DESCRIPTION

Title of Invention: CONTROL APPARATUS

Technical Field

[0001]

The present invention relates to a control apparatus, a control method, and a recording medium.

Background Art

[0002]

Techniques relating to information codes, such as QR Codes®, are known.

[0003]

For example, PTL 1 discloses an information display medium that displays an information code readable by a reading device. According to PTL 1, the information code includes identification information identifying an installation location at which the information display medium is installed, and the identification information is displayed in a visually recognizable manner using information other than linguistic information. For example, PTL 1 discloses that, as a display form for displaying the identification information in a visually recognizable manner, in addition to using a color of a QR Code®, a pattern, design, or the like corresponding to the identification information may be displayed in a space outside a reading region of the information code.

Citation List

Patent Literature

[0004]

PTL 1: JP 2020-177543 A

Summary of Invention

Technical Problem

[0005]

In some cases, such as when an information code is to be read while a user is in a vehicle, the information code is read from a long distance using an imaging device such as a PTZ (pan-tilt-zoom) camera. In such a case, it is desirable to detect, from acquired image data, an information processing terminal such as a smartphone displaying the information code, control an orientation of the imaging device toward the detected information processing terminal, and then read the information code using image data acquired after the control. At this time, in a case where the above-described control is performed merely on the basis of a result of object detection using YOLO (You Only Look Once) or the like, an object other than the target information processing terminal may be erroneously detected, resulting in a risk that the imaging device may be controlled toward an incorrect direction. Consequently, there has been a problem in that it may take time to control the imaging device and read a read target such as an information code.

[0006]

Such a problem cannot be solved even by using the technique described in PTL 1 or the like. Accordingly, an object of the present invention is to provide a control apparatus, a control method, and a recording medium that are capable of solving the above-described problem.

Solution to Problem

[0007]

In order to achieve the object, a control apparatus as an aspect of the present disclosure includes: a detecting unit configured to detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed; an identifying unit configured to identify the control target from the image data in

accordance with the mark detected by the detecting unit; and a control unit configured to control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the control target identified by the identifying unit.

[0008]

Further, a control method as another aspect of the present disclosure is a control method performed by an information processing apparatus, and the control method includes: detecting, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed; identifying the control target from the image data in accordance with the detected mark; and controlling the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

[0009]

Further, a recording medium as another aspect of the present disclosure is a non-transitory computer-readable recording medium on which a program is recorded, and the program includes instructions for causing an information processing apparatus to implement processes to: detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed; identify the control target from the image data in accordance with the detected mark; and control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

Advantageous Effects of Invention

[0010]

According to each of the above-described configurations, it is possible to reduce the time required for reading an information code, for example, when the imaging device

is controlled to read the information code.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a diagram illustrating an example configuration of an overall control system.

[Fig. 2] Fig. 2 is a block diagram illustrating an example configuration of a control apparatus.

[Fig. 3] Fig. 3 is a diagram for explaining example processing performed by the control apparatus.

[Fig. 4] Fig. 4 is a diagram for explaining example processing performed by a candidate identifying unit.

[Fig. 5] Fig. 5 is a diagram for explaining example processing performed by a mark detecting unit.

[Fig. 6] Fig. 6 is a diagram for explaining example processing performed by a control target identifying unit.

[Fig. 7] Fig. 7 is a diagram for explaining example processing performed by a focus adjusting unit.

[Fig. 8] Fig. 8 is a diagram for explaining example processing performed by the focus adjusting unit.

[Fig. 9] Fig. 9 is a flowchart illustrating an example operation of the control apparatus.

[Fig. 10] Fig. 10 is a diagram illustrating an example hardware configuration of a control apparatus according to a second example embodiment of the present disclosure.

[Fig. 11] Fig. 11 is a block diagram illustrating an example configuration of the control apparatus.

[Fig. 12] Fig. 12 is a flowchart illustrating an example operation of the control apparatus.

Example Embodiment

[0012]

[First Example Embodiment]

A first example embodiment of the present invention will be described with reference to Figs. 1 to 9. Fig. 1 is a diagram illustrating an example configuration of an overall control system 100. Fig. 2 is a block diagram illustrating an example configuration of a control apparatus 300. Fig. 3 is a diagram for explaining example processing performed by the control apparatus 300. Fig. 4 is a diagram for explaining example processing performed by a candidate identifying unit 353. Fig. 5 is a diagram for explaining example processing performed by a mark detecting unit 354. Fig. 6 is a diagram for explaining example processing performed by a control target identifying unit 355. Figs. 7 and 8 are diagrams for explaining example processing performed by a focus adjusting unit 357. Fig. 9 is a flowchart illustrating an example operation of the control apparatus 300. In the present disclosure, the drawings may be associated with one or more respective embodiments.

[0013]

The first example embodiment of the present disclosure describes the control system 100 capable of reading, from a long distance or the like, an information code to be read by controlling the imaging device 200, such as a PTZ (pan-tilt-zoom) camera, that acquires image data. For example, when the system user or the like holds up an information processing terminal or the like displaying an information code, the control system 100 acquires image data in which such a state is captured as a subject, by using the imaging device 200. In other words, the control system 100 acquires image data including, as a subject, the information code to be read. Further, upon acquiring the image data from the imaging device 200, the control system 100 uses the acquired image data to detect a mark for identifying the information processing terminal or the like displaying the information code to be read. In other words, the control system 100 detects a mark for identifying the information processing terminal or the like to be a control target toward which an imaging direction or the like of the imaging device 200 is to be directed.

