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United States Patent Application Publication   20250252782
Kind Code   A1
Publication Date   August 07, 2025
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IMAGE PROCESSING APPARATUS, CONTROL METHOD, AND NON-TRANSITORY STORAGE MEDIUM

Abstract

An image processing apparatus (**2000**) acquires a video frame (**14**), and detects a person from the acquired video frame (**14**). The image processing apparatus (**2000**) determines whether the detected person (**30**) satisfies a predetermined condition based on a permission list (**40**). The image processing apparatus (**2000**) performs, on an image region in the video frame (**14**) representing the person (**30**) determined to satisfy the predetermined condition, first treatment processing of setting the person (**30**) in a hardly identified state. The predetermined condition includes a condition that the person (**30**) is included in the permission list (**40**).

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Appl. No.:	**19/188261**
Filed:	**April 24, 2025**

Related U.S. Application Data

parent US continuation 18789906 20240731 PENDING child US 19188261
parent US continuation 17436211 20210903 parent-grant-document US 12094250 WO
continuation PCT/JP2019/009050 20190307 child US 18789906

Publication Classification

Int. Cl.:   **G06V40/20** (20220101); **G06T11/40** (20060101); **G06V40/16** (20220101)

Background/Summary

[0001] This application is a Continuation of U.S. application Ser. No. 18/789,906 filed on Jul. 31, 2024, which is a Continuation of U.S. application Ser. No. 17/436,211 filed on Sep. 3, 2021, which issued as U.S. Pat. No. 12,094,250, which is a National Stage Entry of PCT/JP2019/009050 filed on Mar. 7, 2019, the contents of all of which are incorporated herein by reference, in their entirety.

TECHNICAL FIELD
[0002] The present invention relates to image processing.
BACKGROUND ART
[0003] A system for supporting surveillance (video surveillance) of a facility and the like using a video has been developed. For example, Patent Document 1 discloses a technique for generating a video acquired by superimposing surveillance videos in different times in order to shorten a length of the surveillance video. Herein, a video in a period including a person having high reliability is excluded from a target of superimposition.
RELATED DOCUMENT
Patent Document
[0004] [Patent Document 1] Japanese Patent Application Publication No. 2010-166288
DISCLOSURE OF THE INVENTION
Technical Problem
[0005] The present inventor found out a new technique for supporting video surveillance. An object of the present invention is to provide a new technique for supporting video surveillance.
Solution to Problem
[0006] An image processing apparatus according to the present invention includes 1) a detection unit that acquires a video frame, and detects a person from the acquired video frame, 2) a determination unit that determines whether the detected person satisfies a predetermined condition based on a permission list, and 3) a first treatment processing unit that performs, on an image region in the video frame representing the person being determined to satisfy the predetermined condition, first treatment processing of setting the person in a hardly identified state. The predetermined condition includes a condition that the person is indicated in the permission list.
[0007] A control method according to the present invention is executed by a computer. The control method includes 1) a detection step of acquiring a video frame, and detecting a person from the acquired video frame, 2) a determination step of determining whether the detected person satisfies a predetermined condition based on a permission list, and 3) a first treatment processing step of performing, on an image region in the video frame representing the person being determined to satisfy the predetermined condition, first treatment processing of setting the person in a hardly identified state. The predetermined condition includes a condition that the person is indicated in the permission list.
[0008] A program according to the present invention causes a computer to execute each step included in the control method according to the present invention.
Advantageous Effects of Invention
[0009] The present invention provides a new technique for supporting video surveillance.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above-described object, the other objects, features, and advantages will become more apparent from suitable example embodiments described below and the following accompanying drawings.

[0011] FIG. **1** is a diagram illustrating an outline of an image processing apparatus according to an example embodiment 1.

[0012] FIG. **2** is a diagram illustrating a functional configuration of the image processing apparatus according to the example embodiment 1.

[0013] FIG. **3** is a diagram illustrating a computer for achieving the image processing apparatus.

[0014] FIG. **4** is a flowchart illustrating a flow of processing performed by the image processing apparatus according to the example embodiment 1.

[0015] FIG. **5** is a diagram illustrating a functional configuration of an image processing apparatus according to an example embodiment 2.

[0016] FIG. **6** is a flowchart illustrating processing performed by the image processing apparatus according to the example embodiment 2.

DESCRIPTION OF EMBODIMENTS

[0017] Hereinafter, example embodiments of the present invention will be described with reference to the drawings. Note that, in all of the drawings, a similar component has a similar reference sign, and description thereof will be appropriately omitted. Further, in each block diagram, each block represents a configuration of a functional unit instead of a configuration of a hardware unit unless otherwise described.

Example Embodiment 1

Summary of Invention

[0018] FIG. **1** is a diagram illustrating an outline of an image processing apparatus **2000** according to an example embodiment 1. A camera **10** is installed at a place to be surveyed, and generates video data **12** by performing capturing. The place to be surveyed is a facility such as an airport, a station of a railway, and a stadium, for example. Note that, the place to be surveyed is not limited to indoor, and may be an outdoor place such as a road and an outdoor facility.

[0019] The image processing apparatus **2000** detects a person from each video frame **14** constituting the video data **12**, and determines whether the detected person satisfies a predetermined condition based on a permission list **40**. Hereinafter, a person detected from the video frame **14** is also expressed as a person **30**. The predetermined condition based on the permission list **40** includes at least a condition that the "person **30** is included in the permission list **40**".

