

TITLE OF THE INVENTION

VIDEO MONITORING APPARATUS, DISPLAY CONTROL METHOD, AND
VIDEO MONITORING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to a video monitoring apparatus, a display control method, and a video monitoring system.

2. Description of the Related Art

[0002]

Conventionally, there is generally installed a video monitoring system that transmits information for reporting the situation of a building from a management server of the building to a mobile terminal carried by a worker and performs monitoring activities. In the conventional system, when the occurrence of an abnormality in a building to be monitored is detected, the situation of a place where the abnormality has occurred is transmitted to the terminal possessed by a worker by e-mail, and the abnormality of the building can be grasped by displaying both character information and image information. However, there is a problem that a worker cannot arbitrarily designate a camera installed in a building or designate a date and time when

the designated camera has photographed to display image information, and a situation around a place where an abnormality has occurred and a situation before and after the occurrence of the abnormality cannot be grasped.

[0003]

Accordingly, JP 2016-219923 A discloses a technique for an administrator to quickly check a place where an abnormality has occurred. JP 2016-219923 A discloses a video monitoring system in which a worker operates a mobile terminal including a mobile terminal operation unit that receives an operation to designate a specific camera from a plurality of cameras and a mobile terminal display control unit that displays video data received from a video distribution server via a network on a video display unit, thereby causing the video display unit of the mobile terminal to display video data captured at a capturing date and time when the specific camera is designated.

[0004]

SUMMARY OF THE INVENTION

[0005]

The mobile terminal disclosed in JP 2016-219923 A is small, and the screen of the mobile terminal is generally small. Accordingly, it is difficult for the user to perform an operation of designating a specific camera from

a plurality of cameras using the technique disclosed in JP 2016-219923 A. In addition, when a plurality of videos are reduced and displayed on the screen of the mobile terminal, it has been difficult for the user to confirm a person appearing in a small video.

[0006]

The present invention has been made in view of such a situation and its object is to enable a user to easily check a tracking target through a user terminal.

[0007]

A video monitoring apparatus according to the present invention includes a video acquisition unit configured to acquire a plurality of videos from a plurality of cameras, a tracking target identifying unit configured to identify a tracking target from the plurality of videos acquired by the video acquisition unit, a camera selecting unit configured to select the video in which the tracking target appears, and a display control unit configured to perform control to display the video selected by the camera selecting unit on a user terminal.

[0008]

According to the present invention, since a video showing the tracking target is displayed on the user terminal, the user can easily check the tracking target through the user terminal.

Problems, configurations, and effects other than those described above will be clarified by the following description of an embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a system configuration diagram illustrating an overall configuration example of a video monitoring system according to an embodiment of the present invention;

Fig. 2 is a block diagram illustrating a hardware configuration example of a user terminal according to an embodiment of the present invention;

Fig. 3 is a block diagram illustrating a hardware configuration example of a video monitoring apparatus according to an embodiment of the present invention;

Fig. 4 is a view illustrating the installation position of each camera according to an embodiment of the present invention;

Fig. 5 is a diagram illustrating the positional relationship between cameras according to an embodiment of the present invention;

Fig. 6 is a table configuration diagram illustrating an example of positional relationship information and weighting information according to an embodiment of the

present invention;

Fig. 7 is a diagram illustrating an example of a default display screen of the user terminal according to an embodiment of the present invention;

Fig. 8 is a diagram illustrating an example of person moving route estimation processing according to an embodiment of the present invention;

Fig. 9 is a flowchart illustrating an example of person tracking processing according to an embodiment of the present invention;

Figs. 10A to 10C are views each illustrating an example of a moving route according to an embodiment of the present invention;

Figs. 11A and 11B are views each illustrating a display example of a screen in the moving route of a person who leaves an elevator car and moves in a building according to an embodiment of the present invention;

Figs. 12C and 12D are views each illustrating a display example of a screen in the moving route of a person who leaves an elevator car and moves in a building according to an embodiment of the present invention;

Figs. 13A and 13B are views each illustrating a display example of a screen in the moving route of a person who moves from outside to inside of a building according to an embodiment of the present invention;

Figs. 14C and 14D are views each illustrating a display example of a screen in the moving route of a person who moves from outside to inside of a building according to an embodiment of the present invention;

Fig. 15 is a diagram illustrating a display example of a screen in a re-predicted moving route according to an embodiment of the present invention; and

Fig. 16 is a diagram illustrating a modification of a screen displayed on the user terminal according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010]

Embodiments for carrying out the present invention will be described below reference to the accompanying drawings. In this specification and the drawings, components having substantially the same function or configuration are denoted by the same reference numerals, and redundant description will be omitted.

[0011]

[Embodiment]

Fig. 1 is a system configuration diagram illustrating an overall configuration example of a video monitoring system 10 according to an embodiment.

The video monitoring system 10 includes a user

terminal 1, a video monitoring apparatus 3, and a camera group 5.

The user terminal 1 is used as an example of a user terminal that can be possessed and operated by the user. As the user, for example, the administrator of a building provided with an area for monitoring a video is assumed. The administrator sometimes manages a plurality of buildings and checks the state of a suspicious person by viewing the video displayed on the user terminal 1 in order to check the state of each building while minimizing the movement. In the following description, a suspicious person is also referred to as a "tracking target".

[0012]

Examples of the user terminal 1 include smart devices such as a smartphone and a tablet terminal. The user can check the information displayed on the touch panel display of the user terminal 1 and input various instructions. The user monitors, for example, the situation of a building at night and the situation of a passage or the like leading to an area where entry is limited, such as a server room, by viewing the video displayed on the user terminal 1.

[0013]

The user terminal 1 and the video monitoring apparatus 3 are connected via an Internet line 2 and can

mutually transmit and receive data.

In addition, the video monitoring apparatus 3 and the camera group 5 are connected via the Internet line 4 and can mutually transmit and receive data.

[0014]

The camera group 5 includes six cameras 51 to 56. In the following description, the camera name of the camera 51 is "camera A", the camera name of the camera 52 is "camera B", and the camera name of the camera 53 is "camera C". Similarly, the camera name of the camera 54 is "camera D", the camera name of the camera 55 is "camera E", and the camera name of the camera 56 is "camera F". Note that, in a case where the cameras 51 to 56 are not distinguished, they are referred to as cameras 50. Each camera 50 included in the camera group 5 is installed in a building to be monitored, a passage, a site outside the building, or the like.