Thereafter, the control system 100 identifies the control target from among the image data in accordance with the detected mark. For example, among rectangular objects included in the image data, the control system 100 identifies, as the control target, a rectangular object on which the detected mark is displayed, a rectangular object having the shortest distance from the detected mark, or the like. Then, after controlling the imaging device 200 in such a manner that the identified control target is positioned at the center of the image data, the control system 100 controls the imaging device 200 in such a manner that a size of the information code to be read becomes large enough to be read. In other words, after controlling a pan-tilt function of the imaging device 200 in such a manner that the identified control target is positioned at the center of the image data acquired by the imaging device 200, the control system 100 controls a zoom function of the imaging device 200 until the size of the identified control target becomes sufficiently large.

[0014]

Further, before identifying the control target in accordance with the mark, the control system 100 can identify candidates in accordance with a skeleton of a person detected from the image data. For example, the control system 100 detects a skeleton of a person from the acquired image data. The control system 100 then identifies, in accordance with the detected skeleton, candidates for the control target from among rectangular objects or the like included in the image data. For example, among the rectangular objects included in the image data, the control system 100 identifies, as candidates, a rectangular object having a distance from the detected skeleton that is equal to or less than a predetermined value, a rectangular object having a distance from a skeleton that can be determined to be in a predetermined posture, such as a posture in which an information processing terminal is held up, that is equal to or less than a predetermined value, or the like. In this case, the control system 100 may identify the control target, in accordance with the detected mark, from among the control targets identified as the candidates.

[0015]

Further, after controlling the zoom function of the imaging device 200, the

control system 100 can perform focus adjustment using image data acquired after zooming. For example, the control system 100 acquires a profile of a predetermined portion of the information code, such as a finder pattern for position detection in a QR Code® or the like. In other words, the control system 100 acquires information indicating an outline of the information code, such as a change in pixel values at a predetermined position of the information code. Further, the control system 100 determines whether a width ε of a peak that can be identified by calculating a derivative of the acquired information is equal to or less than a predetermined value. The control system 100 then controls the focus of the imaging device 200 in such a manner that the width ε of the peak is equal to or less than the predetermined value. For example, through the processing described above, after controlling the zoom function, the control system 100 focuses on the information code to be read. Thereafter, the control system 100 can read the information code using image data acquired after the focusing.

[0016]

In the present disclosure, the mark is any mark capable of identifying the control target, which is a target toward which the imaging device 200 is directed, and may include any object, color, pattern, or the like. For example, as will be described later, the mark is a pattern, color, or the like displayed in a margin portion different from a display portion of the information code in an information processing terminal or the like that displays the information code. For example, the mark may be any pattern or color identifiable from a long distance, such as a black circle or red color. Further, the mark may be a predetermined object, such as a side mirror or a steering wheel of a vehicle, in addition to a mark displayed together with the information code in an information processing terminal or the like that displays the information code. For example, when it is predetermined that a person sitting in a driver's seat displays the information code, the side mirror, the steering wheel, or the like may be used as the mark. The mark may be appropriately determined according to, in addition to the examples described above, a prior arrangement concerning a person who displays the information code.

[0017]

Further, the information code to be read described in the present disclosure is, for example, a two-dimensional code such as a QR Code®. The read target may be a one-dimensional code such as a barcode, or may be any other information. Further, in the present disclosure, a case is described in which the information code to be read is displayed on an information processing terminal such as a smartphone or a tablet terminal. In other words, a case is described in which the control target is an information processing terminal such as a smartphone or a tablet terminal. However, the information code may be displayed by a method other than being displayed on the information processing terminal, for example, by being printed on paper. Accordingly, the control target is not necessarily limited to an information processing terminal, and may be paper or the like on which the information code is displayed.

[0018]

Fig. 1 illustrates an example configuration of the overall control system 100. Referring to Fig. 1, the control system 100 includes the imaging device 200 and the control apparatus 300. As illustrated in Fig. 1, the imaging device 200 and the control apparatus 300 are connected to each other in such a manner that they can communicate with each other by wire or wirelessly.

[0019]

Fig. 1 illustrates, as an example, a case in which an information code displayed on an information processing terminal held up by a person present in a vehicle is read using the imaging device 200 and the control apparatus 300. However, the present invention is not limited to a case in which a person is present in a vehicle, and can be applied to various situations, such as any situation in which the imaging device 200 is controlled to read an information code. For example, the control system 100 may be configured to read an information code displayed on an information processing terminal held up by a walking person or the like.

[0020]

The imaging device 200 is a camera, such as a PTZ camera, whose imaging direction is controllable. For example, the imaging device 200 has a pan-tilt function and

a zoom function for swinging the camera in a horizontal direction or a vertical direction and enlarging or reducing an imaging screen in accordance with control from the control apparatus 300.

[0021]

For example, the imaging device 200 acquires time-series image data at predetermined intervals. The imaging device 200 may continue to acquire image data at the predetermined intervals while changing an imaging direction or the like and performing focus adjustment in accordance with control from the control apparatus 300 described later. Further, the imaging device 200 can transmit the acquired image data to the control apparatus 300.

[0022]

The control apparatus 300 is an information processing apparatus that controls the imaging device 200, such as controlling an imaging direction and a zoom function of the imaging device 200 and adjusting focus, and that reads an information code in accordance with image data acquired by the imaging device 200. Referring to Fig. 2, the control apparatus 300 includes, as main components, for example, an operation input unit 310, a screen display unit 320, a communication interface unit 330, a storage unit 340, and an arithmetic processing unit 350.