[0020] When a person **30** satisfies a predetermined condition, the image processing apparatus **2000** performs first treatment processing on an image region (hereinafter, a person region) representing the person **30**. The first treatment processing is processing of making a person hard to identify (making identification difficult). As an example of the first treatment processing, there are processing of preventing the person **30** from being included in the video frame **14** (deleting the person **30** from the video frame **14**) by superimposing a background on a person region, processing of blending a person region with a background, and the like. Note that, the first treatment processing may be performed only on a part of a person region (for example, only on a region of a face) instead of the entire person region. Details of a variation of the first treatment processing will be described later.

Advantageous Effect

[0021] The image processing apparatus **2000** according to the present example embodiment performs the first treatment processing of making a person **30** hard to identify on the person **30** who satisfies a predetermined condition based on the permission list **40** among the persons **30** detected from the video frame **14**. In this way, a person who does not satisfy the predetermined

condition based on the permission list **40** relatively becomes conspicuous. According to this method, even when the plurality of persons **30** are detected from the video frame **14**, video surveillance that focuses on a person who does not satisfy the predetermined condition based on the permission list **40** can be performed. Thus, even when the plurality of persons **30** are detected from the video frame **14**, i.e., even when the plurality of persons **30** are simultaneously included in the video data **12**, video surveillance can be facilitated.

[0022] Further, a person who dislikes to have his/her behavior being surveyed is present among persons who do not take suspicious behavior, and thus it is conceivable that video surveillance that gives consideration to privacy of such a person is also needed. In this point, the image processing apparatus **2000** according to the present example embodiment performs the first treatment processing of making identification of a person difficult on a person region of the person **30** who satisfies the predetermined condition based on the permission list **40**. In this way, video surveillance that gives consideration to privacy of a person captured by the camera **10** can be achieved by making identification difficult for the person **30** who satisfies the predetermined condition based on the permission list **40**.

[0023] Note that, the above-described description referred to FIG. **1** is exemplification for facilitating understanding of the image processing apparatus **2000**, and does not limit the function of the image processing apparatus **2000**. Hereinafter, the image processing apparatus **2000** according to the present example embodiment will be described in more detail.

Example of Functional Configuration

[0024] FIG. **2** is a diagram illustrating a functional configuration of the image processing apparatus **2000** according to the example embodiment 1. The image processing apparatus **2000** according to the example embodiment 1 includes a detection unit **2020**, a determination unit **2040**, and a first treatment unit **2060**. The detection unit **2020** acquires the video frame **14**, and detects a person **30** from the video frame **14**. The determination unit **2040** determines whether the detected person **30** satisfies a predetermined condition based on the permission list **40**. The first treatment unit **2060** performs the first treatment processing on a person region representing the person **30** determined to satisfy the predetermined condition.

Hardware Configuration of Image Processing Apparatus **2000**

[0025] Each functional component unit of the image processing apparatus **2000** may be achieved by hardware (for example, a hard-wired electronic circuit, and the like) that achieves each functional component unit, and may be achieved by a combination of hardware and software (for example, a combination of an electronic circuit and a program that controls the electronic circuit, and the like). Hereinafter, a case where each functional component unit of the image processing apparatus **2000** is achieved by the combination of hardware and software will be further described.

[0026] FIG. **3** is a diagram illustrating a computer **1000** for achieving the image processing apparatus **2000**. The computer **1000** is any computer. For example, the computer **1000** is a stationary computer such as a personal computer (PC) and a server machine. In addition, for example, the computer **1000** is a portable computer such as a smartphone and a tablet terminal. In addition, for example, the computer **1000** may be the camera **10**. In this case, the camera **10** performs processing on the video frame **14** generated by the camera **10** itself. As the camera **10** having a function of operating as the image processing apparatus **2000**, a camera referred to as an intelligent camera, a network camera, an internet protocol (IP) camera, or the like, for example, can be used.

[0027] The computer **1000** includes a bus **1020**, a processor **1040**, a memory **1060**, a storage device **1080**, an input/output interface **1100**, and a network interface **1120**. The bus **1020** is a data transmission path for allowing the processor **1040**, the memory **1060**, the storage device **1080**, the input/output interface **1100**, and the network interface **1120** to transmit and receive data with one another. However, a method of connecting the processor **1040** and the like to each other is not limited to bus connection.

[0028] The processor **1040** is various types of processors such as a central processing unit (CPU), a graphics processing unit (GPU), and a field-programmable gate array (FPGA). The memory **1060** is a main storage apparatus achieved by using a random access memory (RAM) and the like. The storage device **1080** is an auxiliary storage apparatus achieved by using a hard disk, a solid state drive (SSD), a memory card, a read only memory (ROM), or the like.

[0029] The input/output interface **1100** is an interface for connecting the computer **1000** and an input/output device. For example, an input apparatus such as a keyboard and an output apparatus such as a display apparatus are connected to the input/output interface **1100**.

[0030] The network interface **1120** is an interface for connecting the computer **1000** to a communication network. The communication network is, for example, a local area network (LAN) and a wide area network (WAN). A method of connection to the communication network by the network interface **1120** may be wireless connection or wired connection.

[0031] For example, the computer **1000** is communicably connected to the camera **10** via a network. However, a method of communicably connecting the computer **1000** to the camera **10** is not limited to connection via a network. Further, the computer **1000** may not be communicably connected to the camera **10**.

[0032] The storage device **1080** stores a program module that achieves each functional component unit of the image processing apparatus **2000**. The processor **1040** achieves a function associated with each program module by reading each of the program modules to the memory **1060** and executing the program module.

With Regard to Camera **10**

[0033] The camera **10** is any camera that generates the video data **12** by performing capturing. The video data **12** are time-series data constituted by the plurality of video frames **14**. The camera **10** may be a camera having a fixed position (hereinafter, a fixed camera), and may be a camera having a position that is not fixed (hereinafter, a mobile camera). The fixed camera is a camera fixed and installed at various places such as a wall, a pillar, or a ceiling. A place where the fixed camera is installed may be indoor and outdoor.