[0015]

The video monitoring apparatus 3 is an apparatus constructed in a cloud server by the administrator of the video monitoring system 10. The video monitoring apparatus 3 includes a display control unit 31, a camera management unit 32, a video acquisition unit 33, a tracking target identifying unit 34, a camera selecting unit 35, and a moving direction detecting unit 36.

[0016]

The display control unit 31 performs control to display the video selected by the camera selecting unit 35 on the user terminal 1. Accordingly, the display control unit 31 generates a screen to be displayed on the user terminal 1 on the basis of the video output from the video acquisition unit 33 and transmits screen data to the user terminal 1 via the Internet line 2. Therefore, the user terminal 1 displays, for example, the screen illustrated in Fig. 7 to be described later on the basis of the received screen data. Since the screen generated by the display control unit 31 is displayed on the user terminal 1, the user viewing the screen can check the state of the tracking target instructed from the user terminal 1.

[0017]

Note that the display control unit 31 itself may transmit the video of the camera 50 installed in the moving route of the monitoring target illustrated in Figs. 10A to 10C to be described later to the user terminal 1 without generating any screen and may transmit the additional information indicating the video including the person tracked by the tracking target identifying unit 34 to the user terminal 1. In this case, the user terminal 1 displays the video including the person identified by the tracking target identifying unit 34 on a main display unit

401 based on the received additional information and generates a screen (see Fig. 7 to be described later) for displaying the video of the camera 50 installed in the moving route on the sub-display unit 403.

[0018]

When a person tracking command is input to the user terminal 1, the display control unit 31 receives the data of the tracking command from the user terminal 1. The display control unit 31 then instructs the tracking target identifying unit 34 to identify the person to be tracked from the video including the person to which the tracking command is issued and track the person.

[0019]

The camera management unit 32 records positional relationship information 321 that associates the installation positions of the plurality of cameras 50 with each other and weighting information 322 that weights the installation positions of the respective cameras 50. As illustrated in Fig. 6 to be described later, the positional relationship information 321 and the weighting information 322 are used in combination.

[0020]

The positional relationship information 321 is information defining the positional relationship between the respective cameras 50. The installation position of

each camera 50 is registered in the positional relationship information 321 in advance. The relative positional relationship between the adjacent cameras 50 is defined on the basis of the installation position of each camera 50. When the installation position of the camera 50 is changed, the positional relationship information 321 is updated by the user inputting the changed installation position via the user terminal 1.

[0021]

As the weighting information 322, weights are set according to the positions of the cameras 50. When the plurality of cameras 50 are installed in the moving route estimated by the moving direction detecting unit 36, the camera selecting unit 35 selects the video captured by the camera 50 with a large weight on the basis of the weighting information 322 recorded in the camera management unit 32. In this case, if a given area is an area that can be used only by a specific person, such as a security area or a server room, a large weight is set for the camera 50 installed in this area. The user can arbitrarily set weights for the cameras 50.

[0022]

The tracking target identifying unit 34 identifies the tracking target from the plurality of videos acquired by the video acquisition unit 33. The tracking target

identifying unit 34 according to the present embodiment identifies the tracking target instructed by the user terminal 1 from a plurality of videos. The person to be tracked is a person appearing in the video to which the tracking command is input from the user terminal 1. The tracking target identifying unit 34 then tracks the person identified from the plurality of videos acquired from the plurality of cameras 50 and outputs information for identifying the video in which the tracked person appears to the display control unit 31.

[0023]

The camera selecting unit 35 selects an image showing the tracking target. In this case, when the moving direction of the tracking target is detected by the moving direction detecting unit 36, the camera selecting unit 35 selects an image captured by the camera 50 installed in the moving direction. For example, when the person to be tracked moves in one passage, the moving direction detecting unit 36 can determine the camera 50 installed at the destination of the person only by detecting whether the moving direction of the person is left or right. Then, the camera selecting unit 35 can select a video of the camera 50 installed at the destination of the person as a video in which the tracking target appears.

[0024]

The video acquisition unit 33 acquires a plurality of videos captured by each camera 50 from the camera group 5 (the plurality of cameras 50) via the Internet line 4. The plurality of acquired videos are output to the display control unit 31, the video acquisition unit 33, the tracking target identifying unit 34, the camera selecting unit 35, and the moving direction detecting unit 36. The video acquisition unit 33 acquires a video (moving image) captured by each camera 50 in real time. However, a video (still image) captured by each camera 50 every several seconds may be acquired at each capturing timing.

[0025]

<Hardware Configuration Example of User Terminal 1>

A hardware configuration example of the user terminal 1 will be described next.

Fig. 2 is a block diagram illustrating a hardware configuration example of the user terminal 1.

[0026]

The user terminal 1 includes a central processing unit (CPU) 11, a read only memory (ROM) 12, and a random access memory (RAM) 13, each connected to a bus 14. The user terminal 1 further includes a display device 15, an input device 16, a nonvolatile storage 17, and a network interface 18.

[0027]

The CPU 11 reads the program code of software for implementing each function according to the present embodiment from the ROM 12, loads the program codes into the RAM 13, and executes the program codes. Variables, parameters, and the like generated during arithmetic processing of the CPU 11 are temporarily written in the RAM 13, and these variables, parameters, and the like are appropriately read by the CPU 11. However, a micro processing unit (MPU) may be used instead of the CPU 11.

[0028]

The display device 15 is, for example, a liquid crystal display monitor and displays, for example, a result of processing performed in the user terminal 1 to the user. As the input device 16, for example, a keyboard, a mouse, and the like are used, and the user can perform predetermined operation input and instruction. In the user terminal 1, a touch panel display device formed by overlapping the display device 15 and the input device 16 is used.

[0029]

As the nonvolatile storage 17, for example, a hard disk drive (HDD), a solid state drive (SSD), a nonvolatile memory, or the like is used. In addition to an operating system (OS) and various parameters, a program for causing the user terminal 1 to function is recorded in the

nonvolatile storage 17. The ROM 12 and the nonvolatile storage 17 record programs, data, and the like necessary for the operation of the CPU 11, and are used as an example of a computer-readable non-transitory storage medium storing a program executed by the user terminal 1.

