in the face collation zone 301, the management device 50 may display a message indicating the collation success on the first display device 31 when the face collation is successful, and may display a message indicating the collation failure on the first display device 31 when the face collation is unsuccessful.

5 [0158] For the person 1 located in the ID collation zone 303, the management device 50 may not display the message indicating the collation failure on the first display device 31 even if the face collation fails. Accordingly, even if the facial image of the ID collation person located in the ID collation zone 303 is not registered in the face collation database, a collation failure message is not displayed, and thus it is possible to prevent the ID collation person from feeling
10 unpleasant.

[0159] The management device 50 may assign a passage permission flag to a person who has succeeded in face collation or a person who has succeeded in ID collation. The management device 50 may display a message of passable when the passage permission flag is assigned to the person located in the passage determination zone 302, and may display the message of
15 unauthorized passing when the passage permission flag is not assigned to the person located in the passage determination zone 302. Accordingly, even if the person located in the passage determination zone 302 is a person who fails in the face collation, if the person succeeds in the ID collation and is given the passage permission flag, the message of unauthorized passing for the person is not displayed. Therefore, it is possible to prevent the ID collation person from
20 feeling unpleasant. This will be described in detail below.

[0160] <Flowchart of Management Device>

FIG. 20 is a flowchart illustrating an example of the process performed by the management device 50 when the face collation zone 301, the ID collation zone 303, and the passage determination zone 302 are set in the detection area 3 according to Embodiment 2.

25 Next, the process performed by the management device 50 will be described with reference to FIG. 20. The process illustrated in FIG. 20 is a process for one tracked person, and the management device 50 executes the process illustrated in FIG. 20 for each of the plurality of tracked persons detected from the detection area 3.

[0161] The management device 50 detects the person entering the detection area 3 as the tracked person by the method described in Embodiment 1 (S1001).

[0162] The management device 50 determines in which zone the tracked person is located (S1002).

[0163] When the management device 50 determines that the tracked person is located in the

face collation zone 301 (S1002: face collation zone), the management device 50 executes a face collation process (S1003) and proceeds the process to step S1010. The face collation process may be interpreted as a first collation process. Details of the face collation process will be described later (see FIG. 21).

5 [0164] When the management device 50 determines that the tracked person is located in the ID collation zone 303 (S1002: ID collation zone), the management device 50 executes an ID collation process (S1004) and proceeds the process to step S1010. The ID collation process may be interpreted as a second collation process. Details of the ID collation process will be described later (see FIG. 22).

10 [0165] When the management device 50 determines that the tracked person is located in the passage determination zone 302 (S1002: passage determination zone), the management device 50 executes a passage determination process (S1005) and proceeds the process to step S1010. Details of the passage determination process will be described later (see FIG. 23).

[0166] The management device 50 determines whether to end the tracking of the tracked person (S1010). For example, when the tracked person is no longer detected from the detection area 3, the management device 50 ends the tracking of the tracked person. When the tracking of the tracked person is continued (S1010: NO), the management device 50 returns the process to step S1002, and when the tracking of the tracked person is ended (S1010: YES), the management device 50 ends this process.

20 [0167] <Flowchart of Face Collation Process>

FIG. 21 is a flowchart illustrating an example of the face collation process according to Embodiment 2. The process illustrated in FIG. 21 corresponds to details of the process of step S1003 illustrated in FIG. 20.

[0168] The management device 50 performs face collation of the tracked person by the method described in Embodiment 1 (S1101). At this time, the management device 50 may display a message "during collation" on the first display device 31 from the start of the face collation until the display of the result of the face collation.

[0169] The management device 50 determines whether the face collation is successful (S1102).

30 [0170] When the face collation is successful (S1102: YES), the management device 50 displays a collation success message on the first display device 31 (S1103). Then, the management device 50 assigns a passage permission flag to the tracked person (S1104), and completes this process.

[0171] When the face collation fails (S1102: NO), the management device 50 displays the collation failure message on the first display device 31 (S1105), and completes this process.

[0172] The management device 50 may omit the process illustrated in FIG. 21 for a tracked person who has once succeeded or failed in the face collation. After this process is completed, the process of step S1010 illustrated in FIG. 20 is executed.

[0173] <Flowchart of ID Collation Process>

FIG. 22 is a flowchart illustrating an example of an ID collation process according to Embodiment 2. The process illustrated in FIG. 22 corresponds to details of the process of step S1004 illustrated in FIG. 20.

[0174] The management device 50 determines whether the ID is received from the ID reader 71 (S1201).

[0175] When the ID is not received from the ID reader 71 (S1201: NO), the management device 50 completes the this process.

[0176] When the ID is received from the ID reader 71 (S1201: YES), the management device 50 transmits the ID to the ID collation device 70, and the ID collation device 70 performs the ID collation of the transmitted ID (S1202). The ID collation device 70 transmits an ID collation result to the management device 50. The ID collation result includes information indicating success or failure of the ID.

[0177] The management device 50 receives the ID collation result from the ID collation device 70 and determines whether the ID collation is successful (S1203).

[0178] When the ID collation fails (S1203: NO), the management device 50 displays the collation failure message on the first display device 31 (S1204), and completes this process.

[0179] When the ID collation is successful (S1203: YES), the management device 50 displays the collation success message on the first display device 31 (S1205). For example, the management device 50 may display a message such as "collation successful" or "passable" as the collation success message.

[0180] The management device 50 assigns the passage permission flag to the tracked person (S1206).