[0034] Note that, a wall and the like on which the fixed camera is installed may be fixed in a position for a certain period of time, and is not limited to being fixed in a way that they are not movable. For example, a wall and the like on which the fixed camera is installed may be a partition, a pillar, and the like being temporarily installed at an event site and the like.

[0035] In addition, for example, a moving body equipped with a camera that is also usable as a mobile camera described later may be stopped at a certain place, and the camera may be used as a fixed camera. The moving body is, for example, a car, a motorcycle, a robot, a flying object (such as a drone and an airship), or the like.

[0036] The mobile camera is, for example, a camera worn by a person or attached to the moving body described above and the like. The mobile camera worn by a person is, for example, a camera (a video camera and a camera of a portable terminal such as a smartphone) held by a hand, a camera (such as a wearable camera) fixed on a head, a chest, or the like, or the like. The camera attached to a car, a motorcycle, a robot, a flying object, or the like may be a camera attached for being used as a so-called drive recorder, and may be a camera attached separately for generating the video data **12** to be provided to the image processing apparatus **2000**.

Flow of Processing

[0037] FIG. **4** is a flowchart illustrating a flow of processing performed by the image processing apparatus **2000** according to the example embodiment 1. Note that, a series of processing illustrated in the flowchart in FIG. **4** is performed on each video frame **14** constituting the video data **12**.

[0038] The detection unit **2020** acquires the video frame **14** (S**102**). The detection unit **2020** detects the person **30** from the video frame **14** (S**104**).

[0039] S**106** to S**112** constitute loop processing A performed on each of the persons **30** detected from the video frame **14**. In S**106**, the image processing apparatus **2000** determines whether the

loop processing A has already been performed on all of the persons **30** as a target. When the loop processing A has already been performed on all of the persons **30** as a target, the processing in FIG. **4** proceeds to S**114**. On the other hand, when the person **30** that has not yet been a target of the loop processing A is present, the image processing apparatus **2000** selects one of the persons **30**. The person **30** selected herein is expressed as a person i. After the selection of the person i is performed, the processing in FIG. **4** proceeds to S**108**.

[0040] The determination unit **2040** determines whether the person i satisfies a predetermined condition based on the permission list **40** (S**108**). When the person i satisfies the predetermined condition (S**108**: YES), the first treatment unit **2060** performs the first treatment processing on a person region representing the person i (S**110**). S**112** is an end of the loop processing A, and thus the processing in FIG. **4** proceeds to S**106**.

[0041] After the loop processing A is finished, the image processing apparatus **2000** outputs the video frame **14** after the treatment (S**114**).

Acquisition of Video Frame **14**: S**102**

[0042] The detection unit **2020** acquires the video frame **14** (S**102**). Various methods of acquiring the video frame **14** by the detection unit **2020** can be used. For example, the detection unit **2020** acquires the video frame **14** by receiving the video frame **14** transmitted from the camera **10**. In addition, for example, the detection unit **2020** may access the camera **10**, and acquire the video frame **14** stored in the camera **10**. Note that, the camera **10** may store the video frame **14** in a storage apparatus provided outside the camera **10**. In this case, the detection unit **2020** acquires the video frame **14** by accessing the storage apparatus.

[0043] When the camera **10** has a function of the image processing apparatus **2000** (when the camera **10** is used as the computer **1000**), the detection unit **2020** acquires the video frame **14** stored in a storage apparatus (for example, the memory **1060** and the storage device **1080** in FIG. **2**) inside the camera **10**.

[0044] As described above, the video frame **14** constitutes the video data **12**. The detection unit **2020** may acquire, on a one-by-one basis, the video frame **14** constituting the video data **12**, and may collectively acquire the plurality of the video frame **14**. For example, each time a new video frame **14** is generated, the detection unit **2020** acquires the video frame **14**. In addition, for example, the detection unit **2020** collectively acquires, once in a predetermined period of time, the video frame **14** that has not yet been acquired.

Detection of Person **30**: S**104**

[0045] The detection unit **2020** detects the person **30** from the video frame **14** (S**104**). An existing technique can be used as a technique for detecting a person from an image.

[0046] Herein, the detection unit **2020** performs management of each person **30** detected from each video frame **14**. To do so, for example, the detection unit **2020** assigns an identifier to each person **30**. At this time, an identifier assigned when a person **30** is detected from a past video frame **14** is used for the person **30** being already detected from the past video frame **14**. Meanwhile, a new identifier is assigned to a person **30** being newly detected. As a technique for assigning an identifier to an object detected from each video frame constituting video data and managing the object in such a manner, an existing technique used for tracking and the like can be used.

[0047] For example, management of the person **30** detected from the video frame **14** is performed by generating information in which an identifier assigned to the person **30** and an image feature (feature value on an image) acquired from a person region representing the person **30** are associated with each other. Hereinafter, the information is referred to as person management information. Note that, various kinds of image features can be adopted for an image feature usable for identification of a person.

Determination of Whether Predetermined Condition is Satisfied: S**108**

[0048] The determination unit **2040** determines whether the person **30** satisfies a predetermined condition based on the permission list **40** (S**108**). The permission list **40** is previously stored in a

storage apparatus that can be accessed from the image processing apparatus **2000**. The permission list **40** indicates information that can identify a person. For example, the information is an image feature of a person.