[0030]

For example, a network interface card (NIC) or the like is used as the network interface 18, and various data can be transmitted and received between devices via a local area network (LAN), a dedicated line, or the like connected to an NIC terminal.

[0031]

<Hardware Configuration Example of Video Monitoring Apparatus>

The hardware configuration of the video monitoring apparatus 3 will be described next.

Fig. 3 is a block diagram illustrating a hardware configuration example of the video monitoring apparatus 3. The video monitoring apparatus 3 according to the present embodiment implements a display control method performed by the respective functional blocks illustrated in Fig. 1 in cooperation with each other by a computer constituting the video monitoring apparatus 3 executing a program.

[0032]

The video monitoring apparatus 3 includes a CPU 61,

a ROM 62, and a RAM 63 each connected to a bus 64. The video monitoring apparatus 3 further includes a nonvolatile storage 65 and a network interface 66.

[0033]

The CPU 61 reads the program code of software for implementing each function according to the present embodiment from the ROM 62, loads the program codes into the RAM 63, and executes the program codes. Variables, parameters, and the like generated during arithmetic processing of the CPU 61 are temporarily written in the RAM 63, and these variables, parameters, and the like are appropriately read by the CPU 61. However, an MPU may be used instead of the CPU 61.

[0034]

As the nonvolatile storage 65, for example, an HDD, an SSD, a flexible disk, an optical disk, a magneto-optical disk, a CD-ROM, a CD-R, a magnetic tape, or a nonvolatile memory is used. In addition to the OS and various parameters, a program for causing the video monitoring apparatus 3 to function is recorded in the nonvolatile storage 65. The ROM 62 and the nonvolatile storage 65 record programs, data, and the like necessary for the operation of the CPU 61, and are used as an example of a computer-readable non-transitory storage medium storing a program executed by the video monitoring apparatus 3.

[0035]

For example, an NIC or the like is used as the network interface 66, and various data can be transmitted and received between devices via a LAN connected to a terminal of the NIC, a dedicated line, or the like.

[0036]

<Information on Position where Camera is Installed>

The contents of the positional relationship information 321 and the weighting information 322 will be described next with reference to Figs. 4 to 6.

Fig. 4 is a diagram illustrating the installation positions of the cameras 50.

Fig. 4 illustrates the positional relationship between cameras A to F as the cameras 50. In the drawing, two types of reference numerals such as the camera 51 (A) are used for camera A.

[0037]

As described above, the positional relationship information 321 is defined for each adjacent pair of the plurality of cameras 50. Cameras A to F are installed inside and outside a building and capture predetermined imaging ranges (ranges indicated by arcs) in predetermined imaging directions. Cameras A to F are attached to walls of a building and a passage. In addition, the photographing directions and the photographing angle of

views of cameras A to F can be arbitrarily changed.

[0038]

As illustrated in Fig. 4, camera A is installed on a wall near the ceiling of the elevator car and photographs the inside of the car.

Camera B is installed on a wall of the passage and photographs the inside of the passage.

Camera C is installed on a wall near and opposite to camera B and photographs the inside of the passage.

Camera D is installed next to camera B and photographs the inside of the passage.

Camera E is installed in an area requiring more caution than other areas and photographs this area.

Camera F is installed outside the building and photographs the parking lot.

[0039]

Fig. 5 is a diagram illustrating the positional relationship between the cameras 50. Fig. 5 illustrates only the positional relationship between the respective cameras 50 while omitting a description of the structure of the building and the like.

[0040]

Each camera 50 is provided with positional relationship information of R (right side), L (left side), and U (front side) in a direction in which the adjacent

cameras 50 are located. In addition, the lines connecting the cameras 50 represent parts of the route along which a person can move. For example, the person can move between camera A and camera B and between camera B and camera C. On the other hand, camera E and camera F are not connected by a line. This indicates that when the person moves, the person cannot directly go from camera E to camera F and can move only in the order of camera E, camera D, and camera F (or in the reverse order).

[0041]

Note that, when the camera 50 is used by being attached to a ceiling of a passage, a room, or the like, positional relationship information may be attached to a rear direction opposite to the front direction as the positional relationship of the camera 50 in Fig. 5.

[0042]

Fig. 6 is a table configuration diagram illustrating an example of the positional relationship information 321 and the weighting information 322.

The table illustrated in Fig. 6 includes items, namely, camera, left side (L), front side (U), right side (R), and weighing. Note that the No. item on the left side of the table is added to identify each record in the table and may not be configured in an actual table.

[0043]

In the camera item, camera names such as "camera A" and "camera B" are stored as the identification information of the cameras 50.

The left side (L), front side (U), and right side (R) items store identification information (any one of symbols A to F) of the cameras 50 arranged at positions on the left side (L), the front side (U), and the right side (R), with each camera 50 being a starting point.

The weighting item stores a weight assigned to each camera 50.

[0044]

The information for each camera 50 stored in the table illustrated in Fig. 6 is registered by the administrator according to the arrangement status of the cameras 50 installed in the building when the video monitoring apparatus 3 is constructed. In addition, when the arrangement status of the camera 50 is changed due to addition or removal of the camera 50, the administrator re-registers the information for each camera 50 according to the changed arrangement status.

[0045]

As illustrated in Fig. 4, since camera B is installed on the right side of camera A, the symbol "B" representing camera B is stored in the column of the right side (R) among the records of camera A in the No. 1 row.

In addition, since no other camera 50 is installed on the left side and the front side of camera A, "-" is stored in the columns of the left side (L) and the front side (U).

[0046]

Since camera A is installed on the left side of camera B, the symbol "A" representing camera A is stored in the left (L) column among the records of camera B in the No. 2 row. Since camera C is installed in front of camera B, the symbol "C" representing camera C is stored in the column of the front side (U). Since cameras D and E are installed on the right side of camera B, the reference symbols "D" and "E" representing cameras D and E are stored in the column of the right side (R).

Also for the other cameras 50, the positional relationship of each camera 50 is stored in the table in accordance with the positional relationship information 321 illustrated in Fig. 4.

