DESCRIPTION

CONTROL DEVICE, MONITORING SYSTEM, CONTROL METHOD, AND NON-TRANSITORY COMPUTER-READABLE RECORDING MEDIUM

[Technical Field]

[0001]

The present disclosure relates to a technology for controlling a mobile object.

[Background Art]

[0002]

There is a technology of monitoring a target to be monitored by controlling a mobile object such as a multicopter having an imaging function. Since power necessary for operating such a mobile object is supplied from a battery, and thus, an operating time is limited. Therefore, there is a problem that one mobile object cannot continuously monitor a target to be monitored for a long time.

[0003]

PTL 1 discloses a technology in which a plurality of unmanned aerial vehicles monitor a target to be monitored while taking over monitoring according to an instruction.

[0004]

PTL 2 discloses a drone security system having a function of relaying a plurality of drones in order to cover a monitoring range.

[0005]

A user views a video captured by a mobile object and grasps the state of a target to be monitored. As described above, in a case where monitoring is performed using a plurality of mobile objects, a video showing a target to be monitored is switched at the time of takeover of monitoring. Therefore, when monitoring is taken over, a user views a switched video.

The extraction unit 160 extracts a feature amount of the monitoring target with the next highest priority from the imaging data of the monitoring mobile object (S608).

[0145]

The processings of S609 to S612 correspond to the processings of S308 to S311 of the flowchart illustrated in Fig. 8. That is, the control device 103 extracts a feature amount of an object from a video based on imaging data of the selected mobile object, and causes the selected mobile object to monitor the monitoring target in a case where a result of collation using the extracted feature amounts indicates that the extracted feature amounts match each other. Therefore, a detailed description of the processings of S608 to S612 will be omitted.

[0146]

In a case where all the increased targets to be monitored (that is, all the targets to be monitored for which the priority has been set) are monitored by each of the mobile objects 200 (Yes in S613), the control device 103 ends the mobile object addition processing. In a case where not all the increased targets to be monitored are monitored by the mobile objects 200 (~~Yes~~No in S613), the control device 103 returns to the processing of S606.

[0147]

As described above, in a case where there are a plurality of targets to be monitored, the control device 103 according to the fourth example embodiment sets the monitoring priority for each target. In a case where the number of targets to be monitored increases, the control device 103 sets the priority for each target to be monitored, and controls the monitoring mobile object to monitor a monitoring target having the highest priority among the calculated priorities. With this configuration, the control device 103 according to the fourth example embodiment can

[0156]

<Example of Hardware Configuration of Control Device>

Hardware implementing the control devices of the first to fifth example embodiments will be described. Fig. 17 is a block diagram illustrating an example of a hardware configuration of a computer device that implements the control device in each example embodiment. Each block illustrated in Fig. 17 can be implemented by a combination of a computer device 10 that implements the control device and an ~~information processing~~ control method in each example embodiment and software.

[0157]

As illustrated in Fig. 17, the computer device 10 includes a processor 11, a random access memory (RAM) 12, a read only memory (ROM) 13, a storage device 14, an input/output interface 15, a bus 16, and a drive device 17. The control device may be implemented by a plurality of electric circuits.

[0158]

The storage device 14 stores a program (computer program) 18. The processor 11 executes the program 18 of the control device by using the RAM 12. Specifically, for example, the program 18 includes a program that causes a computer to perform the processing illustrated in Figs. 3, 7, 8, 9, 11, 12, 14, and 15. The processor 11 executes the program 18 to implement the functions of the components (for example, the acquisition units 110, 111, and 510, the prediction units 120, 121, and 520, the selection units 130, 131, and 530, the control units 140, 141, 142, and 540 described above) of the control device. The program 18 may be stored in the ROM 13. The program 18 may be recorded in a recording medium 20 and read using the drive device 17, or may be transmitted from an external device (not illustrated) to the computer device 10 via a network (not illustrated).

a control means for controlling the selected mobile object to move to a position for monitoring the target to be monitored.