[0049] As described above, the predetermined condition includes at least a condition that the "person **30** is included in the permission list **40**". In order to determine whether the condition is satisfied, the determination unit **2040** compares an image feature (image feature acquired from a person region representing the person **30**) of the person **30** with an image feature of each person indicated in the permission list **40**. When the permission list **40** indicates an image feature similar to an image feature of the person **30**, the determination unit **2040** determines that the condition that the "person **30** is included in the permission list **40**" is satisfied. On the other hand, when the permission list **40** does not indicate an image feature similar to an image feature of the person **30**, the determination unit **2040** determines that the condition that the "person **30** is included in the permission list **40**" is not satisfied.

[0050] Determination of whether an image feature of the person **30** is similar to an image feature indicated in the permission list **40** is performed by, for example, computing a degree of similarity therebetween, and determining whether the degree of similarity is equal to or more than a predetermined value. An existing technique can be used as a technique for computing a degree of similarity between image features.

Other Condition 1: Place

[0051] The predetermined condition may further include a condition related to a place where the person **30** is captured. In this case, an image feature of the person **30** and identification information about the place are associated with each other in the permission list **40**. Then, as the predetermined condition, an AND condition of two conditions that 1) an image feature similar to an image feature of the person **30** detected from the video frame **14** is included in the permission list **40**, and 2) a place associated with the image feature in the permission list **40** coincides with a place where the person **30** is captured is used.

[0052] Thus, when an image feature similar to an image feature of the person **30** detected from the video frame **14** is included in the permission list **40**, the determination unit **2040** compares an identifier of a place associated with the image feature with an identifier of a place where the person **30** is captured. Then, when the identifier of the place associated with the image feature in the permission list **40** coincides with the identifier of the place where the person **30** is captured, the determination unit **2040** determines that the person **30** satisfies the predetermined condition. On the other hand, when the identifiers of the places do not coincide with each other, the determination unit **2040** determines that the person **30** does not satisfy the predetermined condition. Further, when an image feature similar to an image feature of the person **30** is not included in the permission list **40**, the determination unit **2040** also determines that the person **30** does not satisfy the predetermined condition.

[0053] A place where the person **30** is captured is determined by an installation place of the camera **10** that generates the video frame **14** including the person **30**. For example, for each camera **10**, information (hereinafter, camera information) in which an identifier of the camera **10** and an identifier of an installation place of the camera **10** are associated with each other is previously stored in a storage apparatus that can be accessed from the image processing apparatus **2000**. The image processing apparatus **2000** acquires, in association with the video frame **14**, an identifier (hereinafter, a camera identifier) of the camera **10** that generates the video frame **14**. Then, the image processing apparatus **2000** acquires, by using the camera information, an identifier of an installation place being associated with the camera identifier of the camera **10** associated with the video frame **14**, and uses the identifier of the installation place as an identifier of a place where the person **30** to be detected from the video frame **14** is captured. Note that, when the camera **10** functions as the image processing apparatus **2000**, the camera **10** uses a camera identifier assigned to the camera **10** itself as an identifier of a place where the person **30** detected from the video frame

14 is captured.

[0054] In this way, necessity and importance of surveillance of a person can be determined for each place by taking a place where the person **30** is captured into consideration. For example, when a person is registered in the permission list **40** by a prior application as described later, it is conceivable to make the application that specifies a place. In this case, it is conceivable that necessity of surveillance of a person for whom a prior application is made is low at an applied place, whereas it is conceivable that necessity of surveillance of the person is not low at a place other than the applied place. Thus, for example, a person and a place for which a prior application is made are associated with each other in the permission list **40**. In this way, the first treatment processing can be performed, for the person, only on the video frame **14** acquired at the place for which the prior application is made.

Other Condition 2: Level

[0055] In addition, for example, the predetermined condition may include a condition related to a comparison between a level of the person **30** and a level of a place where the person **30** is captured. In this case, for each place, a level representing importance of surveillance of the place is associated. Furthermore, an image feature of each person **30** and a level of the person **30** are associated with each other in the permission list **40**. Then, as the predetermined condition, an AND condition of two conditions that 1) an image feature similar to an image feature of the person **30** detected from the video frame **14** is included in the permission list **40**, and 2) a level associated with the image feature in the permission list **40** is equal to or more than a level of a place where the person **30** is captured is used.

[0056] Thus, when an image feature similar to an image feature of the person **30** detected from the video frame **14** is included in the permission list **40**, the determination unit **2040** compares a level associated with the image feature with a level of a place where the person **30** is captured. Then, when the level associated with the image feature of the person **30** is equal to or more than the level of the place where the person **30** is captured, the determination unit **2040** determines that the person **30** satisfies the predetermined condition. On the other hand, when the level associated with the image feature of the person **30** is lower than the level of the place where the person **30** is captured, the determination unit **2040** determines that the person **30** does not satisfy the predetermined condition. Further, when an image feature similar to an image feature of the person **30** is not included in the permission list **40**, the determination unit **2040** also determines that the person **30** does not satisfy the predetermined condition.

[0057] For example, a level of a place is set for each camera **10**. In other words, camera information in which an identifier of the camera **10** and a level of a place where the camera **10** is installed are associated with each other is prepared. The determination unit **2040** acquires camera information about the camera **10** that generates the video frame **14**, and uses a level indicated in the camera information as a level of a place where the person **30** detected from the video frame **14** is captured.

[0058] For example, a level of a place represents importance of surveillance of the place, and a level of a person represents a degree of necessity (reliability of the person) of surveillance of the person. In this way, whether the first treatment processing is performed for each person can be determined by weighing up the importance of the place and the reliability of the person.