[0023]

Fig. 2 illustrates, as an example, a case in which functions as the control apparatus 300 are implemented using one information processing apparatus. However, at least part of the functions as the control apparatus 300 may be implemented using a plurality of information processing apparatuses, for example, by being implemented on a cloud. Further, the control apparatus 300 need not include part of the configuration described above, such as the operation input unit 310 or the screen display unit 320, and may have a configuration other than the configuration described above.

[0024]

The operation input unit 310 includes an operation input device such as a keyboard and a mouse. The operation input unit 310 detects an operation performed by an

operator who operates the control apparatus 300, and outputs the detected operation to the arithmetic processing unit 350.

[0025]

The screen display unit 320 includes a screen display device such as a liquid crystal display or an organic EL (electro-luminescence) display. The screen display unit 320 can display, on a screen, various types of information stored in the storage unit 340 in accordance with an instruction from the arithmetic processing unit 350.

[0026]

The communication interface unit 330 includes a data communication circuit or the like. The communication interface unit 330 performs data communication with an external device, such as the imaging device 200, connected via a communication line.

[0027]

The storage unit 340 is a storage device such as a hard disk or a memory. The storage unit 340 stores processing information and a program 342 necessary for various types of processing performed by the arithmetic processing unit 350. The program 342 implements various processing units by being loaded into and executed by the arithmetic processing unit 350. The program 342 is read in advance from an external device or a recording medium via a data input/output function such as the communication interface unit 330, and is stored in the storage unit 340. Main information stored in the storage unit 340 includes, for example, image information 341.

[0028]

The image information 341 includes image data acquired by the imaging device 200. For example, the image information 341 includes time-series image data acquired by the imaging device 200. The image information 341 is updated in response to, for example, acquisition of image data from the imaging device 200 by an image data acquiring unit 351.

[0029]

The arithmetic processing unit 350 includes an arithmetic processing device such as a CPU (Central Processing Unit) and peripheral circuits thereof. The arithmetic

processing unit 350 reads the program 342 from the storage unit 340 and executes the program 342, thereby causing the hardware described above and the program 342 to cooperate with each other to implement various processing units. Main processing units implemented by the arithmetic processing unit 350 include, for example, the image data acquiring unit 351, a skeleton detecting unit 352, a candidate identifying unit 353, a mark detecting unit 354, a control target identifying unit 355, an imaging device control unit 356, a focus adjusting unit 357, a reading unit 358, and the like.

[0030]

The arithmetic processing unit 350 may include, instead of the CPU described above, a GPU (Graphic Processing Unit), a DSP (Digital Signal Processor), an MPU (Micro Processing Unit), an FPU (Floating Point Number Processing Unit), a PPU (Physics Processing Unit), a TPU (Tensor Processing Unit), a quantum processor, a microcontroller, or a combination thereof.

[0031]

The image data acquiring unit 351 acquires, from the imaging device 200, image data acquired by the imaging device 200. Further, the image data acquiring unit 351 stores the acquired image data in the storage unit 340 as the image information 341.

[0032]

As illustrated in Fig. 3, the skeleton detecting unit 352 detects, in accordance with image data, a skeleton of a person included in the image data. For example, the skeleton detecting unit 352 can detect the skeleton of the person in response to inputting the image data to a skeleton detection model trained in advance.

[0033]

For example, in response to inputting the image data to the skeleton detection model, the skeleton detecting unit 352 detects respective parts corresponding to at least an upper body of the person, such as shoulders, elbows, and wrists of the person, and acquires information indicating coordinates of the respective parts in the image data. The skeleton detecting unit 352 may be configured to also detect parts other than the upper body.

[0034]

As will be described later, the skeleton detecting unit 352 may be configured to detect a skeleton and to detect a posture that can be determined in accordance with the detected skeleton. For example, the skeleton detecting unit 352 may detect a skeleton and a posture in accordance with the image data in response to inputting the image data to a model trained in advance in such a manner as to detect a skeleton and a posture.

[0035]

The candidate identifying unit 353 identifies, from the image data, candidates for a control target toward which an imaging direction of the imaging device 200 is to be directed, in accordance with a detection result obtained by the skeleton detecting unit 352. For example, the candidate identifying unit 353 detects rectangular objects in accordance with the image data, and identifies candidates for the control target from among the detected rectangular objects in accordance with the detection result obtained by the skeleton detecting unit 352. As one example, the candidate identifying unit 353 can identify candidates for the control target in accordance with a distance between a rectangular object detected in accordance with the image data and a skeleton of a person detected by the skeleton detecting unit 352.

[0036]

For example, the candidate identifying unit 353 detects rectangular objects in the image data using an object detection model such as YOLO (You Only Look Once). Further, the candidate identifying unit 353 identifies, as candidates for the control target, rectangular objects satisfying a predetermined condition among the detected rectangular objects. For example, the candidate identifying unit 353 identifies, as a candidate for the control target, a rectangular object whose distance from a predetermined part, such as an elbow or a wrist, among parts corresponding to the skeleton detected by the skeleton detecting unit 352, is equal to or less than a predetermined value. Further, the candidate identifying unit 353 may perform the above identification in accordance with a distance from a skeleton that can be determined to be in a predetermined posture, such as a posture of holding up an information processing terminal. For example, the candidate identifying

unit 353 determines whether a posture of a person is a predetermined posture, such as a posture of holding up an information processing terminal, by determining whether coordinates of the respective parts detected by the skeleton detecting unit 352 satisfy a predetermined condition. Thereafter, the candidate identifying unit 353 identifies, as a candidate for the control target, a rectangular object whose distance from a predetermined part, such as an elbow or a wrist, of a skeleton that can be determined to be in the predetermined posture is equal to or less than a predetermined value.