[0181] The management device 50 stores, in the memory 1002 (see FIG. 37), an ID collation facial image, which is a facial image obtained by capturing an image of the tracked person who has succeeded in the ID collation, in association with the ID that has succeeded in the ID collation (S1207). The ID collation facial image may be captured by the first image capturing device 21. Alternatively, the ID collation facial image may be captured by an image capturing

device installed near the ID reader 71. A method of using the ID collation facial image will be described later. Then, the management device 50 completes this process.

[0182] The management device 50 may omit the process illustrated in FIG. 22 for the tracked person who has once succeeded or failed in the ID collation. After this process is completed, the process of step S1010 illustrated in FIG. 20 is executed.

[0183] Further, the management device 50 may display the message "during collation" in the process of step S1101 of FIG. 21, continue to display the message "during collation" in the process of step S1105 of FIG. 21, then display the message "during ID collation" when the ID is received in the process of S1201 of FIG. 22, then display the message "collation failed" in the process of step S1204 of FIG. 22, and then display the message "collation successful" or "passable" in the process of step S1205 of FIG. 22. Accordingly, the person 1 can know a current state related to the passage determination from the displayed message.

[0184] <Flowchart of Passage Determination Process>

FIG. 23 is a flowchart illustrating an example of a passage determination process according to Embodiment 2. The process illustrated in FIG. 23 corresponds to details of the process of step S1005 illustrated in FIG. 20.

[0185] The management device 50 determines whether the passage permission flag is assigned to the tracked person (S1301).

[0186] When the passage permission flag is assigned to the tracked person (S1301: YES), the management device 50 displays the message of passable on the first display device 31 (S1302), and completes this process.

[0187] When the passage permission flag is not assigned to the tracked person (S1301: NO), the management device 50 displays the message of unauthorized passing on the first display device 31 (S1303).

[0188] The management device 50 determines whether the tracked person is a person who has entered the passage determination zone 302 from the ID collation zone 303 (S1304).

[0189] When the tracked person is not the person who has entered the passage determination zone 302 from the ID collation zone 303 (S1304: NO), the management device 50 completes this process.

[0190] When the tracked person is the person who has entered the passage determination zone 302 from the ID collation zone 303 (S1304: YES), the management device 50 transmits the ID collation facial image stored in the memory 1002 to, for example, a terminal of a staff member who monitors entry and exit (S1305), and completes this process.

[0191] For example, in the passage determination zone 302, the tracking of the person 1 may be interrupted for some reason, and the person 1 may be re-detected as a new tracked person. When the newly detected tracked person is a person who has obtained the passage permission by the face collation success, the face collation of the person may be performed again. However, when the newly detected tracked person is a person who has obtained the passage permission by the successful ID collation, the ID collation of the person cannot be performed again, and since the face collation of the person fails, the message of unauthorized passing is displayed for the person. Therefore, in this case, the management device 50 transmits the ID collation facial image and the facial image of the person displayed as unauthorized passing to the terminal of the staff member, and the terminal displays the transmitted ID collation facial image and the facial image of the person displayed as the unauthorized passing. The staff member determines whether there is a facial image of the same person as the ID collation facial image displayed on the terminal among the facial images of the person displayed as the unauthorized passing displayed on the terminal. When the staff member determines that there is a facial image of the same person as the ID collation facial image among the facial images of the person displayed as the unauthorized passing, the staff member may determine that the unauthorized passing is not performed since the person is succeeded in the ID collation. In this case, the staff member may operate the terminal to transmit an instruction to cancel the display of the message of unauthorized passing from the terminal to the management device 50, and the management device 50 may receive the instruction to cancel the display and cancel the display of the message of unauthorized passing for the person. Alternatively, the staff member may orally notify the person that the person is permitted to pass. Accordingly, even if the ID collation is successful but the unauthorized passing is displayed due to the interruption of the tracking of the person, the staff member can quickly recover, and the unpleasant feeling given to the ID collation person can be minimized.

[0192] When the unauthorized passing does not occur for a certain period of time after the ID collation is performed, the management device 50 may delete the ID collation image corresponding to the ID collation from the memory 1002. This is because an unnecessary facial image is preferably deleted from the viewpoint of personal information protection.

[0193] The management device 50 may use the ID collation facial image stored in the memory 1002 as the collation facial image for the person 1 located in the passage determination zone 302. For example, the management device 50 collates a facial image obtained by capturing an image of a person located in the passage determination zone 302 with the ID collation facial

image, and when the collation is successful, the management device 50 may not display the message of unauthorized passing for the person 1. Accordingly, even when the tracking of the person 1 is interrupted and the person 1 is re-detected as a new tracked person as described above, if the newly detected tracked person is a person who is permitted to pass by successful ID collation, collation between the captured facial image and the ID collation facial image is successful, and the message of unauthorized passing is not displayed. Therefore, even when the tracking of the ID collation person is interrupted, the message of unauthorized passing is not displayed, and it is possible to prevent the ID collation person from feeling unpleasant.

[0194] Further, the management device 50 may omit the process illustrated in FIG. 23 for the tracked person who has once indicated as passable or as unauthorized passing. After this process is completed, the process of step S1010 illustrated in FIG. 20 is executed.

[0195] According to the above process, for the person who has succeeded in either the face collation or the ID collation, the message of unauthorized passing is not displayed in the passage determination zone 302, and thus it is possible to prevent the ID collation person passing through the passage determination zone 302 from feeling unpleasant due to displaying of the message of unauthorized passing.

[0196] <In Setting ID Collation Zone and Passage Determination Zone in Detection Area>

FIG. 24 is a diagram illustrating a first example of setting the ID collation zone 303 and the passage determination zone 302 in the detection area 3 according to Embodiment 2.