[0059] For example, a level of a person is set according to a kind and an amount of personal information provided from the person. For example, a level of a person who provides biometric information (information about a face, a fingerprint, a vein, an iris, or the like) usable for biometric authentication is set higher than a level of a person who provides only simple information such as a name, an address, and an SNS account. Further, it is conceivable that a higher level is set for a person who also provides information about his/her family in addition to information about himself/herself.

Cache of Determination Result

[0060] For a person **30** on which determination of the predetermined condition is already performed when the person **30** is detected from a past video frame **14**, the determination may be omitted. For example, when determination of whether a certain person **30** satisfies the predetermined condition is performed, the determination unit **2040** records a cache representing a result of the determination in person management information described above. In other words, in association with an identifier of the person **30** on which determination of the predetermined condition is performed, a result of the determination is recorded in person management information.

[0061] When the determination unit **2040** determines whether the person **30** detected from the video frame **14** satisfies the predetermined condition, the determination unit **2040** determines whether a cache of a determination result is present by first referring to person management information about the person **30**. When the cache is present, the determination unit **2040** uses the determination result indicated in the cache. On the other hand, when the cache is not present, the determination unit **2040** performs, by the method described above, determination of whether the predetermined condition is satisfied.

[0062] By using a cache of a determination result in such a manner, time required for determination of whether the predetermined condition is satisfied can be reduced.

[0063] Note that, when a condition such as a place and a level is included in the predetermined condition, a cache of a determination result also includes information representing which place the determination is performed on. In other words, a combination of an "identifier of a place where the person **30** is captured and a determination result" is recorded, in person management information, in association with an identifier of the person **30** on which determination of the predetermined condition is performed.

[0064] In this way, determination processing of whether the person **30** satisfies the predetermined condition can be omitted when the person **30** appears at the same place for a plurality of times, whereas the determination processing for a new place can be performed when the person **30** appears at the new place. Thus, while the determination processing for each place can be achieved, time required for the determination processing can be reduced.

First Treatment Processing: S**110**

[0065] When it is determined that the person **30** satisfies the predetermined condition based on the permission list **40** (S**108**: YES), the first treatment unit **2060** performs the first treatment processing on a person region representing the person **30** (S**110**). As described above, the first treatment processing is processing of making a person hard to identify. Particularly, it is suitable to perform processing of making identification of a face difficult. Hereinafter, a variation of the first treatment processing is illustrated. Note that, treatment described later may be performed only on a part of a person region, such as only on a region of a face.

Deletion Processing

[0066] For example, the first treatment unit **2060** performs, as the first treatment processing, processing of deleting a person region representing the person **30** from the video frame **14**. Deletion of a person region is achieved by superimposing an image of a background on the person region, for example. The image of a background can be extracted from the video frame **14** that does not include the person **30**, for example. The video frame **14** that does not include the person **30** is previously stored in a storage apparatus that can be accessed from the first treatment unit **2060**.

[0067] The first treatment unit **2060** may replace a person region with anything other than a background. For example, as such processing, there are processing of filling a person region with a predetermined color, processing of replacing a person region with a background and then superimposing a predetermined mark on the portion, and the like. By performing filling and superimposition of a mark, a person who views the video frame **14** cannot identify the person **30**, but can recognize that there is a person in the portion.

[0068] Herein, the color and the mark described above may be used commonly to all persons, and

may be determined according to an attribute of a person. As the attribute of a person, for example, there are gender, an age group, and the like. By using a color and a mark varying for each attribute, such as gender and an age group, in such a manner, a person who views the video frame **14** cannot identify the person **30**, but can recognize what kind of a person is present. Video surveillance may be used for not only recognizing a dangerous person but also for recognizing a person who needs help, and thus it is preferable that an attribute of a person can be recognized from the video frame **14** in such a manner. Note that, information in which a color and a mark are associated with an attribute of a person is previously prepared in a storage apparatus that can be accessed from the first treatment unit **2060**.

Blending of a Background

[0069] In addition, for example, the first treatment unit **2060** performs, as the first treatment processing, processing of blending a person region representing the person **30** and a background. In this way, the background can be viewed through the person region (the person region becomes semitransparent). As processing of making a background visible through an object such as a person by blending an image region representing the object and the background in such a manner, an existing technique can be used.

Other Processing

[0070] In addition, for example, the first treatment unit **2060** may add, as the first treatment processing, any processing of making the person **30** hard to identify, such as processing of putting mosaic, processing of making it blurry, processing of reducing a resolution, processing of adding random noise, or the like, to a person region representing the person **30**.

Output of Result: S**114**

[0071] The image processing apparatus **2000** outputs the video frame **14** after the treatment (S**114**). Herein, the image processing apparatus **2000** successively performs the processing on each video frame **14** constituting the video data **12**, and outputs a result. In this way, the video data **12** constituted by the video frame **14** after the treatment are output.

[0072] There are various output destinations of the video frame **14**. For example, the image processing apparatus **2000** outputs the video frame **14** to a display apparatus. For example, the display apparatus is viewed by a supervisor and the like. In addition, for example, the image processing apparatus **2000** may output the video frame **14** to a storage apparatus that can be accessed from each terminal being used for viewing the video data **12**. In this way, the video data **12** constituted by the video frame **14** subjected to the treatment by the image processing apparatus **2000** can be viewed from various terminals.

With Regard to Method of Generating Permission List **40**

[0073] The permission list **40** can be generated by any method. Hereinafter, a functional configuration unit that generates the permission list **40** is referred to as a permission list generation unit. The permission list generation unit may be provided in the image processing apparatus **2000**, and may be provided in an apparatus other than the image processing apparatus **2000**. When the permission list generation unit is provided in an apparatus other than the image processing apparatus **2000**, a hardware configuration of the apparatus can be similar to the hardware configuration of the image processing apparatus **2000** (see FIG. **3**).