[0047]

The weight assigned to each camera 50 is managed by the weighting information 322. In the table illustrated in Fig. 6, the weights of cameras A to D and F are set to "1", and the weight of camera E is set to "2". In this example, camera E is installed in an area more important than the areas where the other cameras 50 are installed (for example, a warehouse where valuable items are stored).

Therefore, camera E has a higher weight than other cameras.

[0048]

Note that a weight is information that changes depending on the operation of the site where the camera 50 is installed. For example, when there is a plurality of cameras 50 that capture the same area, if the video captured by the camera 50 from a specific direction is important, the weight of the camera 50 is set high. In addition, if the important area changes depending on the time zone, the weighting may be changed according to the time zone in which the important area changes. Such weighting can be performed via the user terminal 1.

[0049]

In addition, when a large number of cameras 50 are installed in a building, videos captured by all cameras 50 cannot be displayed on a sub-display unit 403. Accordingly, for example, setting a higher weight for the camera 50 installed in a specific area than that for each camera 50 installed in other areas makes it possible to preferentially display the camera 50 installed in the specific area on the default display screen.

[0050]

<Display Screen of User Terminal>

An example of the display screen of the user terminal 1 will be described next.

Fig. 7 is a diagram illustrating an example of the default display screen of the user terminal 1.

[0051]

The display screen of the user terminal 1 is the screen acquired from the video monitoring apparatus 3 by the user terminal 1 accessing the video monitoring apparatus 3 via the Internet line 2 as a result of the user operating the user terminal 1. The default display screen includes the main display unit 401, a person tracking function switching button 402, and the sub-display unit 403. The display control unit 31 then displays, on the user terminal 1, the main display unit 401 that displays the video selected by the camera selecting unit 35, the sub-display unit 403 that sequentially displays a plurality of videos rearranged in accordance with the moving direction of the tracking target detected by the moving direction detecting unit 36, and the person tracking function switching button 402.

[0052]

The main display unit 401 displays a video in which a person (tracking target) of interest to the user is currently captured. The user can check the enlarged video displayed on the main display unit 401 showing the tracking target. The user can arbitrarily change the camera 50 that captures the video displayed on the main display unit 401.

However, the video may be automatically switched under the control of the display control unit 31.

[0053]

The person tracking function switching button 402 is used by the user to switch ON or OFF of the person tracking function. In the default state illustrated in Fig. 7, the person tracking function is turned off. Accordingly, the main display unit 401 may display a video in which a person does not appear. When the user touches the person tracking function switching button 402, the person tracking function is turned on. In this case, a video in which a person appears is displayed on the main display unit 401.

Accordingly, an operation in which the user touches the person tracking function switching button 402 is used as an instruction to start tracking the tracking target. The tracking target identifying unit 34 then starts tracking the tracking target based on the tracking start instruction received from the user terminal 1. Since the tracking target identifying unit 34 starts tracking the tracking target in response to the instruction to start tracking, only the video of the tracking target that the user wants to watch is displayed on the main display unit 401. When the person moves and disappears from the video displayed on the main display unit 401, another video in which the person appears is displayed on the main display unit 401.

[0054]

On the sub-display unit 403, the camera names (for example, camera A and camera B) of the cameras 50 installed in the building and a plurality of videos captured by the cameras 50 are displayed in a list form arranged vertically. Therefore, the list is displayed in the list form, and the user can easily check a plurality of videos captured by each camera 50. In this case, the main display unit 401 displays a video larger than the sub-display unit 403 does. Accordingly, the user can easily check the tracking target selected from the sub-display unit 403 and appearing in the video displayed on the main display unit 401.

[0055]

The video displayed on the sub-display unit 403 includes all the videos captured by the six cameras 50, namely, cameras A to F. All the videos displayed on the sub-display unit 403 are acquired by the video acquisition unit 33 from the cameras 50 of the camera group 5 via the Internet line 4. In addition, on the default display screen, the videos displayed in the list on the sub-display unit 403 may be arranged in the order of identifiers for identifying the cameras 50.

[0056]

The moving direction detecting unit 36 then

estimates the moving route of the tracking target based on the positional relationship information 321 recorded in the camera management unit 32. The display control unit 31 displays the plurality of videos acquired by the video acquisition unit 33 on the sub-display unit 403 in the order of the cameras 50 installed along the moving route. Therefore, the user can grasp the estimated moving route from the videos displayed on the sub-display unit 403. The tracking target is then instructed by selecting a video in which the tracking target appears from the plurality of videos displayed on the sub-display unit 403. Therefore, the person to be tracked by the tracking target identifying unit 34 can be easily identified.

[0057]

In addition, a radio button is displayed next to each camera name displayed on the sub-display unit 403. When the user selects a video from the sub-display unit 403, the radio button provided corresponding to the camera 50 that captures the video displayed on the main display unit 401 is turned on.

[0058]

The video displayed on the main display unit 401 and the video of each camera 50 displayed on the sub-display unit 403 are interlocked. When the user selects an arbitrary video from the sub-display unit 403, the video

selected by the user is displayed on the main display unit 401. At this time, the radio button corresponding to the camera name of the camera 50 that is capturing the video displayed on the main display unit 401 is turned on. The user can check the video captured by the camera 50 installed in the moving route of the tracking target from the sub-display unit 403.

[0059]

<Example of Moving Route Estimation Processing When Tracking Function Is ON>

An example of the moving route estimation processing when the tracking function is ON will be described next with reference to the flowcharts illustrated in Figs. 8 and 9 and examples of the display screen of the user terminal 1 illustrated in Figs. 10A to 15.

[0060]

Fig. 8 is a diagram illustrating an example of person moving route estimation processing.

[0061]

It is assumed that the user has pressed the person tracking function switching button 402 on the user terminal 1 before the start of the processing. When the switching button 402 for switching the state in which the person tracking function is OFF is pressed, the person tracking function is turned ON. The data of the person tracking

command indicating that the person tracking function is turned ON is input to the display control unit 31 of the video monitoring apparatus 3 illustrated in Fig. 1 via the Internet line 2.