[0037]

For example, in the case illustrated in Fig. 3, the candidate identifying unit 353 detects rectangular objects r1, r2, and r3 from the image data using the object detection model. Further, in the example illustrated in Fig. 3, each of the rectangular objects r1 and r2 has a distance from a predetermined part, such as an elbow or a wrist, detected by the skeleton detecting unit 352, the distance being equal to or less than a predetermined value. On the other hand, the rectangular object r3 has a distance from the predetermined part, such as the elbow or the wrist, detected by the skeleton detecting unit 352, the distance exceeding the predetermined value. Accordingly, as illustrated in Fig. 4, the candidate identifying unit 353 identifies, as candidates for the control target, the rectangular objects r1 and r2 among the rectangular objects r1, r2, and r3 in the image data, in accordance with the detection result obtained by the skeleton detecting unit 352.

[0038]

The candidate identifying unit 353 may determine the posture by inputting the coordinates of the respective parts detected by the skeleton detecting unit 352 to a model trained in advance. Further, as described above, the posture may be determined by the skeleton detecting unit 352 instead of the candidate identifying unit 353. In this case, the candidate identifying unit 353 may identify candidates for the control target using the posture detected by the skeleton detecting unit 352.

[0039]

Further, the candidate identifying unit 353 may identify candidates in accordance with a detection result of a face of a person or the like, instead of the skeleton or the

posture. For example, the candidate identifying unit 353 may be configured to identify candidates by detecting a face of a person in accordance with image data and determining whether the detected face of the person faces forward. For example, the candidate identifying unit 353 can identify candidates in accordance with a distance between a face facing forward and a rectangular object.

[0040]

The mark detecting unit 354 detects, in accordance with the image data, a predetermined mark for identifying the control target.

[0041]

For example, the mark detecting unit 354 detects, as the mark, a mark that is a predetermined color or pattern. For example, as illustrated in Fig. 5, when an information code is displayed on an information processing terminal or the like, a predetermined pattern, color, or the like is displayed in a margin portion different from a display portion of the information code. The mark detecting unit 354 can detect the mark displayed as described above by detecting a color or pattern present in a rectangular object that is a candidate for the control target identified by the candidate identifying unit 353 in the image data. The mark detecting unit 354 may detect, as the mark, at least one predetermined one of a color and a pattern. Further, instead of, or together with, the color, the pattern, or the like, the mark detecting unit 354 can detect, as the mark, a predetermined object present outside the rectangular object, such as a side mirror or a steering wheel of a vehicle. The mark detecting unit 354 may detect, as the mark, any object determined in advance, in addition to the side mirror or the like. The mark detecting unit 354 may detect the mark by any means, such as by using a predetermined model.

[0042]

For example, in the case illustrated in Figs. 3 to 5, the mark detecting unit 354 can detect, in accordance with the image data, a mark m1 that is a predetermined color, pattern, or the like as the mark. Further, the mark detecting unit 354 may detect, as the mark, a mark m2 that is a predetermined object together with the mark m1 or instead of

the mark m1.

[0043]

The mark detecting unit 354 may be configured to detect a mark other than the marks described above. For example, the mark detecting unit 354 may be configured to detect, as the mark, a skeleton of a person or the like by using a processing result of the skeleton detecting unit 352 described above or by performing processing similar to that of the skeleton detecting unit 352. Further, the mark detecting unit 354 may be configured to detect, as the mark, a face of a person, such as a person looking forward. For example, the mark detecting unit 354 may be configured to detect the mark by detecting a face of a person in accordance with the image data and determining whether the detected face of the person faces forward.

[0044]

The control target identifying unit 355 identifies a control target from the image data using the mark detected by the mark detecting unit 354. For example, the control target identifying unit 355 can identify the control target from among the candidates for the control target identified by the candidate identifying unit 353 using the mark detected by the mark detecting unit 354.

[0045]

For example, among the candidates for the control target identified by the candidate identifying unit 353, the control target identifying unit 355 identifies, as the control target, a candidate in which the mark has been detected inside the rectangle by the mark detecting unit 354. Further, among the candidates for the control target identified by the candidate identifying unit 353, the control target identifying unit 355 may identify, as the control target, a candidate having the shortest distance from the mark detected by the mark detecting unit 354.

[0046]

For example, in the case illustrated in Fig. 4, rectangular objects r1 and r2 in the image data are identified as candidates for the control target by the candidate identifying unit 353. Further, as illustrated in Fig. 4, the mark m1 is detected by the mark detecting

unit 354 inside the rectangular object r2 among the candidates. Alternatively, the distance between the mark m2 detected by the mark detecting unit 354 and the rectangular object r2 is shorter than the distance between the mark m2 and the rectangular object r1. Accordingly, as illustrated in Fig. 6, the control target identifying unit 355 identifies, as the control target, the rectangular object r2 in which the mark m1 has been detected, among the candidates for the control target. Alternatively, the control target identifying unit 355 identifies, as the control target, the rectangular object r2 having the shortest distance from the mark m2 among the candidates for the control target. When different control targets can be identified in accordance with respective ones of a plurality of marks, the control target identifying unit 355 may identify the control target in accordance with, for example, priorities of the marks determined in advance.