[0074] For example, the permission list generation unit receives a use application in advance from a person who desires to use a facility to be surveyed and the like, adds information related to the person to the permission list **40** according to the application, and thus generates and updates the permission list **40**. An image feature of a person to be included in the permission list **40** is extracted from a picture attached to a use application, for example.

[0075] In addition, for example, a gate may be provided at a place to be surveyed, and an application for entering the gate may be received near the gate. For example, an apparatus that receives an input of a name and an address, and an apparatus that receives registration (such as photographing of a face picture or reading of a fingerprint and an iris) of biometric information are

installed near a gate. Then, an application for an entry into the gate is received by registration of personal information using the apparatuses. For example, the permission list generation unit generates the permission list **40** indicating a person who registers personal information herein. At this time, the permission list generation unit sets the level described above for a person who makes an application in the permission list **40** according to a kind and an amount of registered personal information. In this way, determination using the predetermined condition including the "other condition 2" described above can be performed.

[0076] Note that, the gate described above may be provided at not only an entrance of a facility but also at each gateway of a place having different importance of surveillance in the facility, and an entry application may be made at each place. In the permission list **40**, a place where an entry application of a person is made is associated, in association with the person. In this way, determination using the predetermined condition including the "other condition 1" described above can be performed.

Example Embodiment 2

[0077] An image processing apparatus **2000** according to an example embodiment 2 performs, on a person region of a person **30** determined not to satisfy a predetermined condition based on a permission list **40**, second treatment processing based on a degree of suspiciousness of the person **30**. The second treatment processing is treatment processing for further facilitating surveillance of the person **30** having a higher degree of suspiciousness. For example, the second treatment processing is emphasis processing (such as superimposition of a frame) for a person region of the person **30** having a high degree of suspiciousness. In addition, for example, the second treatment processing may be processing similar to the first treatment processing described above being performed on the person **30** having a low degree of suspiciousness. A degree of suspiciousness is determined based on a result of a behavior analysis performed in advance.

[0078] The image processing apparatus **2000** according to the present example embodiment further facilitates surveillance of the person **30** having a higher degree of suspiciousness among the persons **30** determined not to satisfy the predetermined condition based on the permission list **40**. In this way, in a case where many persons who do not satisfy the predetermined condition based on the permission list **40** (for example, persons who have not made a prior use application) are included in a video frame **14**, a person having a higher degree of suspiciousness can be more easily surveyed.

[0079] Hereinafter, the image processing apparatus **2000** according to the present example embodiment will be described in more detail.

Example of Functional Configuration

[0080] FIG. **5** is a diagram illustrating a functional configuration of the image processing apparatus **2000** according to the example embodiment 2. The image processing apparatus **2000** according to the example embodiment 2 further includes a second treatment unit **2080**. The second treatment unit **2080** determines a degree of suspiciousness of the person **30** determined not to satisfy the predetermined condition based on the permission list **40**, and performs, on a person region representing the person **30** in the video frame **14**, the second treatment processing based on the degree of suspiciousness of the person **30**.

Example of Hardware Configuration

[0081] A hardware configuration of a computer that achieves the image processing apparatus **2000** according to the example embodiment 2 is represented in FIG. **3**, for example, similarly to the example embodiment 1. However, a program module that achieves a function of the image processing apparatus **2000** according to the present example embodiment is stored in a storage device **1080** of a computer **1000** that achieves the image processing apparatus **2000** according to the present example embodiment.

Flow of Processing

[0082] FIG. **6** is a flowchart illustrating processing performed by the image processing apparatus

2000 according to the example embodiment 2. The flowchart in FIG. **6** is the same as the flowchart in FIG. **4** except for a point that steps described below are included.

[0083] When it is determined that a person i does not satisfy the predetermined condition based on the permission list **40** (S**108**: NO), the second treatment unit **2080** determines a degree of suspiciousness of the person i (S**202**). The second treatment unit **2080** performs, based on the degree of suspiciousness of the person i, the second treatment processing on a person region representing the person i (S**204**).

Determination of Degree of Suspiciousness: S**202**

[0084] The second treatment unit **2080** determines a degree of suspiciousness of the person **30** (S**202**). The degree of suspiciousness of the person **30** is determined based on behavior of the person **30** at a facility to be surveyed and the like, for example. Specifically, a behavior analysis of each captured person is previously performed by using video data **12** generated by each camera **10** set at a place to be surveyed. In the behavior analysis, a degree of suspiciousness of each person is computed based on suspicious behavior such as loitering, dwelling, and abandonment of baggage, for example. The computed degree of suspiciousness is included in person management information described above. In this case, the second treatment unit **2080** determines the degree of suspiciousness of the person **30** by referring to the person management information about the person **30**.

[0085] In addition, for example, a degree of suspiciousness of the person **30** may be computed by analyzing behavior of the person **30** on the Internet. The behavior on the Internet is, for example, a post, a message, and the like in a social networking service (SNS). For example, a system in which, "when there is a person who writes a suspicious post or a suspicious message on the Internet, information in which a history of the suspicious behavior and a face picture of the person are associated with each other is provided" is previously created. Such a system can be created by cooperating with an administrator of an SNS, for example.

[0086] For example, information (hereinafter, a refusal list) in which a degree of suspiciousness and an image feature of a person are associated with each other is generated by an analysis of behavior on the Internet. The generated refusal list is stored in a storage apparatus that can be accessed from the second treatment unit **2080**. The generation of the refusal list may be performed by the image processing apparatus **2000**, and may be performed by another apparatus.