[0062]

The video monitoring apparatus 3 starts the moving route estimation processing (S1). First of all, when the data of a person tracking command is input from the user terminal 1, the display control unit 31 outputs the person tracking command to the tracking target identifying unit 34 and the moving direction detecting unit 36. The tracking target identifying unit 34 and the moving direction detecting unit 36 start tracking a person appearing in the video displayed on the main display unit 401 or a person selectively input on the user terminal 1 among the videos displayed on the sub-display unit 403 as a tracking target.

[0063]

The moving direction detecting unit 36 detects the moving direction of the person appearing in the video displayed on the main display unit 401. The moving direction detecting unit 36 determines whether the camera 50 different from the camera 50 that captures the video displayed on main display unit 401 is installed in the detected moving direction (also referred to as a movement destination) (S2).

[0064]

In step S2, if the moving direction detecting unit 36 determines that the camera 50 is not installed at the destination of the person (NO in S2), the process proceeds to step S8 described later. In contrast to this, upon determining that the camera 50 is installed at the destination of the person in step S2 (YES in S2), the moving direction detecting unit 36 determines whether the number of installed cameras 50 at the destination is two or more (S3).

[0065]

If the number of installed cameras 50 at the movement destination is not 2 or more (NO in S3), the moving direction detecting unit 36 adds the camera 50 at the movement destination to the moving route (S4). In contrast to this, if the number of cameras 50 installed at the movement destination is 2 or more (YES in S3), the moving direction detecting unit 36 adds the camera 50 with the largest weight to the moving route among the cameras 50 at the two or more movement destinations (S5).

[0066]

After step S4 or S5, the moving direction detecting unit 36 determines whether or not the next camera 50 is installed at the movement destination with the movement destination camera 50 as a starting point (S6). If the

next camera 50 is not installed at the movement destination (NO in S6), the process proceeds to step S8 described later.

[0067]

In contrast to this, if the moving direction detecting unit 36 determines in step S6 that the next camera 50 is installed at the moving destination (YES in S6), this camera 50 represents the camera 50 already registered in the moving route and corresponds to the return path of the person. Therefore, the moving direction detecting unit 36 excludes the next camera 50 installed at the destination determined in step S6 from the moving route (S7). Thereafter, the moving direction detecting unit 36 returns to step S3 and repeats the processing in steps S3 to S7.

[0068]

After NO in step S2 or NO in step S6, the moving direction detecting unit 36 completes the addition of all the cameras 50 in the moving route. Therefore, the camera selecting unit 35 transmits the video captured by the camera 50 selected according to the moving route to the display control unit 31. The display control unit 31 performs processing for displaying the video captured by each camera 50 on the sub-display unit 403 of the user terminal 1 on the basis of the information of the camera 50

received from the camera selecting unit 35 (S8).

Thereafter, the tracking target identifying unit 34 starts the person tracking processing (S9).

[0069]

Fig. 9 is a flowchart illustrating an example of the person tracking processing.

First of all, the tracking target identifying unit 34 determines whether the person photographed by the camera 50 displayed on the main display unit 401 has disappeared from the photographing range of the camera 50, that is, the video captured by the camera 50 (S11).

[0070]

Upon determining that the person has not disappeared from the photographing range of the camera 50 (NO in S11), the tracking target identifying unit 34 continues the processing in step S11 again. In contrast to this, upon determining that the person has disappeared from the photographing range of the camera 50 (YES in S11), the tracking target identifying unit 34 continues to monitor whether the tracking target person appears in the video captured by the camera 50 in which the person has disappeared from the video, that is, the camera 50 displayed on the main display unit 401, and the video captured by the camera 50 installed in the moving direction of the camera 50 (S12).

[0071]

The tracking target identifying unit 34 then determines whether or not the person to be tracked has appeared in the video in the photographing range photographed by the camera 50 installed at the destination in the moving direction among the videos of the cameras 50 monitored in step S12 (S13). If the person to be tracked has not appeared in the video (NO in S13), the tracking target identifying unit 34 continues the processing in step S12.

[0072]

In contrast to this, when the person to be tracked appears in the image (YES in S13), the camera selecting unit 35 outputs information of the camera 50 that captures the video in which the person to be tracked appears to the display control unit 31. The display control unit 31 then displays the video of the camera 50 that captures the video in which the person appears, acquired from the video acquisition unit 33 based on the information of the camera 50 input from the camera selecting unit 35, on the main display unit 401 of the user terminal 1 (S14).

[0073]

Next, the camera selecting unit 35 determines whether or not the camera 50 that captures the video in which the person to be tracked appears is the camera 50

added to the moving route in step S4 or S5 in Fig. 8 (S15). If the camera is the camera 50 added to the moving route (YES in S15), the tracking target identifying unit 34 returns the process to step S11.

[0074]

In contrast to this, if the camera 50 is not added to the moving route (NO in S15), the moving route is erroneously estimated. Therefore, the moving direction detecting unit 36 estimates the moving route again (S16) and returns the process to step S11.

[0075]

As described above, when the tracking target that has disappeared from the video on the main display unit 401 appears in the video captured by the camera 50 not installed in the moving route, the moving direction detecting unit 36 estimates the moving route again from the camera 50 that captures the image in which the tracking target appears as a starting point. The display control unit 31 then displays a plurality of videos on the sub-display unit 403 in the order of the cameras 50 installed along the moving route estimated again. Therefore, the user can check the video of the camera 50 installed on the estimated moving route again without performing a special operation.

[0076]

Based on the flowcharts of Figs. 8 and 9, a display example of the screen displayed on the user terminal 1 when the person to be tracked moves will be described next with reference to Figs. 10A to 15.

[0077]

Figs. 10A to 10C are diagrams each illustrating an example of a moving route. In each drawing in Fig. 10, the moving route is represented by the thick arrow.

Fig. 10A is an example of the moving route of a person who leaves the elevator car and moves in a building. A display example of the screen corresponding to Fig. 10A is illustrated in Figs. 11A, 11B, 12C, and 12D described later.

Fig. 10B is an example of the moving route of the person moving from outside to inside of the building. A display example of the screen corresponding to Fig. 10B is illustrated in Figs. 13A, 13B, 14C, and 14D described later.

Fig. 10C illustrates an example of the re-estimated moving route. A display example of the screen corresponding to Fig. 10C is illustrated in Fig. 15 described later.