[0166]

[Supplementary Note 2]

The control device according to Supplementary Note 1, in which

the selection means selects a mobile object having the longest monitorable time among the standby mobile objects.

[0167]

[Supplementary Note 3]

The control device according to Supplementary Note 2, in which

in a case where there are a plurality of mobile objects having the longest monitorable time,

the selection means selects a ~~standby~~ mobile object that takes the shortest time to move to a position of the monitoring mobile object among the standby mobile objects.

[0168]

[Supplementary Note 4]

The control device according to any one of Supplementary Notes 1 to 3, further including

a priority setting means for setting a monitoring priority for each target in a case where there are a plurality of targets to be monitored,

in which in a case where the number of targets to be monitored has increased,

the priority setting means sets the priority for each of the targets to be monitored, and

the control means controls the monitoring mobile object to monitor a target to be monitored having the highest set priority among the set priority.

[0169]

[Supplementary Note 5]

among the plurality of mobile objects, the standby mobile object being a mobile object being on standby among the plurality of mobile objects, the monitorable time being a time for which the target to be monitored is monitorable by each standby mobile object;

selecting, based on the monitorable time, at least one mobile object of a plurality of the standby mobile objects; and

controlling the selected mobile object to move to a position for monitoring the target to be monitored.

[0179]

[Supplementary Note 15]

The control method according to Supplementary Note 14, further including

selecting a mobile object having the longest monitorable time among the standby mobile objects.

[0180]

[Supplementary Note 16]

The control method according to Supplementary Note 15, further including,

in a case where there is a plurality of mobile objects having the longest monitorable time,

selecting a ~~standby~~ mobile object that takes the shortest time to move to a position of the monitoring mobile object among the standby mobile objects.

[0181]

[Supplementary Note 17]

The control method according to any one of Supplementary Notes 14 to 16, further including,

in a case where the number of targets to be monitored has increased, setting a monitoring priority for each target to be monitored, and

The computer-readable recording medium according to Supplementary Note 26, further causing a computer to perform,

in a case where there are a plurality of mobile objects having the longest monitorable time,

in the selecting processing, selecting a ~~standby~~ mobile object that takes the shortest time to move to a position of the monitoring mobile object among the standby mobile objects.

[0192]

[Supplementary Note 28]

The computer-readable recording medium according to any one of Supplementary Notes 25 to 27, further causing a computer to perform processing of

setting a monitoring priority for each target in a case where there are a plurality of targets to be monitored, and

in a case where the number of targets to be monitored has increased,

in the priority setting processing, setting the priority for each of the targets to be monitored, and

in the controlling processing, controlling the monitoring mobile object to monitor a target to be monitored having the highest set priority among the set priority.

[0193]

[Supplementary Note 29]

The computer-readable recording medium according to Supplementary Note 28, further causing the computer to perform processing of,

for the plurality of targets to be monitored except a target to be monitored that is being monitored by the monitoring mobile object in descending order of the set priority for the targets to be monitored,

CLAIMS

[Claim 1]

A control device comprising:

an acquisition means for acquiring position information, battery information, and movement capability information of each of a plurality of mobile objects;

a prediction means for predicting a monitorable time based on the position information of a monitoring mobile object, the position information of a standby mobile object, and the battery information and the movement capability information of each of the plurality of mobile objects, the monitoring mobile object being a mobile object monitoring a target to be monitored among the plurality of mobile objects, the standby mobile object being a mobile object being on standby among the plurality of mobile objects, the monitorable time being a time for which the target to be monitored is monitorable by each standby mobile object;

a selection means for selecting, based on the monitorable time, at least one mobile object of a plurality of the standby mobile objects; and

a control means for control the selected mobile object to move to a position for monitoring the target to be monitored.