[0047]

The imaging device control unit 356 controls the imaging device 200 in accordance with a result identified by the control target identifying unit 355. For example, the imaging device control unit 356 controls a pan-tilt function of the imaging device 200 in accordance with the result identified by the control target identifying unit 355, and then controls a zoom function of the imaging device 200.

[0048]

For example, in accordance with the result identified by the control target identifying unit 355, the imaging device control unit 356 controls the pan-tilt function of the imaging device 200 in such a manner that an imaging direction of the imaging device 200 is directed toward the control target identified by the control target identifying unit 355. In other words, the imaging device control unit 356 controls the pan-tilt function of the imaging device 200 in such a manner that the identified control target is positioned at the center of image data acquired by the imaging device 200. Further, after the above control, the imaging device control unit 356 controls the zoom function of the imaging device 200. For example, the imaging device control unit 356 controls the zoom function of the imaging device 200 until a size of the control target identified by the control target identifying unit 355 in the image data acquired by the imaging device 200 becomes

sufficiently large. The degree to which zooming is performed may be determined as desired.

[0049]

After the zoom function is controlled by the imaging device control unit 356, the focus adjusting unit 357 performs focus adjustment using image data acquired by the imaging device 200 after zooming. For example, when only zooming is performed, focus may not be achieved, and in a case where an attempt is made to read the information code in such a state, unnecessary time may be spent on the reading process. Accordingly, after the zoom function is controlled by the imaging device control unit 356, the focus adjusting unit 357 performs focus adjustment using image data acquired by the imaging device 200 after zooming.

[0050]

Fig. 7 illustrates an example profile of a finder pattern in a state in which focus is not achieved, and Fig. 8 illustrates an example profile of a finder pattern in a state in which focus is achieved. As illustrated in Fig. 7, in a state in which focus is not achieved, when changes in pixel values corresponding to respective positions passing through the finder pattern as indicated by the arrow in Fig. 7 are acquired and a derivative thereof is calculated, a width ε of a peak exceeds a predetermined value, as illustrated in Fig. 7. On the other hand, as illustrated in Fig. 8, in a state in which focus is achieved, when changes in pixel values corresponding to respective positions passing through the finder pattern are acquired and a derivative thereof is calculated, the width ε of the peak becomes substantially zero. Accordingly, the focus adjusting unit 357 identifies the width ε of the peak by acquiring, using image data acquired by the imaging device 200 after zooming, changes in pixel values at predetermined positions and calculating a derivative thereof. Further, the focus adjusting unit 357 performs focus adjustment by adjusting a focus value or the like in the imaging device 200 in such a manner that the identified width ε of the peak becomes equal to or less than a predetermined value, such as zero.

[0051]

The reading unit 358 reads an information code serving as a read target using

image data acquired by the imaging device 200. For example, the reading unit 358 can read the information code using image data acquired by the imaging device 200 after the focus adjustment by the focus adjusting unit 357.

[0052]

The above is an example configuration of the control apparatus 300. Next, an example operation of the control apparatus 300 will be described with reference to Fig. 9. The processing illustrated in Fig. 9 can be started, for example, when it is detected that a vehicle has entered a predetermined area. Here, the predetermined area is, for example, an area in which immigration examination is performed at an immigration examination gate. Entry into such an area may be detected using a sensor or the like installed at the immigration examination gate. The above-described sensor may be implemented by imaging means such as a camera, or may be a proximity sensor or the like. Further, the sensor may be a sensor that detects weight or the like. The flow illustrated in Fig. 9 may be executed immediately after the entry is detected, or may be executed after the entry is detected and after predetermined processing, such as processing for requesting display of the information code, is executed. The processing illustrated in Fig. 9 may be started at any timing other than the examples described above.

[0053]

Fig. 9 is a flowchart illustrating an example operation of the control apparatus 300. Referring to Fig. 9, the skeleton detecting unit 352 detects, in accordance with image data, a skeleton of a person included in the image data (step S101). For example, the skeleton detecting unit 352 may detect the skeleton of the person in response to inputting the image data to a skeleton detection model trained in advance.

[0054]

The candidate identifying unit 353 identifies, from the image data, candidates for a control target toward which an imaging direction of the imaging device 200 is to be directed, in accordance with a detection result obtained by the skeleton detecting unit 352 (step S102). For example, the candidate identifying unit 353 detects rectangular objects in accordance with the image data, and identifies candidates for the control target from

among the detected rectangular objects in accordance with the detection result obtained by the skeleton detecting unit 352.

[0055]

The mark detecting unit 354 detects, in accordance with the image data, a predetermined mark for identifying the control target (step S103). For example, the mark detecting unit 354 can detect, as the mark, a color or pattern present at a predetermined location, a predetermined object, or the like.

[0056]

The control target identifying unit 355 identifies the control target from among the candidates for the control target identified by the candidate identifying unit 353 using the mark detected by the mark detecting unit 354 (step S104).

[0057]

The imaging device control unit 356 controls the imaging device 200 in accordance with a result identified by the control target identifying unit 355 (step S105). For example, the imaging device control unit 356 controls a pan-tilt function of the imaging device 200 in accordance with the result identified by the control target identifying unit 355, and then controls a zoom function of the imaging device 200.