[0078]

In the following description, the cameras 50 are referred to as "camera A" to "camera F" in accordance with

the display names of the cameras 50 displayed on the user terminal 1. Furthermore, as the video captured by each camera 50, for example, the video captured by camera A is referred to as a "the video of camera A".

[0079]

<Moving Route of Person Who Leaves Car and Moves in Building>

Fig. 11A is a diagram illustrating an example in which the video of camera A is displayed on the main display unit 401.

[0080]

(Video of Camera A)

When the display screen of the user terminal 1 is in the display state illustrated in Fig. 7 described above, the video captured by camera A and displaying a person in the car is displayed on the main display unit 401. Therefore, when the user of the user terminal 1 presses the person tracking function switching button 402, the person tracking function switching button 402 is displayed as "person tracking ON" as illustrated in Fig. 11A.

[0081]

According to the flowchart illustrated in Fig. 8, the moving direction detecting unit 36 then adds camera B installed on the right side of camera A, camera E having the largest weight after camera B, camera D at the moving

destination, and camera F at the moving destination to the moving route. As illustrated in Fig. 11A, the main display unit 401 displays the video of camera A. The sub-display unit 403 then displays the videos of camera A, camera B, camera E, camera D, and camera F added to the moving route in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera A as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0082]

(Video of Camera B)

Assume next that after the person to be tracked disappears from the video of camera A, the person appears in the video of camera B. In this case, the tracking target identifying unit 34 determines that the person appears in the video of camera B according to the flowchart illustrated in Fig. 9, and the display control unit 31 displays the video of camera B on the main display unit 401.

[0083]

As illustrated in Fig. 11B, the main display unit 401 displays the video of camera B. The sub-display unit 403 then displays the videos of camera A, camera B, camera E, camera D, and camera F in the order of the cameras

arranged along the moving route. In addition, the selection of the video of camera B as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0084]

(Video of Camera E)

Assume next that after the person to be tracked disappears from the video of camera B, the person appears in the video of camera E. In this case, the tracking target identifying unit 34 determines that the person appears in the video of camera E according to the flowchart illustrated in Fig. 9, and the display control unit 31 displays the video of camera E on the main display unit 401.

[0085]

As illustrated in Fig. 12C, the main display unit 401 displays the video of camera E. The sub-display unit 403 then displays the videos of camera A, camera B, camera E, camera D, and camera F in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera E as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0086]

(Video of Camera D)

Assume next that after the person to be tracked disappears from the video of camera B, the person appears in the video of camera D. Camera D is not set in the moving route next to camera B. Accordingly, the tracking target identifying unit 34 determines that the person appears in the video of camera D according to the flowchart illustrated in Fig. 9, and the display control unit 31 displays the video of camera D on the main display unit 401. In addition, the moving direction detecting unit 36 re-estimates a moving route according to the flowchart illustrated in Fig. 9. At this time, the moving direction detecting unit 36 adds camera E having the largest weight as illustrated in Fig. 6 among cameras E and F next to camera D to the moving route.

[0087]

As illustrated in Fig. 12D, the main display unit 401 displays the video of camera D. The sub-display unit 403 then displays the videos of camera A, camera B, camera D, and camera E in the newly estimated moving route in the order of the cameras arranged along the moving route.

In addition, the selection of the video of camera D as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button. Thereafter, although not illustrated, it is assumed that the person to be added has moved to the

outside of the building. Note that, as illustrated in Fig. 5, since camera E and camera F are not located at adjacent positions, camera F is located outside the moving route. Accordingly, the sub-display unit 403 in Fig. 12D does not include the video of camera F.

[0088]

<Moving Route of Person Moving from Outside to Inside of Building>

An example of each video displayed on the user terminal 1 when the person moves from outside to inside of a building along the moving route illustrated in Fig. 10B will be described with reference to Figs. 13A to 14D.

[0089]

(Video of Camera F)

As illustrated in Fig. 13A, when the person to be tracked is outside the building, the person appears in the video of camera F. In this case, since the person tracking function switching button 402 is displayed as "OFF", the person tracking function is turned off. Referring to Fig. 13A, since the moving route is not estimated yet, the sub-display unit 403 sequentially displays the videos of camera A, camera B, camera C, camera D, camera E, and camera F. In addition, the selection of the video of camera F as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio

button.

[0090]

When the user of the user terminal 1 then presses the person tracking function switching button 402, the person tracking function switching button 402 is displayed as "person tracking ON" as illustrated in Fig. 13B. According to the flowchart illustrated in Fig. 8, the moving direction detecting unit 36 then adds camera B installed on the left side of camera F, camera E having the largest weight after camera B, camera D at the moving destination, camera B at the moving destination, camera C, and camera A to the moving route.

[0091]

Note that, as illustrated in Fig. 10B, camera B and camera C are installed at a destination from camera B. However, as illustrated in Fig. 6, the weights of camera B and camera C are both "1". Accordingly, the moving direction detecting unit 36 adds both camera B and camera C to the moving route. Therefore, two moving routes are estimated.

[0092]

As illustrated in Fig. 13B, the main display unit 401 displays the video of camera F. The sub-display unit 403 then displays the videos of camera F, camera D, camera E, camera B, camera C, and camera A in the newly estimated

moving route in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera F as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0093]

(Video of Camera D)

Assume next that after the person to be tracked disappears from the video of camera F, the person appears in the video of camera D. In this case, the tracking target identifying unit 34 determines that the person appears in the video of camera D according to the flowchart illustrated in Fig. 9, and the display control unit 31 displays the video of camera D on the main display unit 401.

[0094]

As illustrated in Fig. 14C, the main display unit 401 displays the video of camera D. The sub-display unit 403 then displays the videos of camera F, camera D, camera E, camera B, camera C, and camera A in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera D as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0095]

(Video of Camera E)

Assume next that after the person to be tracked disappears from the video of camera D, the person appears in the video of camera E. In this case, the tracking target identifying unit 34 determines that the person appears in the video of camera E having the largest weight according to the flowchart illustrated in Fig. 9, and the display control unit 31 displays the video of camera E on the main display unit 401.