[0087] Herein, there may be a case where the person **30** detected from the video frame **14** is not included in the refusal list. In this case, the second processing unit **2080** sets a predetermined low degree of suspiciousness (for example, a degree of suspiciousness=0) for the person **30**.

[0088] Note that, a degree of suspiciousness based on a behavior analysis using the video data **12** and a degree of suspiciousness indicated in the refusal list may be used together. For example, the second treatment unit **2080** determines a degree of suspiciousness of the person **30** from a statistic (such as weighted addition and a maximum value) of the two degrees of suspiciousness.

Second Treatment Processing: S**204**

[0089] The second treatment unit **2080** performs, based on the degree of suspiciousness of the person **30**, the second treatment processing on a person region representing the person **30** (S**204**). For example, the second treatment processing is processing of making the person **30** having a higher degree of suspiciousness more conspicuous (emphasizing the person **30** having a higher degree of suspiciousness). For example, the second treatment unit **2080** superimposes a frame and a mark on a person region of the person **30** having a degree of suspiciousness equal to or more than a threshold value. Further, a color and a shape of a frame and a mark may be determined according to a level of a degree of suspiciousness. For example, a frame is made thicker as a degree of suspiciousness is higher, and a color of a frame is set to be a more conspicuous color as a degree of suspiciousness is higher.

[0090] In addition, for example, the second treatment processing may be processing of making the person **30** having a lower degree of suspiciousness less conspicuous. For example, the second

treatment unit **2080** performs processing (processing of reducing opacity) of blending, with a background, a person region of the person **30** having a degree of suspiciousness equal to or less than a predetermined threshold value.

[0091] While the example embodiments of the present invention have been described with reference to the drawings, the example embodiments are only exemplification of the present invention, and a configuration that combines the example embodiments described above and various configurations other than the above-described example embodiments can also be employed.

[0092] The whole or part of the example embodiments described above can be described as, but not limited to, the following supplementary notes. [0093] 1. An image processing apparatus, including: [0094] a detection unit that acquires a video frame, and detects a person from the acquired video frame; [0095] a determination unit that determines whether the detected person satisfies a predetermined condition based on a permission list; and [0096] a first treatment processing unit that performs, on an image region in the video frame representing the person being determined to satisfy the predetermined condition, first treatment processing of setting the person in a hardly identified state, wherein [0097] the predetermined condition includes a condition that the person is indicated in the permission list. [0098] 2. The image processing apparatus according to supplementary note 1, wherein [0099] the permission list associates a person and a place with each other, and [0100] the predetermined condition further includes a condition that a place where the detected person is captured is associated with the person in the permission list. [0101] 3. The image processing apparatus according to supplementary note 1, wherein [0102] the permission list associates a person and a level with each other, and [0103] the predetermined condition includes a condition that a level associated with the detected person is equal to or more than a surveillance level of a place where the detected person is captured. [0104] 4. The image processing apparatus according to supplementary note 3, wherein [0105] a level indicated in association with the person in the permission list is determined by either one or both of an amount and a kind of personal information provided by the person. [0106] 5. The image processing apparatus according to supplementary notes 1 to 4, wherein [0107] the first treatment processing is any one of [0108] processing of replacing an image region representing the person with a background, [0109] processing of filling an image region representing the person with a predetermined color, [0110] processing of replacing an image region representing the person with a background, and superimposing a predetermined mark on the image region, and [0111] processing of blending an image region representing the person with a background. [0112] 6. The image processing apparatus according to any one of supplementary notes 1 to 5, further including [0113] a second treatment processing unit that determines a degree of suspiciousness of the person being determined not to satisfy the predetermined condition, and performs, on an image region representing the person in the video frame, second treatment processing based on the determined degree of suspiciousness. [0114] 7. The image processing apparatus according to supplementary note 6, wherein [0115] a degree of suspiciousness of the person is determined by any one or more of an analysis of behavior of the person at a place to be surveyed, and an analysis of behavior of the person on the Internet. [0116] 8. The image processing apparatus according to supplementary note 6 or 7, wherein [0117] the second treatment processing is emphasis processing being performed on an image region representing the person having the degree of suspiciousness equal to or more than a threshold value, or processing of making a person hard to identify being performed on an image region representing the person having the degree of suspiciousness smaller than a threshold value. [0118] 9. A control method executed by a computer, including: [0119] a detection step of acquiring a video frame, and detecting a person from the acquired video frame; [0120] a determination step of determining whether the detected person satisfies a predetermined condition based on a permission list; and [0121] a first treatment processing step of performing, on an image region in the video frame representing the person being determined to satisfy the predetermined condition, first treatment processing of setting the person in a hardly identified state, wherein [0122] the