[Claim 2]

The control device according to claim 1, wherein

the selection means selects a mobile object having a longest monitorable time among the standby mobile objects.

[Claim 3]

The control device according to claim 2, wherein

in a case where there are a plurality of mobile objects having the longest monitorable time,

the selection means selects a ~~standby~~ mobile object that takes a shortest time to move to a position of the monitoring mobile object among the standby mobile objects.

[Claim 4]

The control device according to any one of claims 1 to 3, further comprising

a priority setting means-for setting a monitoring priority for each target in a case where there are a plurality of targets to be monitored, wherein

in a case where the number of targets to be monitored has increased,

the priority setting means sets the priority for each of the targets to be monitored, and

the control means controls the monitoring mobile object to monitor a target to be monitored having a highest set priority among the set priority.

[Claim 5]

The control device according to claim 4, wherein,

for the plurality of targets to be monitored except a target to be monitored that is being monitored by the monitoring mobile object in descending order of the set priority for the targets to be monitored,

the prediction means predicts the monitorable times of the plurality of standby mobile objects,

the selection means selects at least one mobile object of the plurality of standby mobile objects, and

the control means moves the selected mobile object to the position for monitoring the target to be monitored.

[Claim 6]

The control device according to any one of claims 1 to 5, wherein

in a case where each of a plurality of the monitoring mobile objects monitors each of a plurality of the targets to be monitored, and the plurality of targets to be monitored join,

the control means controls one mobile object of the plurality of mobile objects to monitor the targets to be monitored after the joining, and controls another mobile object to move to a standby facility in which the mobile body stands by.

[Claim 7]

The control device according to any one of claims 1 to 6, wherein

the plurality of mobile objects each include

an imaging means for generating imaging data by imaging, and

a communication means for transmitting the imaging data,

the control device further comprises:

an extraction means for extracting a feature amount of an object included in a video based on imaging data transmitted from the selected mobile object and a feature amount of the target to be monitored included in a video based on imaging data transmitted from the monitoring mobile object; and

a collation means for collating the feature amount of the object with the feature amount of the target to be monitored, and

the control means controls the selected mobile object to monitor the target to be monitored in a case where the feature amount of the object and the feature amount of the target to be monitored match each other.

[Claim 8]

The control device according to any one of claims 1 to 7, wherein

the acquisition means acquires information indicating availability of the standby facility in which the mobile object stands by, and

the control means moves the monitoring mobile object to an available standby facility located closest to the position of the monitoring mobile object based on the information indicating the availability of the standby facility.

~~[Claim 9]~~

~~The control device according to claim 8, wherein~~

~~the prediction means predicts a cruising distance of the monitoring mobile object based on the battery information of the monitoring mobile object and the movement capability information of the monitoring mobile object, and~~

~~in a case where the cruising distance is insufficient for a distance from the position of the monitoring mobile object to the standby facility to which the monitoring mobile object is to be moved,~~

~~the control means moves a mobile object that is on standby in the standby facility located closest to the monitoring mobile object to another available standby facility, and moves the monitoring mobile object to the standby facility located closest to the monitoring mobile object.~~

~~[Claim 10]~~

~~The control device according to any one of claims 1 to 9, wherein~~

~~in a case where no target to be monitored is detected by the monitoring mobile object,~~

~~the control means causes the monitoring mobile object to monitor a predetermined range including a position at which no target to be monitored is detected, and moves the monitoring mobile object to the standby facility in which the mobile object stands by in a case where the monitoring mobile object did not detected the target to be monitored within a predetermined time.~~

~~[Claim 11]~~

~~The control device according to any one of claims 1 to 10, wherein~~

~~the acquisition means acquires information on a category of the target to be monitored, and~~

~~the selection means selects a mobile object movable at a speed corresponding to the category of the target to be monitored from among~~

~~the standby mobile objects whose monitorable time is equal to or longer than a predetermined value.~~