[0096]

As illustrated in Fig. 14D, the main display unit 401 displays the video of camera E. The sub-display unit 403 then displays the videos of camera F, camera D, camera E, camera B, camera C, and camera A in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera E as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0097]

<Re-estimated Moving Route>

An example of the video displayed on the user terminal 1 when the moving route illustrated in Fig. 10B is re-estimated and the moving route illustrated in Fig. 10C is estimated will be described next with reference to Fig. 15.

[0098]

(Video of Camera B)

Assume next that after the person to be tracked disappears from the video of camera D, the person appears in the video of camera B. Camera B is not set in the moving route next to camera D. Therefore, the tracking target identifying unit 34 determines that the person appears in the video of camera B according to the flowchart illustrated in Fig. 9 and re-estimates a moving route. The display control unit 31 then displays the video of camera B on the main display unit 401. At this time, the moving direction detecting unit 36 adds camera E having the largest weight illustrated in Fig. 6 among cameras E and F next to camera B to the moving route.

[0099]

As illustrated in Fig. 15, the main display unit 401 displays the video of camera B. The sub-display unit 403 then displays the videos of camera F, camera D, camera B, and camera E in the newly estimated moving route in the order of the cameras arranged along the moving route. In addition, the selection of the video of camera B as the video to be displayed on the main display unit 401 is indicated by the inversion of the color of the radio button.

[0100]

In the video monitoring system 10 according to the embodiment described above, the video monitoring apparatus 3 selects a video in which the tracking target appears from the videos captured by the plurality of cameras 50 and displays the video on the user terminal 1. In this case, the video monitoring apparatus 3 automatically tracks the suspicious person (tracking target) and displays the video of the camera 50 showing the tracking target identified by the tracking target identifying unit 34 on the user terminal 1 in a large size. Therefore, the user can easily check the tracking target from the video of the camera 50 also in the user terminal 1.

[0101]

In addition, along with the movement of the suspicious person, the moving route of the suspicious person is estimated. The videos captured by the plurality of cameras 50 installed in the moving route are displayed as a list on the sub-display unit 403. This allows the user to simultaneously check the plurality of videos displayed on the user terminal 1. When wanting to pay attention to the movement of the suspicious person appearing in a certain video, the user can issue an instruction to start tracking the suspicious person appearing in the video by selecting the video. Accordingly, the user can check, on the main display unit

401, the video in which the suspicious person is enlarged and displayed by an easy operation.

[0102]

In addition, after the instruction to start tracking is issued, the video is automatically switched so that the video in which the suspicious person appears is displayed on the main display unit 401. This allows the user to easily check the state of the suspicious person from the video displayed on the main display unit 401. The video displayed on main display unit 401 is larger than the video displayed on sub-display unit 403. Therefore, even if the display screen of the user terminal 1 is small, the user can easily check the video in which the suspicious person appears, displayed on the main display unit 401.

[0103]

In addition, the positional relationship information 321 is recorded in the camera management unit 32. When estimating the moving route of the suspicious person from the video in which the suspicious person appears, for whom the instruction to start tracking is received from the user, the moving direction detecting unit 36 automatically estimates the moving direction of the suspicious person using the positional relationship information 321. This allows the moving direction detecting unit 36 to estimate the moving route in accordance with the positional

relationship between the cameras 50.

[0104]

In addition, the weighting information 322 is recorded in the camera management unit 32. A larger weight is set for the camera 50 that captures an important area in which the user wants to check the situation with particular attention than the cameras 50 that capture other areas.

The moving route estimated by the moving direction detecting unit 36 preferentially includes the installation position of the camera 50 that captures an area with a large weight. Accordingly, the user can monitor whether a suspicious person has intruded into the important area and what kind of behavior the suspicious person has performed in a case where the suspicious person has intruded.

[0105]

In addition, when the suspicious person moves out of the estimated moving route after an instruction to start tracking the suspicious person is input from the user terminal 1, the moving direction detecting unit 36 re-estimates a moving route with the camera 50 that captures a video in which the suspicious person newly appears as a starting point. Based on the moving route estimated again, the display control unit 31 updates the video displayed on the sub-display unit 403 so as to display a list of videos captured by the camera 50 installed in the moving route.

Therefore, even if the suspicious person disappears from the video once, the user can easily continuously monitor the video in which the suspicious person appears again.

[0106]

In addition, the video of the camera 50 installed at a position outside the moving route is not displayed on the sub-display unit 403. Accordingly, the user only needs to check the sub-display unit 403 on which the video of the camera 50 installed at a position along the moving route is displayed, and the burden at the time of checking the video is reduced.

[0107]

[Modification]

Fig. 16 is a diagram illustrating a modification of the screen displayed on the user terminal 1.

The user terminal 1 includes the moving route display unit 404 in addition to the main display unit 401, the person tracking function switching button 402, and the sub-display unit 403.

On the moving route display unit 404, the moving route estimated by the moving direction detecting unit 36 and the symbols (A to F) representing the camera names of the cameras are displayed together with a diagram of premises. By checking the moving route displayed on the moving route display unit 404, the user can specifically

grasp the place where the suspicious person for whom the instruction to start tracking has been issued is in the premises. In addition, the user can easily grasp what moving route is estimated.

[0108]

Note that the area monitored by the camera 50 is not limited to a hallway or interior in the building, but also includes the parking lot outside the building and the inside and outside of the site.

[0109]

The tracking target whose behavior is monitored by the video monitoring apparatus 3 is not limited to a person such as a suspicious person. For example, a moving object such as a drone, a robot, or a car may be set as a tracking target. As described above, since the moving object including at least one of the person and the drone is set as a tracking target, the user can check the states of various types of tracking targets according to the area to be monitored.

[0110]

The size of the main display unit 401 may be about the same as that of the sub-display unit 403. When the user terminal 1 is a tablet terminal having a large screen, the position of the main display unit 401 may be fixed to a specific position (for example, upper left) in the screen,

the position of the sub-display unit 403 may be set below the main display unit 401, and the sub-display unit 403 may display the videos of the cameras 50 in a tile shape. Even in this form, the user can correctly check the behavior of a suspicious person from the video on the main display unit 401.