[0197] The management device 50 may set the passage determination zone 302 and the ID collation zone 303 in the detection area 3. For example, as illustrated in FIG. 24, the management device 50 sets the passage determination zone 302 in the entire detection area 3, and sets the ID collation zone 303 in a part on the entrance side in the first direction (for example, an end on the entrance side). The ID reader 71 is installed in the ID collation zone 303.

[0198] The ID collation person may enter the ID collation zone 303 from the entrance side, perform the ID collation by the ID reader 71, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

[0199] The face collation person may enter the passage determination zone 302 or the ID collation zone 303 from the entrance side, automatically perform the face collation, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

[0200] FIG. 25 is a diagram illustrating a second example of setting the ID collation zone 303 and the passage determination zone 302 in the detection area 3 according to Embodiment

2.

[0201] The management device 50 may set the passage determination zone 302 and the ID collation zone 303 in the detection area 3. For example, as illustrated in FIG. 25, the management device 50 sets the ID collation zone 303 on the entrance side in the first direction, and sets the passage determination zone 302 on the exit side in the first direction. The ID reader 71 is installed in the ID collation zone 303.

[0202] The ID collation person may enter the ID collation zone 303 from the entrance side, perform the ID collation by the ID reader 71, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

[0203] The face collation person may enter the ID collation zone 303 from the entrance side, automatically perform the face collation, move to the passage determination zone 302, pass through the passage determination zone 302, and exit from the exit side.

[0204] FIG. 26 is a flowchart illustrating an example of the passage determination process when the ID collation zone 303 and the passage determination zone 302 are set in the detection area 3 according to Embodiment 2.

[0205] When the ID collation zone 303 and the passage determination zone 302 are set in the detection area 3, the management device 50 may not perform the process (face collation process) of step S1003 illustrated in FIG. 20, and may perform the following passage determination process described with reference to FIG. 26 instead of the process of step S1005 illustrated in FIG. 20.

[0206] The management device 50 performs the face collation of the tracked person by the method described in Embodiment 1 (S1401).

[0207] The management device 50 determines whether the face collation is successful (S1402).

[0208] When the face collation fails (S1402: NO), the management device 50 proceeds the process to step S1404.

[0209] When the face collation is successful (S1402: YES), the management device 50 assigns the passage permission flag to the tracked person (S1403), and proceeds the process to step S1404.

[0210] The management device 50 determines whether the passage permission flag is assigned to the tracked person (S1404). Here, the passage permission flag is assigned to the tracked person who has succeeded in the ID collation or the tracked person who has succeeded in the face collation.

[0211] When the passage permission flag is assigned to the tracked person (S1404: YES), the management device 50 displays the message of passable on the first display device 31 (S1405), and completes this process.

[0212] When the passage permission flag is not assigned to the tracked person (S1404: NO), the management device 50 displays the message of unauthorized passing on the first display device 31 (S1406).

[0213] The management device 50 determines whether the tracked person is a person who has entered the passage determination zone 302 from the ID collation zone 303 (S1407).

[0214] When the tracked person is not a person who has entered the passage determination zone 302 from the ID collation zone 303 (S1407: NO), the management device 50 completes this process.

[0215] When the tracked person is the person who has entered the passage determination zone 302 from the ID collation zone 303 (S1407: YES), the management device 50 transmits the ID collation facial image stored in the memory 1002 to the terminal of the staff member (S1408), and completes this process.

[0216] Note that the management device 50 may omit the processing illustrated in FIG. 26 for the tracked person who has once indicated as passable or as unauthorized passing. After this process is completed, the process of step S1010 illustrated in FIG. 20 is executed.

[0217] According to the above process, for the person who has succeeded in either the face collation or the ID collation, the message of unauthorized passing is not displayed in the passage determination zone 302, and thus it is possible to prevent the ID collation person passing through the passage determination zone 302 from feeling unpleasant due to displaying of the message of unauthorized passing.

[0218] <In Estimating Whether Person is Heading for ID Collation Zone>

FIG. 27 is a diagram illustrating a first example in which an ID collation person moves toward the ID collation zone 303 according to Embodiment 2.

[0219] For example, as illustrated in FIG. 27, the management device 50 sets the face collation zone 301 and an ID collation zone 303 on the entrance side in the first direction, and sets the passage determination zone 302 on the exit side in the first direction. The ID reader 71 is installed in the ID collation zone 303.

[0220] In this case, as indicated by a dotted arrow 401, an ID collation person 1A may move to the ID collation zone 303 through the face collation zone 301.

[0221] FIG. 28 is a diagram illustrating a second example in which the ID collation person

moves toward the ID collation zone 303 according to Embodiment 2.

[0222] For example, as illustrated in FIG. 28, the management device 50 sets the face collation zone 301 on the entrance side in the first direction, sets the passage determination zone 302 on the exit side in the first direction, and sets the ID collation zone 303 on a part of the exit side (for example, an end on the exit side). The ID reader 71 is installed in the ID collation zone 303.

[0223] In this case, as indicated by a dotted arrow 402, the ID collation person 1A may move to the ID collation zone 303 through the face collation zone 301 and the passage determination zone 302.

[0224] FIG. 29 is a diagram illustrating a third example in which the ID collation person moves toward the ID collation zone 303 according to Embodiment 2.