[0058]

The focus adjusting unit 357 identifies a width ε of a peak by acquiring, using image data acquired by the imaging device 200 after zooming, changes in pixel values at predetermined positions and calculating a derivative thereof (step S106). Further, when the width ε of the peak exceeds a predetermined value (step S107, No), the focus adjusting unit 357 adjusts a focus value of the imaging device 200 (step S108). Thereafter, the process returns to step S106. On the other hand, when the width ε of the peak is equal to or less than the predetermined value (step S107, Yes), the reading unit 358 reads the information code using image data acquired by the imaging device 200 after focus adjustment by the focus adjusting unit 357 (step S109).

[0059]

The above is an example operation of the control apparatus 300.

[0060]

As described above, the control apparatus 300 includes the mark detecting unit 354, the control target identifying unit 355, and the imaging device control unit 356. According to such a configuration, the imaging device control unit 356 can control the imaging device 200 in such a manner that the imaging direction is directed toward the control target identified by the control target identifying unit 355 in accordance with the mark detected by the mark detecting unit 354. For example, when rectangular objects such as information processing terminals are simply detected using YOLO or the like, it may be impossible to distinguish an information processing terminal displaying an information code serving as a read target from other rectangular objects. As a result, the imaging device 200 may be controlled in an erroneous direction. On the other hand, according to the present disclosure, because the control target is identified in accordance with the mark as described above, the possibility that the imaging device 200 is controlled in an erroneous direction can be reduced. This makes it possible to reduce time required for reading.

[0061]

Further, the control apparatus 300 includes the skeleton detecting unit 352 and the candidate identifying unit 353. According to such a configuration, the control target identifying unit 355 can identify the control target from among the candidates identified by the candidate identifying unit 353 in accordance with the detection result obtained by the skeleton detecting unit 352. As a result, the control target can be identified more appropriately, and time required for reading can be reduced more appropriately.

[0062]

Further, the control apparatus 300 includes the focus adjusting unit 357 and the reading unit 358. According to such a configuration, the reading unit 358 can read the information code using image data acquired after adjustment by the focus adjusting unit 357 has been performed. When reading is attempted in a state in which focus is not achieved after zooming, unnecessary effort may be required and unnecessary time may be spent. By reading the information code after focus adjustment as in the present disclosure,

time required for reading can be reduced more appropriately.

[0063]

In the present disclosure, a case has been illustrated in which the control apparatus 300 identifies the control target from among the candidates for the control target. However, the control apparatus 300 may be configured to identify the control target from among rectangular objects in the image data in accordance with the detected mark, without identifying the candidates. In such a configuration, the control apparatus 300 need not have functions as the skeleton detecting unit 352 or the candidate identifying unit 353. Further, the control target identifying unit 355 may have a function of performing object detection such as YOLO.

[0064]

The control system 100 described in the present disclosure can be used, for example, to enable faster examination at the time of immigration examination, such as in a case where any information including passport information is read using an information code in a state in which an entrant is present in a vehicle. In addition to the cases described above, the control system 100 may be applied to various situations in which it is necessary to control the imaging device 200 when reading an information code.

[0065]

Further, in the present disclosure, a case has been described in which the control system 100 includes the imaging device 200 and the control apparatus 300. However, the imaging device 200 may have at least part of the functions of the control apparatus 300. Further, when the imaging device 200 has the functions of the control apparatus 300 described in the present disclosure, the control system 100 may be constituted only by the imaging device 200.

[0066]

[Second Example Embodiment]

Next, a second example embodiment of the present disclosure will be described with reference to Figs. 10 to 12. Fig. 10 is a diagram illustrating an example hardware configuration of a control apparatus 400. Fig. 11 is a block diagram illustrating an

example configuration of the control apparatus 400. Fig. 12 is a flowchart illustrating an example operation of the control apparatus 400.

[0067]

In the second example embodiment of the present disclosure, the control apparatus 400, which is an information processing apparatus that controls an imaging device for the purpose of reading a read target such as an information code, will be described. Fig. 10 illustrates an example hardware configuration of the control apparatus 400. Referring to Fig. 10, as an example, the control apparatus 400 has the following hardware configuration including:

a CPU (Central Processing Unit) 401, which is an arithmetic processing device;

a ROM (Read Only Memory) 402, which is a storage device;

a RAM (Random Access Memory) 403, which is a storage device;

programs 404 loaded into the RAM 403;

a storage device 405 that stores the programs 404;

a drive device 406 that reads from and writes to a recording medium 410 external to the information processing apparatus;

a communication interface 407 connected to a communication network 411 external to the information processing apparatus;

an input/output interface 408 that inputs and outputs data; and

a bus 409 that connects the respective components.

[0068]

Further, the control apparatus 400 can implement functions as a detecting unit 421, an identifying unit 422, and a control unit 423 illustrated in Fig. 11 by causing the CPU 401 to acquire and execute the programs 404. The programs 404 are, for example, stored in advance in the storage device 405 or the ROM 402, and are loaded into the RAM 403 or the like and executed by the CPU 401 as necessary. Further, the programs 404 may be supplied to the CPU 401 via the communication network 411, or may be stored in advance in the recording medium 410 and supplied to the CPU 401 by being read by the drive device 406.

[0069]

Fig. 10 illustrates an example hardware configuration of the control apparatus 400. The hardware configuration of the control apparatus 400 is not limited to the example described above. For example, the control apparatus 400 may be constituted by part of the configuration described above, such as a configuration not including the drive device 406. Further, the CPU 401 may be a GPU or the like described as an example in the first example embodiment.