[0111]

In the above embodiment, the user selects the video of the camera 50 in which the tracking target appears, but the tracking target identifying unit 34 may automatically identify the tracking target. For example, the tracking target identifying unit 34 may identify an abnormal behavior and set a person who performs the abnormal behavior as a tracking target. In addition, the tracking target identifying unit 34 may set a person or the like intruding in a time zone in which there should be no person as a tracking target. As the tracking target identifying unit 34 automatically identifies the tracking target in this manner, it is not necessary for the user to continuously view the video displayed on the user terminal 1 at all times, and the burden of monitoring on the user is reduced.

[0112]

Note that the present invention is not limited to the embodiments described above, and it is obvious that

various other application examples and modifications can be taken without departing from the gist of the present invention described in the claims.

For example, the above embodiment has been described in detail for easy understanding of the present invention and is not necessarily limited to one having all the configurations described above. Moreover, it is possible to add, delete, and replace other configurations with respect to part of the configurations of this embodiment.

In addition, the control lines and the information lines indicate what is considered to be necessary for the description, and do not necessarily indicate all the control lines and the information lines in terms of products. In practice, it may be considered that almost all the configurations are connected to each other.

What is claimed is:

1. A video monitoring apparatus comprising:
 - a video acquisition unit configured to acquire a plurality of videos from a plurality of cameras;
 - a tracking target identifying unit configured to identify a tracking target from the plurality of videos acquired by the video acquisition unit;
 - a camera management unit that records positional relationship information in which installation positions of the plurality of cameras are associated with each other;
 - a movement direction detection unit that detects a movement direction of the tracking target and estimates a movement route of the tracking target based on the positional relationship information recorded in the camera management unit;
 - a camera selecting unit configured to select the video captured by the camera installed in the moving direction and in which the tracking target appears; and
 - a display control unit configured to perform control to display the video selected by the camera selecting unit on a user terminal;
- the display control unit displays, on the user terminal, a main display unit that displays the video selected by the camera selection unit and including the

tracking target tracked by the tracking target identification unit, a sub-display unit that sequentially displays the plurality of videos rearranged in accordance with the moving direction detected by the moving direction detection unit in a list format in order, and a moving route display unit that displays the moving route, and displays the plurality of videos acquired by the video acquisition unit on the sub-display unit in order of the cameras installed along the moving route;

the tracking target is instructed by selecting the video in which the tracking target appears from the plurality of videos displayed on the sub-display unit, and when the video in which the tracking target appears is captured by a camera that is not set on the movement route, the movement direction detection unit re-estimates the movement route.

2. The video monitoring apparatus according to claim 1, wherein the camera management unit manages weighting information indicating that the installation position of each of the cameras is weighted, and when the plurality of cameras are installed in the moving route, the camera selecting unit selects the video captured by the camera with a large weight based on the weighting information recorded in the camera management unit.

3. The video monitoring apparatus according to claim

2, wherein when the tracking target that has disappeared from the video on the main display unit appears in the video captured by the camera not installed in the moving route, the moving direction detecting unit estimates the moving route again with the camera that captures the video in which the tracking target appears as a starting point, and the display control unit displays the plurality of videos on the sub-display unit in order of the cameras installed along the moving route estimated again.

4. The video monitoring apparatus according to claim 3, wherein the tracking target identifying unit starts tracking the tracking target based on a tracking start instruction received from the user terminal.

5. The video monitoring apparatus according to claim 1, wherein the main display displays the video larger than the sub-display, and the sub-display displays the plurality of videos in a list format.

6. The video monitoring apparatus according to claim 1, wherein the display control unit displays a moving route display unit that displays the moving route on the user terminal.

7. The video monitoring apparatus according to any one of claims 1 to 6, wherein the tracking target is a moving object including at least one of a person or a drone.

8. A display control method comprising:

a process of acquiring a plurality of videos from a plurality of cameras;

a process of detecting a tracking target instructed by a user terminal from the plurality of videos and selecting the video in which the tracking target appears;

recording positional relationship information in which installation positions of the plurality of cameras are associated with each other;

detecting a movement direction of the tracking target and estimating a movement route of the tracking target based on the positional relationship information recorded in the camera management unit;

selecting the video captured by the camera installed in the moving direction and in which the tracking target appears; and

a process of performing control to display the selected video on the user terminal;

displaying, on the user terminal, a main display unit that displays the video selected by the camera selection unit and including the tracking target tracked by the tracking target identification unit, a sub-display unit that sequentially displays the plurality of videos rearranged in accordance with the moving direction detected by the moving direction detection unit in a list format in

order, and a moving route display unit that displays the moving route, and displaying the plurality of videos acquired by the video acquisition unit on the sub-display unit in order of the cameras installed along the moving route;

the tracking target is instructed by selecting the video in which the tracking target appears from the plurality of videos displayed on the sub-display unit, and when the video in which the tracking target appears is captured by a camera that is not set on the movement route, the movement direction detection unit re-estimates the movement route

9. A video monitoring system comprising a user terminal and a video monitoring apparatus,

the user terminal including a display unit configured to display a plurality of videos received from the video monitoring apparatus, and

the video monitoring apparatus including

a video acquisition unit configured to acquire the plurality of videos from a plurality of cameras,

a tracking target identifying unit configured to identify a tracking target from the plurality of videos acquired by the video acquisition unit,

a camera management unit that records positional relationship information in which installation positions of

the plurality of cameras are associated with each other;

a movement direction detection unit that detects a movement direction of the tracking target and estimates a movement route of the tracking target based on the positional relationship information recorded in the camera management unit;

a camera selecting unit configured to select the video captured by the camera installed in the moving direction and in which the tracking target appears, and

a display control unit configured to perform control to display the video selected by the camera selecting unit on the user terminal;

the display control unit displays, on the user terminal, a main display unit that displays the video selected by the camera selection unit and including the tracking target tracked by the tracking target identification unit, a sub-display unit that sequentially displays the plurality of videos rearranged in accordance with the moving direction detected by the moving direction detection unit in a list format in order, and a moving route display unit that displays the moving route, and displays the plurality of videos acquired by the video acquisition unit on the sub-display unit in order of the cameras installed along the moving route;

the tracking target is instructed by selecting the

video in which the tracking target appears from the plurality of videos displayed on the sub-display unit, and when the video in which the tracking target appears is captured by a camera that is not set on the movement route, the movement direction detection unit re-estimates the movement route.