[0225] For example, as illustrated in FIG. 29, the management device 50 sets the face collation zone 301 on the entrance side in the first direction, sets the passage determination zone 302 on the exit side in the first direction, and sets the ID collation zone 303 at a part of an intermediate point (for example, an end of the intermediate point) in the passage determination zone 302. For example, station staff 501 is present in a place where ID collation zone 303 can be accessed, and the station staff 501 performs ID collation of the ID collation person 1A located in the ID collation zone 303 using the ID reader 71. Alternatively, the station staff 501 may operate a predetermined terminal (for example, a PC, a tablet terminal, or a smartphone) to assign the passage permission flag to the ID collation person 1A located in the ID collation zone 303.

[0226] In this case, as indicated by a dotted arrow 403, the ID collation person 1A may move to the ID collation zone 303 through the face collation zone 301 and the passage determination zone 302.

[0227] As illustrated in FIG. 27, FIG. 28, or FIG. 29, when the ID collation person 1A whose facial image is not registered in advance passes through the face collation zone 301 or the passage determination zone 302 in order to move to the ID collation zone 303, there is a possibility that the face collation fails during the passage and the collation failure message or the message of unauthorized passing is displayed. This may give the ID collation person unpleasant feeling. Therefore, in the present embodiment, it is estimated whether the person 1 is heading for the ID collation zone 303, and the collation failure message or the message of unauthorized passing may not be displayed for the person 1 estimated to be heading for the ID collation zone 303 while the person 1 passes through the face collation zone 301 or the passage

determination zone 302. This will be described in detail below.

[0228] FIG. 30 is a flowchart of the face collation process including a process of estimating whether a person is heading for the ID collation zone 303.

[0229] The management device 50 may perform the following face collation operation described with reference to FIG. 30, instead of the face collation operation illustrated in FIG. 21.

[0230] The management device 50 performs the face collation of the tracked person by the method described in Embodiment 1 (S1501).

[0231] The management device 50 determines whether the face collation is successful (S1502).

[0232] When the face collation is successful (S1502: YES), the management device 50 displays the collation success message on the first display device 31 (S1503). Then, the management device 50 assigns the passage permission flag to the tracked person (S1504), and completes this process.

[0233] When the face collation fails (S1502: NO), the management device 50 estimates whether the tracked person is heading for the ID collation zone 303 (S1505). Details of an estimation method will be described later.

[0234] When the management device 50 estimates that the tracked person is heading for the ID collation zone 303 (S1505: YES), the management device 50 displays a message of during collation on the first display device 31 (S1506), and completes this process.

[0235] When the management device 50 estimates that the tracked person is not heading for the ID collation zone 303 (S1505: NO), the management device 50 displays the collation failure message on the first display device 31 (S1507), and completes this process.

[0236] Accordingly, in the face collation zone 301, even if the face collation of the person 1 estimated to be heading for the ID collation zone 303 fails, the collation failure message is not displayed. Therefore, it is possible to prevent the ID collation person from feeling unpleasant.

[0237] FIG. 31 is a flowchart of the passage determination process including a process of estimating whether the person 1 is moving toward the ID collation zone 303 according to Embodiment 2.

[0238] The management device 50 may perform the following passage determination process described with reference to FIG. 31 instead of the passage determination process illustrated in FIG. 23.

[0239] The management device 50 determines whether the passage permission flag is

assigned to the tracked person (S1601).

[0240] When the passage permission flag is assigned to the tracked person (S1601: YES), the management device 50 displays the message of passable on the first display device 31 (S1602), and completes this process.

5 [0241] When the passage permission flag is not assigned to the tracked person (S1601: NO), the management device 50 estimates whether the tracked person is heading for the ID collation zone 303 (S1603). Details of the estimation method will be described later.

[0242] When the management device 50 estimates that the tracked person is heading for the ID collation zone 303 (S1603: YES), the management device 50 displays the message during
10 collation on the first display device 31 (S1604), and completes this process.

[0243] When the management device 50 estimates that the tracked person is not moving toward the ID collation zone 303 (S1603: NO), the management device 50 displays the message of unauthorized passing on the first display device 31 (S1605).

[0244] The management device 50 determines whether the tracked person is a person who
15 has entered the passage determination zone 302 from the ID collation zone 303 (S1606).

[0245] When the tracked person is not a person who has entered the passage determination zone 302 from the ID collation zone 303 (S1606: NO), the management device 50 completes this process.

[0246] When the tracked person is the person who has entered the passage determination
20 zone 302 from the ID collation zone 303 (S1606: YES), the management device 50 transmits the ID collation facial image stored in the memory 1002 to the terminal of the staff member (S1607), and completes this process.

[0247] Accordingly, in the passage determination zone 302, even if the face collation of the person 1 estimated to be heading for the ID collation zone 303 fails, the collation failure
25 message is not displayed. Therefore, it is possible to prevent the ID collation person from feeling unpleasant.

[0248] <Method of Estimating Whether Person is Moving Toward ID Collation Zone>

FIG. 32 is a diagram illustrating a method of estimating whether the person 1 is heading for the ID collation zone 303 according to Embodiment 2. The management device 50
30 may estimate whether the person is moving toward the ID collation zone 303 by the following method.

[0249] The management device 50 calculates a straight line 411 connecting a detection position of the person 1 to the ID collation zone 303, and sets a movement determination zone

412 having a predetermined width LA in the gate width direction (X-axis direction) of the passage 2 with the straight line 411 as a center line.