~~[Claim 12]~~

~~A monitoring system comprising:~~

~~a standby facility including a management means for managing a standby mobile object that is on standby in the standby facility; and~~

~~the control device according to any one of claims 1 to 11, wherein~~

~~the management means transmits, to the control device, the position information of the standby mobile object that is on standby in the standby facility and the battery information of the standby mobile object that is on standby in the standby facility.~~

~~[Claim 13]~~

~~The monitoring system according to claim 12, wherein~~

~~the management means acquires the position information of the monitoring mobile object and the battery information of the monitoring mobile object from the monitoring mobile object, and transmits the acquired position information of the monitoring mobile object and the acquired battery information of the monitoring mobile object to the control means.~~

[Claim ~~14~~9]

A control method comprising:

acquiring position information, battery information, and movement capability information of each of a plurality of mobile objects;

predicting a monitorable time based on the position information of a monitoring mobile object, the position information of a standby mobile object, and the battery information and the movement capability information of each of the plurality of mobile objects, the monitoring mobile object being a mobile object monitoring a target to be monitored among the plurality of mobile objects, the standby mobile object being a

mobile object being on standby among the plurality of mobile objects, the monitorable time being a time for which the target to be monitored is monitorable by each standby mobile object;

selecting, based on the monitorable time, at least one mobile object of a plurality of the standby mobile objects; and

controlling the selected mobile object to move to a position for monitoring the target to be monitored.

~~[Claim 15]~~

~~The control method according to claim 14, further comprising~~

~~selecting a mobile object having a longest monitorable time among the standby mobile objects.~~

~~[Claim 16]~~

~~The control method according to claim 15, further comprising,~~

~~in a case where there is a plurality of mobile objects having the longest monitorable time~~

~~selecting a standby mobile object that takes a shortest time to move to a position of the monitoring mobile object.~~

~~[Claim 17]~~

~~The control method according to any one of claims 14 to 16, further comprising,~~

~~in a case where the number of targets to be monitored has increased,~~

~~setting a monitoring priority for each target to be monitored, and~~

~~controlling the monitoring mobile object to monitor a target to be monitored having a highest set priority among the set priority.~~

~~[Claim 18]~~

~~The control method according to claim 17, further comprising,~~

~~for a plurality of targets to be monitored except a target to be monitored that is being monitored by the monitoring mobile object in~~

~~descending order of the set priority for the targets to be monitored,~~

~~predicting the monitorable times of the plurality of standby mobile objects,~~

~~selecting at least one mobile object of the plurality of standby mobile objects, and~~

~~moving the selected mobile object to the position for monitoring the target to be monitored.~~

~~[Claim 19]~~

~~The control method according to any one of claims 14 to 18, further comprising,~~

~~in a case where each of a plurality of the monitoring mobile objects monitors each of a plurality of the targets to be monitored, and the plurality of targets to be monitored join,~~

~~controlling one mobile object of the plurality of mobile objects to monitor the targets to be monitored after the joining, and controlling another mobile object to move to a standby facility in which the mobile body stands by.~~

~~[Claim 20]~~

~~The control method according to any one of claims 14 to 19, wherein~~

~~the plurality of mobile objects each include~~

~~an imaging means for generating imaging data by imaging, and~~

~~a communication means for transmitting the imaging data, and~~

~~the control method further comprises:~~

~~extracting a feature amount of an object included in a video based on imaging data transmitted from the selected mobile object and a feature amount of the target to be monitored included in a video based on imaging data transmitted from the monitoring mobile object;~~

~~collating the feature amount of the object with the feature amount~~

~~of the target to be monitored; and~~

~~controlling the selected mobile object to monitor the target to be monitored in a case where the feature amount of the object and the feature amount of the target to be monitored match each other.~~

~~[Claim 21]~~

~~The control method according to any one of claims 14 to 20, further comprising:~~

~~acquiring information indicating availability of the standby facility in which the mobile object stands by; and~~