predetermined condition includes a condition that the person is indicated in the permission list. [0123] 10. The control method according to supplementary note 9, wherein [0124] the permission list associates a person and a place with each other, and [0125] the predetermined condition further includes a condition that a place where the detected person is captured is associated with the person in the permission list. [0126] 11. The control method according to supplementary note 9, wherein [0127] the permission list associates a person and a level with each other, and [0128] the predetermined condition includes a condition that a level associated with the detected person is equal to or more than a surveillance level of a place where the detected person is captured. [0129] 12. The control method according to supplementary note 11, wherein [0130] a level indicated in association with the person in the permission list is determined by either one or both of an amount and a kind of personal information provided by the person. [0131] 13. The control method according to supplementary notes 9 to 12, wherein [0132] the first treatment processing is any one of [0133] processing of replacing an image region representing the person with a background, [0134] processing of filling an image region representing the person with a predetermined color, [0135] processing of replacing an image region representing the person with a background, and superimposing a predetermined mark on the image region, and [0136] processing of blending an image region representing the person with a background. [0137] 14. The control method according to any one of supplementary notes 9 to 13, further including [0138] a second treatment processing step of determining a degree of suspiciousness of the person being determined not to satisfy the predetermined condition, and performing, on an image region representing the person in the video frame, second treatment processing based on the determined degree of suspiciousness. [0139] 15. The control method according to supplementary note 14, wherein [0140] a degree of suspiciousness of the person is determined by any one or more of an analysis of behavior of the person at a place to be surveyed, and an analysis of behavior of the person on the Internet. [0141] 16. The control method according to supplementary note 14 or 15, wherein [0142] the second treatment processing is emphasis processing being performed on an image region representing the person having the degree of suspiciousness equal to or more than a threshold value, or processing of making a person hard to identify being performed on an image region representing the person having the degree of suspiciousness smaller than a threshold value. [0143] 17. A program causing a computer to execute each step of the control method according to any one of supplementary notes 9 to 16.

Claims

1. An image processing apparatus comprising: at least one memory storing instructions; and at least one processor configured to execute the instructions to: detect a person from at least one acquired video frame; determine a degree of suspiciousness of the detected person; in a case in which the degree is equal to or more than a threshold value, emphasize an image region including the detected person; and in a case in which the degree is smaller than the threshold value, make the detected person more difficult to identify in the image region.

2. The image processing apparatus according to claim 1, wherein the at least one processor is further configured to execute the instructions to detect a predetermined person from a plurality of video frames captured in a plurality of places, and in a case in which the predetermined person is detected in a first video frame captured in a predetermined place among the plurality of places, perform a treatment of making the detected predetermined person more difficult to identify in the first video frame.

3. The image processing apparatus according to claim 2, wherein the at least one processor is further configured to execute the instructions to, in a case in which the predetermined person is detected in a second video frame captured in a place different from the predetermined place, do not perform the treatment of making the detected predetermined person more difficult to identify in the second video frame.

4. The image processing apparatus according to claim 2, wherein the predetermined place is registered in advance for each of the predetermined person.

5. The image processing apparatus according to claim 1, wherein the at least one processor is further configured to execute the instructions to detect a predetermined person from a plurality of video frames captured in a plurality of places, and in a case in which the predetermined person is detected in a first video frame captured in a first place among the plurality of places, perform a treatment of making the detected predetermined person more difficult to identify in the first video frame, the first place having a level lower than a standard level.

6. The image processing apparatus according to claim 5, wherein the at least one processor is further configured to execute the instructions to, in a case in which the predetermined person is detected in a second video frame captured in a second place among the plurality of places, do not perform the treatment of making the detected predetermined person more difficult to identify in the second video frame, the second place having a level higher than the standard level.

7. The image processing apparatus according to claim 5, wherein the standard level is set in advance for each of the predetermined person.

8. The image processing apparatus according to claim 5, wherein the at least one processor is further configured to execute the instructions to set the standard level for each of the predetermined person according to a kind or an amount of personal information provided from the predetermined person.

9. The image processing apparatus according to claim 8, wherein the standard level of the predetermined person who provides biometric information is higher than the standard level of the predetermined person who does not provide biometric information.

10. The image processing apparatus according to claim 8, wherein the standard level of the predetermined person who provides information about his or her family is higher than the standard level of the predetermined person who does not provide information about his or her family.

11. The image processing apparatus according to claim 5, wherein the level of each of the places is set in advance.

12. The image processing apparatus according to claim 5, wherein the at least one processor is further configured to execute the instructions to set the level of each of the places according to importance of the place.

13. An image processing method executed by a computer, the method comprising: detecting a person from at least one acquired video frame; determining a degree of suspiciousness of the detected person; in a case in which the degree is equal to or more than a threshold value, emphasizing an image region including the detected person; and in a case in which the degree is smaller than the threshold value, making the detected person more difficult to identify in the image region.

14. The image processing method according to claim 13, wherein the computer detects a predetermined person from a plurality of video frames captured in a plurality of places, and in a case in which the predetermined person is detected in a first video frame captured in a predetermined place among the plurality of places, performs a treatment of making the detected predetermined person more difficult to identify in the first video frame.

15. The image processing method according to claim 14, wherein computer, in a case in which the predetermined person is detected in a second video frame captured in a place different from the predetermined place, does not perform the treatment of making the detected predetermined person more difficult to identify in the second video frame.

16. The image processing method according to claim 14, wherein the predetermined place is registered in advance for each of the predetermined person.

17. A non-transitory computer-readable medium storing a program that causes a computer to: detect a person from at least one acquired video frame; determine a degree of suspiciousness of the detected person; in a case in which the degree is equal to or more than a threshold value, emphasize

an image region including the detected person; and in a case in which the degree is smaller than the threshold value, make the detected person more difficult to identify in the image region.

18. The non-transitory computer-readable medium according to claim 17, wherein the program causes the computer to detect a predetermined person from a plurality of video frames captured in a plurality of places, and in a case in which the predetermined person is detected in a first video frame captured in a predetermined place among the plurality of places, perform a treatment of making the detected predetermined person more difficult to identify in the first video frame.

19. The non-transitory computer-readable medium according to claim 18, wherein the program causes the computer to, in a case in which the predetermined person is detected in a second video frame captured in a place different from the predetermined place, do not perform the treatment of making the detected predetermined person more difficult to identify in the second video frame.

20. The non-transitory computer-readable medium according to claim 18, wherein the predetermined place is registered in advance for each of the predetermined person.