[0250] When the person 1 is present in the movement determination zone 412 and the person 1 is moving closer to the ID collation zone 303 (that is, a distance between the position of the person 1 and the ID collation zone 303 is shortened), the management device 50 may estimate that the person 1 is heading for the ID collation zone 303. When the person 1 is out of the movement determination zone 412, the management device 50 may estimate that the person 1 is not heading for the ID collation zone 303. Even when the person 1 is present in the movement determination zone 412, when the person 1 is moving away from the ID collation zone 303 (that is, the distance between the position of the person 1 and the ID collation zone 303 is increased), the management device 50 may estimate that the person 1 is not heading for the ID collation zone 303.

[0251] The management device 50 may change the width LA of the movement determination zone 412 according to the number of persons 1 present in the detection area 3. For example, the management device 50 may set the width LA of the movement determination zone 412 when the number of persons 1 present in the detection area 3 is a first number to be wider than the width LA of the movement determination zone 412 when the number of persons 1 present in the detection area 3 is a second number smaller than the first number. This is because, when the large number of persons 1 are present in the detection area 3, the person 1 heading for the ID collation zone 303 is likely to move while avoiding the large number of persons 1, and thus it is preferable to widen the width of the movement determination band 412 to loosen an estimation tolerance. On the other hand, when not so many the person 1 are present in the detection area 3, the person 1 heading for the ID collation zone 303 is likely to move substantially straight, and thus it is preferable to narrow the width LA of the movement determination zone 412 to tighten the estimation tolerance.

[0252] Whether the person 1 is moving closer to the ID collation zone 303 may be determined, for example, as follows. That is, the management device 50 calculates the distance between the position of the person 1 and the ID collation zone 303 at regular time intervals. Then, the management device 50 compares a first average distance obtained by averaging the plurality of distances calculated in the first period with a second average distance obtained by averaging the plurality of distances calculated in a second period after the first period, and determines that the person 1 is moving closer to the ID collation zone 303 when the second average distance is shorter than the first average distance.

[0253] With the above process, it is possible to estimate whether the person 1 is heading for the ID collation zone 303.

[0254] <Display Example of Collation Results>

FIGS. 33A to 33D illustrate diagrams of a display example of collation result images according to Embodiment 2.

[0255] For example, the management device 50 may display the collation result images as illustrated in FIGS. 33A to 33D on the first display device 31 by the above-described process.

[0256] As illustrated in FIG. 33A, when the management device 50 estimates that the person 1 who is located in the face collation zone 301 and has failed in the face collation is heading for the ID collation zone 303, the management device 50 may display, on the first display device 31, a blurred image 420 obtained by blurring a facial image obtained by capturing an image of the person 1 and a message 421 during the collation. By using the blurred image 420, an image that can be distinguished by the person himself or herself but is difficult for others to distinguish can be obtained, making it possible to display the image in consideration of privacy.

[0257] As illustrated in FIG. 33B, the management device 50 may display, on the first display device 31, the blurred image 420 obtained by blurring the facial image obtained by capturing an image of the person 1 who is located in the ID collation zone 303 and for which the ID collation has not been performed, and a message 422 of waiting for ID input.

[0258] As illustrated in FIG. 33C, the management device 50 may display, on the first display device 31, the blurred image 420 obtained by blurring the facial image obtained by capturing an image of the person 1 who is located in the ID collation zone 303 and has succeeded in the ID collation, and a collation success message 423.

[0259] As illustrated in FIG. 33D, the management device 50 may display, on the first display device 31, the blurred image 420 obtained by blurring the facial image obtained by capturing an image of the person 1 and the message of passable for the person 1 who is located in the passage determination zone 302 and has succeeded in the ID collation.

[0260] Accordingly, the management device 50 can display an appropriate message indicating the situation to the ID collation person without displaying an incorrect message of unauthorized passing, and thus can prevent the ID collation person from feeling uncomfortable.

[0261] (Modifications of Gate System)

The configuration of the gate system 9 is not limited to the configuration illustrated in FIG. 1. Hereinafter, modifications of the configuration of the gate system 9 will be described.

[0262] FIG. 34 is a diagram illustrating a first modification of the gate system 9 according

to the present disclosure.

[0263] As illustrated in FIG. 34, in a passage having a ceiling, the gate system 9 may include the first image capturing devices 21 and the first display devices 31, and the second image capturing devices 22 and the second display devices 32, which are suspended from the ceiling.

5 In FIG. 34, the description of the second image capturing devices 22 and the second display devices 32 and the description of the persons 1 moving in the second direction are omitted.

[0264] FIG. 35 is a diagram illustrating a second modification of the gate system 9 according to the present disclosure.

[0265] As illustrated in FIG. 35, the gate system 9 has a tunnel-type configuration through which the persons 1 can pass, and may be an integrated device that includes the first image capturing devices 21, the first display device 31, the second image capturing devices 22, and the second display device 32 on a top surface of a tunnel. That is, the first gate 11 and the second gate 12 described above may be integrally configured. In FIG. 35, the description of the second image capturing devices 22 and the second display device 32 and the description of the persons 1 moving in the second direction are omitted. The tunnel-type gate system 9 may be fixedly installed or may be installed in any place in a movable manner.

[0266] FIG. 36 is a diagram illustrating a third modification of the gate system 9 according to the present disclosure.

[0267] As illustrated in FIG. 36, the gate system 9 does not necessarily need to have a gate shape through which the persons 1 pass, and may include a movable first set including the first image capturing device 21 and the first display device 31, and a movable second set including the second image capturing device 22 and the second display device 32. Then, the first set may be installed at a position in which the image of the face of the person 1 can be captured without interfering with the movement of the person 1 in the first direction, and the second set may be installed at a position in which the image of the face of the person 1 can be captured without interfering with the movement of the person 1 in the second direction.