[0070]

The detecting unit 421 acquires image data including, as a subject, a read target such as an information code. Then, in accordance with the acquired image data, the detecting unit 421 detects, from the image data, a predetermined mark capable of identifying a control target, the control target being a target that displays the read target and toward which an imaging device that acquires the image data is to be directed.

[0071]

The identifying unit 422 identifies the control target from the image data in accordance with the mark detected by the detecting unit 421. For example, among rectangular objects detected from the image data, the identifying unit 422 identifies, as the control target, a rectangular object in which the mark has been detected by the detecting unit 421.

[0072]

The control unit 423 controls the imaging device that acquires the image data in such a manner that an imaging direction of the imaging device is directed toward the control target identified by the identifying unit 422.

[0073]

The above is an example configuration of the control apparatus 400. Next, an example operation of the control apparatus 400 will be described with reference to Fig. 12.

[0074]

Fig. 12 is a flowchart illustrating an example operation of the control apparatus

400. Referring to Fig. 12, in accordance with image data including a read target as a subject, the detecting unit 421 detects, from the image data, a predetermined mark capable of identifying a control target, the control target being a target that displays the read target and toward which an imaging device that acquires the image data is to be directed.

[0075]

The identifying unit 422 identifies the control target from the image data in accordance with the mark detected by the detecting unit 421.

[0076]

The control unit 423 controls the imaging device that acquires the image data in such a manner that an imaging direction of the imaging device is directed toward the control target identified by the identifying unit 422.

[0077]

The above is an example operation of the control apparatus 400.

[0078]

As described above, the control apparatus 400 includes the detecting unit 421, the identifying unit 422, and the control unit 423. According to such a configuration, the control unit 423 can control the imaging device that acquires the image data in such a manner that the imaging direction of the imaging device is directed toward the control target identified by the identifying unit 422 in accordance with the mark detected by the detecting unit 421. As a result, the possibility that the imaging device is controlled toward an erroneous target can be reduced. This makes it possible to reduce time required for reading.

[0079]

The control apparatus 400 described above can be implemented by incorporating a predetermined program into an information processing apparatus such as the control apparatus 400. Specifically, a program according to another aspect of the present invention is a program for causing an information processing apparatus such as the control apparatus 400 to **implement processing to** detect, from image data and in

accordance with the image data including a read target as a subject, a predetermined mark capable of identifying a control target, the control target being a target that displays the read target and toward which an imaging device that acquires the image data is to be directed; identify the control target from the image data in accordance with the detected mark; and control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

[0080]

Further, a control method executed by an information processing apparatus such as the control apparatus 400 described above is a method in which the information processing apparatus detects, from image data and in accordance with the image data including a read target as a subject, a predetermined mark capable of identifying a control target, the control target being a target that displays the read target and toward which an imaging device that acquires the image data is to be directed; identifies the control target from the image data in accordance with the detected mark; and controls the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

[0081]

An invention directed to the program having the configuration described above, a computer-readable recording medium recording the program, or the control method can achieve the object of the present disclosure described above because the invention produces operations and effects similar to those of the control apparatus 400 described above.

[0082]

<Supplementary Notes>

Some or all of the above-described example embodiments may also be described as in the following supplementary notes. An outline of a control apparatus and the like according to the present invention will be described below. However, the present invention is not limited to the following configurations.

[0083]

(Supplementary Note 1)

A control apparatus comprising:

a detecting unit configured to detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed;

an identifying unit configured to identify the control target from the image data in accordance with the mark detected by the detecting unit; and

a control unit configured to control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the control target identified by the identifying unit.

(Supplementary Note 2)

The control apparatus according to supplementary note 1, wherein the detecting unit is configured to detect, as the mark, at least one of a predetermined pattern and a predetermined color, the at least one being present, in the image data, inside a rectangular object detected from the image data.

(Supplementary Note 3)

The control apparatus according to supplementary note 1 or 2, wherein the detecting unit is configured to detect, as the mark, a predetermined object present, in the image data, outside a rectangular object detected from the image data.

(Supplementary Note 4)

The control apparatus according to any one of supplementary notes 1 to 3, further comprising:

a skeleton detecting unit configured to detect, in accordance with the image data, a skeleton of a person included in the image data; and

a candidate identifying unit configured to identify, from the image data, a candidate for the control target in accordance with a detection result obtained by the skeleton detecting unit,

wherein the identifying unit is configured to identify, in accordance with the

mark detected by the detecting unit, the control target from the candidate identified by the candidate identifying unit.

(Supplementary Note 5)

The control apparatus according to supplementary note 4, wherein the candidate identifying unit is configured to identify a candidate for the control target in accordance with a posture of a person determinable in accordance with a detection result obtained by the skeleton detecting unit.

(Supplementary Note 6)

The control apparatus according to supplementary note 4 or 5, wherein the candidate identifying unit is configured to identify a candidate for the control target in accordance with a distance between a rectangular object detected in accordance with the image data and a skeleton of a person detected by the skeleton detecting unit.

(Supplementary Note 7)

The control apparatus according to any one of supplementary notes 1 to 6, wherein the control unit is configured to control a zoom function of the imaging device, after the imaging direction of the imaging device is directed toward the control target, in such a manner that a size of the control target in image data acquired by the imaging device becomes a predetermined size,

the control apparatus further comprising:

a focus adjusting unit configured to perform focus adjustment using image data acquired by the imaging device after zooming; and

a reading unit configured to perform processing for reading the read target using image data acquired by the imaging device after the adjustment by the focus adjusting unit.