[0268] (Hardware Configuration)

FIG. 37 is a diagram illustrating an example of a hardware configuration of a computer according to the present disclosure.

30 [0269] Each of the first edge device 41, the second edge device 42, the management device 50, and the face collation device 60 described above may include a computer 1000 illustrated in FIG. 32. The processes performed by the first edge device 41, the second edge device 42, the management device 50, and the face collation device 60 may be implemented by the computer

1000 illustrated in FIG. 32 executing computer programs.

[0270] The computer 1000 includes a processor 1001, the memory 1002, the storage 1003, an input device 1004, an output device 1005, a communication device 1006, a graphics processing unit (GPU) 1007, a reading device 1008, and a bus 1009. The processor 1001, the memory 1002, the storage 1003, the input device 1004, the output device 1005, the communication device 1006, the GPU 1007, and the reading device 1008 are connected to the bus 1009 and can transmit and receive data in both directions via the bus 1009.

[0271] The processor 1001 executes the computer programs stored in the memory 1002 to implement the processes performed by the devices described above. Therefore, the processes performed by the devices described above can be interpreted as processes mainly performed by the processor 1001. Examples of the processor 1001 include a central processing unit (CPU), a micro processing unit (MPU), a controller, a large scale integration (LSI), an application specific integrated circuit (ASIC), a programmable logic device (PLD), and a field-programmable gate array (FPGA).

[0272] The memory 1002 stores the computer programs and data handled by the computer 1000. The memory 1002 may include a read-only memory (ROM) and a random access memory (RAM). Further, the memory 1002 may be implemented by a volatile storage medium or a nonvolatile storage medium.

[0273] The storage 1003 is implemented by a nonvolatile storage medium, and stores the computer programs and data handled by the computer 1000. Examples of the storage 1003 include a hard disk drive (HDD), a solid state drive (SSD), and a flash memory.

[0274] The input device 1004 receives data to be input to the processor 1001. Examples of the input device 1004 include a keyboard, a mouse, a touch pad, and a microphone.

[0275] The output device 1005 outputs data generated by the processor 1001. For example, the output device 1005 outputs the display data generated by the processor 1001 to the first display device 31 or the second display device 32. Alternatively, the output device 1005 may be a display and display the display data by itself. Alternatively, the output device 1005 outputs the audio data generated by the processor 1001 to the speaker.

[0276] The communication device 1006 transmits and receives data to and from another device via the communication network 4. The communication device 1006 may include a transmitter that transmits data and a receiver that receives data. The communication device 1006 may support either wired communication or wireless communication.

[0277] The GPU 1007 is a device that processes image depiction at a high speed. The GPU

1007 may be used for AI processing (for example, machine learning or deep learning).

[0278] The reading device 1008 is a device that reads data from an external recording medium such as a digital versatile disk read only memory (DVD-ROM) or a universal serial bus (USB) memory.

5 [0279] (Summary of Present Disclosure)

The following techniques are disclosed based on the above-described description of the embodiment.

[0280] <Technique 1>

10 A person collation system including: an image capturing device (for example, a first image capturing device 21 or a second image capturing device 22) configured to capture an image of a plurality of persons moving in a predetermined passage 2; an information processing device (for example, a management device 50) configured to execute a first collation process (for example, a face collation process) of collating the person using a facial image of the person captured by the image capturing device and a second collation process (for example, an ID
15 collation process) of collating the person by another collation method different from the collation using the facial image; and a display device (for example, a first display device 31 or a second display device 32) configured to display information on a collation result of the person, in which the information processing device displays, on the display device, the information on the collation result of the person estimated as a target of the second collation process in a
20 different manner to that used when collation is performed in the first collation process.

Accordingly, the information processing device can display the information on the collation result in an appropriate manner for a person who requests collation by the other collation method.

[0281] <Technique 2>

25 In the person collation system according to Technique 1, the information processing device sets, in the passage 2, a first collation area (for example, a face collation zone 301) in which the collation using the facial image is performed and a second collation area (for example, an ID collation zone 303) in which the other collation method is performed, and estimates the person located in the second collation area as the target of the second collation process.

30 In this way, by setting the first collation area and the second collation area, the information processing device can estimate whether a person located in the passage 2 is the target of the second collation process.

[0282] <Technique 3>

In the person collation system according to Technique 2, the information processing device also performs the collation using the facial image on the person located in the second collation area.

Accordingly, a person who requests collation using the facial image can receive the collation using the facial image through the second collation area.

[0283] <Technique 4>

In the person collation system according to Technique 2 or 3, the information processing device estimates the person moving toward the second collation area as the target of the second collation process.

Accordingly, it is possible to estimate whether a person located in the passage 2 is the target of the second collation process.

[0284] <Technique 5>

In the person collation system according to Technology 4, the information processing device determines that the person closer to the second collation area without deviating from a movement determination zone, which is an area of a predetermined width connecting a position where the person is first detected to the second collation area with a straight line, is the person moving in a direction of the second collation area.

Accordingly, it is possible to estimate whether a person located in the passage 2 is the target of the second collation process.

[0285] <Technique 6>

In the person collation system according to Technique 5, the information processing device determines a width of the movement determination zone based on a number of persons present in the passage.

Accordingly, it is possible to estimate whether a person located in the passage is the target of the second collation process.

[0286] <Technique 7>

In the person collation system according to Technique 6, a width of the movement determination zone when the number of persons present in the passage 2 is a first number is wider than a width of the movement determination zone when the number of persons present in the passage is a second number smaller than the first number.

Accordingly, it is possible to estimate whether a person located in the passage 2 is the target of the second collation process.

[0287] <Technique 8>

In the person collation system according to any one of Techniques 5 to 7, the information processing device acquires a distance connecting a position of the person to the second collation area at a predetermined time interval, calculates a first average distance obtained by averaging a plurality of distances acquired in a first period and a second average distance obtained by averaging a plurality of distances acquired in a second period after the first period, and determines that the person is closer to the second collation area when the second average distance is shorter than the first average distance.

Accordingly, it is possible to estimate whether a person located in the passage 2 is the target of the second collation process.

[0288] <Technique 9>

In the person collation system according to any one of Techniques 2 to 8, when the person who failed in the collation by the first collation process is the person estimated as the target of the second collation process, the information processing device does not display, on the display device, information indicating a collation failure for the person.

Accordingly, since the information indicating the collation failure of the first collation process is not displayed for the person estimated to be the target of the second collation process, it is possible to prevent the person who requests the collation by the other collation method from feeling uncomfortable.

[0289] <Technique 10>

In the person collation system according to any one of Techniques 2 to 9, when the person estimated as the target of the second collation process succeeded in the collation by the second collation process, the information processing device displays, on the display device, information indicating a collation success for the person.

Accordingly, it is possible to notify the person estimated to be the target of the second collation process of the success of the collation by the second collation process.

[0290] <Technique 11>

In the person collation system according to any one of Techniques 2 to 10, an identification information reading device (for example, an ID reader 71) for reading identification information possessed by the person is disposed in the second collation area as a device used for the other collation method, and the information processing device performs the second collation process using the identification information read by the identification information reading device.

Accordingly, a person who requests the collation using the identification information

can cause the identification information reading device to read the identification information and receive the collation using the identification information.

[0291] <Technique 12>

5 In the person collation system according to Technique 11, when the collation is successful in the second collation process using the identification information, the information processing device stores a second collation facial image obtained by capturing an image of a face of the person who succeeded in the collation in the second collation process.

10 Accordingly, the information processing device can use the stored second collation facial image of the person who has succeeded in the collation in the second collation process in subsequent tracking processing of the person.

[0292] <Technique 13>

In the person collation system according to Technique 12, the information processing device displays the second collation facial image on a predetermined terminal different from the display device.

15 Accordingly, when the person passing through the passage is the person of the second collation facial image displayed on the terminal, a staff member carrying the terminal can determine that the person is the person who has succeeded in the collation by the other collation method.

[0293] <Technique 14>

20 In the person collation system according to Technique 13, the information processing device causes the terminal to display, together with the second collation facial image, the facial image obtained by capturing an image a first collation failed person who is the person who failed in the collation of the first collation process.

25 Accordingly, the staff member carrying the terminal can easily confirm whether there is a facial image of the same person as the second collation facial image displayed on the terminal among the facial images of the first collation failed person displayed on the terminal. When there is a facial image of the same person as the second collation facial image among the facial images of the first collation failed person, the staff member can determine that the person is a person who has succeeded in collation by the other collation method.

30 [0294] <Technique 15>

In the person collation system according to the Technique 14, when a display cancellation instruction of information indicating the collation failure of the first collation failed person is received from the terminal, the information processing device cancels the display of

the information indicating the collation failure of the first collation failed person on the display device.

Accordingly, the staff member can cancel the display of the information indicating the collation failure for the person who has succeeded in the collation by the other collation method on the display device through the terminal.

[0295] <Technique 16>

An information processing device (for example, a management device 50) including: a processor 1001 configured to execute a first collation process of collating a person using a facial image of the person captured by an image capturing device that captures an image of a plurality of the persons moving in a predetermined passage and a second collation process of collating the person by another collation method different from collation using the facial image; and an output device 1005 configured to cause a display device to display information on a collation result of the person estimated as a target of the second collation process in a different manner to that used when the collation is performed in the first collation process.

[0296] <Technique 17>

A person collation method including: executing a first collation process of collating a person using a facial image of the person captured by an image capturing device that captures an image of a plurality of the persons moving in a predetermined passage 2 and a second collation process of collating the person by another collation method different from the collation using the facial image; and displaying, on a display device, information on a collation result of the person estimated as a target of the second collation process in a different manner to that used when the collation is performed in the first collation process.

[0297] <Technique 18>

A person analysis program causes a computer to execute the person analysis method according to Technique 17.

[0298] Although the embodiment has been described above with reference to the accompanying drawings, the present disclosure is not limited thereto. It is apparent to those skilled in the art that various modifications, corrections, substitutions, additions, deletions, and equivalents can be conceived within the scope described in the claims, and it is understood that such modifications, corrections, substitutions, additions, deletions, and equivalents also fall within the technical scope of the present disclosure. In addition, components in the embodiments described above may be combined freely in a range without departing from the gist of the invention.

[0299] The present application is based on a Japanese Patent Application (Japanese Patent Application No. 2023-007266) filed on January 20, 2023, and contents thereof are incorporated herein by reference.

5 INDUSTRIAL APPLICABILITY

[0300] The technology of the present disclosure is useful when efficiently collating or authenticating a plurality of persons.