(Supplementary Note 8)

The control apparatus according to supplementary note 7, wherein the focus adjusting unit is configured to perform focus adjustment by adjusting a focus value of the imaging device in such a manner that a width of a peak identifiable in accordance with a change in pixel values at a predetermined position in the image data becomes equal to or

less than a predetermined value.

(Supplementary Note 9)

A control method performed by an information processing apparatus, the control method comprising:

detecting, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed;

identifying the control target from the image data in accordance with the detected mark; and

controlling the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

(Supplementary Note 10)

A program comprising instructions for causing an information processing apparatus to implement processes to:

detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed;

identify the control target from the image data in accordance with the detected mark; and

control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

[0084]

Some or all of the configurations described in Supplementary Notes 2 to 8, which depend from the control apparatus described in Supplementary Note 1, may also depend, in a similar dependent relationship, from the control method described in Supplementary Note 9, the program described in Supplementary Note 10, and the like. Furthermore, not only with respect to Supplementary Notes 9 and 10, but also with

respect to various hardware, software, various recording means for recording software, or systems within a range not departing from the example embodiments described above, some or all of the configurations described as the supplementary notes may similarly depend therefrom.

[0085]

The program described in each of the above-described example embodiments and supplementary notes may be stored in a storage device or recorded on a computer-readable recording medium. For example, the recording medium is a portable medium such as a flexible disk, an optical disk, a magneto-optical disk, or a semiconductor memory.

[0086]

Although the present invention has been described above with reference to the above-described example embodiments, the present invention is not limited to the example embodiments described above. Various changes that can be understood by a person skilled in the art may be made to the configuration and details of the present invention within the scope of the present invention.

[0087]

The present invention enjoys the benefit of priority based on Japanese Patent Application No. 2024-035762 filed in Japan on March 8, 2024, and the overall contents described in the patent application are incorporated herein.

Reference Signs List

[0088]

100 control system
200 imaging device
300 control apparatus
310 operation input unit
320 screen display unit
330 communication interface unit

340 storage unit
341 image information
342 program
350 arithmetic processing unit
351 image data acquiring unit
352 skeleton detecting unit
353 candidate identifying unit
354 mark detecting unit
355 control target identifying unit
356 imaging device control unit
357 focus adjusting unit
358 reading unit
400 control apparatus
401 CPU
402 ROM
403 RAM
404 programs
405 storage device
406 drive device
407 communication interface
408 input/output interface
409 bus
410 recording medium
411 communication network
421 detecting unit
422 identifying unit
423 control unit

CLAIMS

[Claim 1]

A control apparatus comprising:

a detecting unit configured to detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed;

an identifying unit configured to identify the control target from the image data in accordance with the mark detected by the detecting unit; and

a control unit configured to control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the control target identified by the identifying unit.

[Claim 2]

The control apparatus according to claim 1, wherein the detecting unit is configured to detect, as the mark, at least one of a predetermined pattern and a predetermined color, the at least one being present, in the image data, inside a rectangular object detected from the image data.

[Claim 3]

The control apparatus according to claim 1, wherein the detecting unit is configured to detect, as the mark, a predetermined object present, in the image data, outside a rectangular object detected from the image data.

[Claim 4]

The control apparatus according to claim 1, further comprising:

a skeleton detecting unit configured to detect, in accordance with the image data, a skeleton of a person included in the image data; and

a candidate identifying unit configured to identify, from the image data, a candidate for the control target in accordance with a detection result obtained by the skeleton detecting unit,

wherein the identifying unit is configured to identify, in accordance with the mark detected by the detecting unit, the control target from the candidate identified by the candidate identifying unit.

[Claim 5]

The control apparatus according to claim 4, wherein the candidate identifying unit is configured to identify a candidate for the control target in accordance with a posture of a person determinable in accordance with a detection result obtained by the skeleton detecting unit.

[Claim 6]

The control apparatus according to claim 4, wherein the candidate identifying unit is configured to identify a candidate for the control target in accordance with a distance between a rectangular object detected in accordance with the image data and a skeleton of a person detected by the skeleton detecting unit.

[Claim 7]

The control apparatus according to claim 1, wherein the control unit is configured to control a zoom function of the imaging device, after the imaging direction of the imaging device is directed toward the control target, in such a manner that a size of the control target in image data acquired by the imaging device becomes a predetermined size,

the control apparatus further comprising:

a focus adjusting unit configured to perform focus adjustment using image data acquired by the imaging device after zooming; and

a reading unit configured to perform processing for reading the read target using

image data acquired by the imaging device after the adjustment by the focus adjusting unit.

[Claim 8]

The control apparatus according to claim 7, wherein the focus adjusting unit is configured to perform focus adjustment by adjusting a focus value of the imaging device in such a manner that a width of a peak identifiable in accordance with a change in pixel values at a predetermined position in the image data becomes equal to or less than a predetermined value.

[Claim 9]

A control method performed by an information processing apparatus, the control method comprising:

detecting, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging device that acquires the image data is to be directed;

identifying the control target from the image data in accordance with the detected mark; and

controlling the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.

[Claim 10]

A non-transitory computer-readable recording medium on which a program is recorded, the program comprising instructions for causing an information processing apparatus to implement processes to:

detect, in accordance with image data including a read target as a subject, from the image data, a predetermined mark by which a control target can be identified, the control target displaying the read target and being a target toward which an imaging

device that acquires the image data is to be directed;

identify the control target from the image data in accordance with the detected mark; and

control the imaging device in such a manner that an imaging direction of the imaging device is directed toward the identified control target.