REFERENCE SIGNS LIST

- | | |
|----|--------------------------------------|
| 10 | [0301] 1 person |
| | 1A ID collation person |
| | 2 passage |
| | 3: detection area |
| | 4 communication network |
| 15 | 9 gate system |
| | 10 gate device |
| | 11 first gate |
| | 12 second gate |
| | 21 first image capturing device |
| 20 | 22 second image capturing device |
| | 31 first display device |
| | 32 second display device |
| | 41 first edge device |
| | 42 second edge device |
| 25 | 50 management device |
| | 60 face collation device |
| | 70 ID collation device |
| | 71 ID reader |
| | 100 person information |
| 30 | 102 first image capturing time point |
| | 103 image update time point |
| | 104 body image |
| | 105 body image update time point |

	106 body coordinate
	107 facial image
	108 facial image update time point
	109 face coordinate
5	110 face collation ID
	111 collation state
	112 movement direction
	200 body image
	201, 201A, 201B body coordinate
10	202 body coordinate
	220 facial image
	221, 221A face coordinate
	301 face collation zone
	302 passage determination zone
15	303 ID collation zone
	311 predetermined area closer to first gate
	312 predetermined area closer to second gate
	412 movement determination zone
	420 blurred image
20	501 station staff
	1000 computer
	1001 processor
	1002 memory
	1003 storage
25	1004 input device
	1005 output device
	1006 communication device
	1007 GPU
	1008 reading device
30	1009 bus

CLAIMS

1. A person collation system comprising:
 - an image capturing device configured to capture an image of a plurality of persons
 - 5 moving in a predetermined passage;
 - an information processing device configured to execute a first collation process of collating a person using a facial image of the person captured by the image capturing device and a second collation process of collating a person by another collation method different from collation using the facial image; and
 - 10 a display device configured to display information on a collation result of the person, wherein
 - the information processing device displays, on the display device, the information on the collation result of the person estimated as a target of the second collation process in a different manner to that used when the collation is performed in the first collation process.
 - 15
2. The person collation system according to claim 1, wherein
 - the information processing device
 - sets, in the passage, a first collation area in which the collation using the
 - facial image is performed and a second collation area in which the other collation method is
 - 20 performed, and
 - estimates the person located in the second collation area as the target of the
 - second collation process.
3. The person collation system according to claim 2, wherein
 - 25 the information processing device also performs the collation using the facial image on the person located in the second collation area.
4. The person collation system according to claim 2, wherein
 - the information processing device estimates the person moving toward the second
 - 30 collation area as the target of the second collation process.
5. The person collation system according to claim 4, wherein
 - the information processing device determines that the person closer to the second

collation area without deviating from a movement determination zone, which is an area of a predetermined width connecting a position where the person is first detected to the second collation area with a straight line, is the person moving in a direction of the second collation area.

5

6. The person collation system according to claim 5, wherein
the information processing device determines a width of the movement determination zone based on a number of persons present in the passage.

10

7. The person collation system according to claim 6, wherein
a width of the movement determination zone when the number of persons present in the passage is a first number is wider than a width of the movement determination zone when the number of persons present in the passage is a second number smaller than the first number.

15

8. The person collation system according to claim 5, wherein
the information processing device
acquires a distance connecting a position of the person to the second collation area at a predetermined time interval,
calculates a first average distance obtained by averaging a plurality of
distances acquired in a first period and a second average distance obtained by averaging a
plurality of distances acquired in a second period after the first period, and
determines that the person is closer to the second collation area when the second average distance is shorter than the first average distance.

25

9. The person collation system according to any one of claims 2 to 8, wherein
when the person who failed in the collation by the first collation process is the person estimated as the target of the second collation process, the information processing device does not display, on the display device, information indicating a collation failure for the person.

30

10. The person collation system according to any one of claims 2 to 8, wherein
when the person estimated as the target of the second collation process succeeded in the collation by the second collation process, the information processing device displays, on the display device, information indicating a collation success for the person.

11. The person collation system according to any one of claims 2 to 8, wherein
an identification information reading device for reading identification information
possessed by the person is disposed in the second collation area as a device used for the other
5 collation method, and
the information processing device performs the second collation process using the
identification information read by the identification information reading device.
12. The person collation system according to claim 11, wherein,
10 when the collation is successful in the second collation process using the
identification information, the information processing device stores a second collation facial
image obtained by capturing an image of a face of the person who succeeded in the collation in
the second collation process.
- 15 13. The person collation system according to claim 12, wherein
the information processing device displays the second collation facial image on a
predetermined terminal different from the display device.
14. The person collation system according to claim 13, wherein
20 the information processing device causes the terminal to display, together with the
second collation facial image, the facial image obtained by capturing an image a first collation
failed person who is the person who failed in the collation of the first collation process.
15. The person collation system according to claim 14, wherein
25 when a display cancellation instruction of information indicating the collation failure
of the first collation failed person is received from the terminal, the information processing
device cancels the display of the information indicating the collation failure of the first collation
failed person on the display device.
- 30 16. An information processing device comprising:
a processor configured to execute a first collation process of collating a person using
a facial image of the person captured by an image capturing device that captures an image of a
plurality of the persons moving in a predetermined passage and a second collation process of

collating the person by another collation method different from collation using the facial image;
and

an output device configured to cause a display device to display information on a
collation result of the person estimated as a target of the second collation process in a different
5 manner to that used when the collation is performed in the first collation process.

17. A person collation method comprising:

executing a first collation process of collating a person using a facial image of the
person captured by an image capturing device that captures an image of a plurality of the
10 persons moving in a predetermined passage and a second collation process of collating the
person by another collation method different from collation using the facial image; and

displaying, on a display device, information on a collation result of the person
estimated as a target of the second collation process in a different manner to that used when the
collation is performed in the first collation process.

15

18. A person collation program causing a computer to execute the person collation
method according to claim 17.