~~moving the monitoring mobile object to an available standby facility located closest to the position of the monitoring mobile object based on the information indicating the availability of the standby facility.~~

~~[Claim 22]~~

~~The control method according to claim 21, further comprising:~~

~~predicting a cruising distance of the monitoring mobile object based on the battery information of the monitoring mobile object and the movement capability information of the monitoring mobile object; and~~

~~in a case where the cruising distance is insufficient for a distance from the position of the monitoring mobile object to the standby facility to which the monitoring mobile object is to be moved,~~

~~moving a mobile object that is on standby in the standby facility located closest to the monitoring mobile object to another available standby facility, and moving the monitoring mobile object to the standby facility located closest to the monitoring mobile object.~~

~~[Claim 23]~~

~~The control method according to any one of claims 14 to 22, further comprising,~~

~~in a case where no target to be monitored is detected by the~~

~~monitoring mobile object,~~

~~causing the monitoring mobile object to monitor a predetermined range including a position at which no target to be monitored is detected, and moving the monitoring mobile object to the standby facility in which the mobile object stands by in a case where the monitoring mobile object did not detected the target to be monitored within a predetermined time.~~ ~~[Claim 24]~~

~~The control method according to any one of claims 14 to 23, further comprising:~~

~~acquiring information on a category of the target to be monitored; and~~

~~selecting a mobile object movable at a speed corresponding to the category of the target to be monitored from among the standby mobile objects whose monitorable time is equal to or longer than a predetermined value.~~

[Claim ~~25~~10]

A non-transitory computer-readable recording medium storing a program causing a computer to perform:

processing of acquiring position information, battery information, and movement capability information of each of a plurality of mobile objects;

processing of predicting a monitorable time based on the position information of a monitoring mobile object, the position information of a standby mobile object, and the battery information and the movement capability information of each of the plurality of mobile objects, the monitoring mobile object being a mobile object monitoring a target to be monitored among the plurality of mobile objects, the standby mobile object being a mobile object being on standby among the plurality of mobile objects, the monitorable time being a time for which the target to

be monitored is monitorable by each standby mobile object;

processing of selecting, based on the monitorable time, at least one mobile object of a plurality of the standby mobile objects; and

processing of controlling the selected mobile object to move to a position for monitoring the target to be monitored.

~~[Claim 26]~~

~~The computer-readable recording medium according to claim 25, further causing a computer to perform,~~

~~in the selecting processing, selecting a mobile object having a longest monitorable time among the standby mobile objects.~~

~~[Claim 27]~~

~~The computer-readable recording medium according to claim 26, further causing a computer to perform,~~

~~in a case where there are a plurality of mobile objects having the longest monitorable time,~~

~~in the selecting processing, selecting a standby mobile object that takes a shortest time to move to a position of the monitoring mobile object.~~

~~[Claim 28]~~

~~The computer-readable recording medium according to any one of claims 25 to 27, further causing a computer to perform processing of~~

~~setting a monitoring priority for each target in a case where there are a plurality of targets to be monitored, and~~

~~in a case where the number of targets to be monitored has increased,~~

~~in the priority setting processing, setting the priority for each of the targets to be monitored, and~~

~~in the controlling processing, controlling the monitoring mobile object to monitor a target to be monitored having a highest set priority~~

~~among the set priority.~~

~~[Claim 29]~~

~~The computer readable recording medium according to claim 28, further causing the computer to perform processing of,~~

~~for the plurality of targets to be monitored except a target to be monitored that is being monitored by the monitoring mobile object in descending order of the set priority for the targets to be monitored,~~

~~predicting the monitorable times of the plurality of standby mobile objects in the predicting processing,~~

~~selecting at least one mobile object of the plurality of standby mobile objects in the selecting processing, and~~

~~moving the selected mobile object to the position for monitoring the target to be monitored in the controlling processing.~~

~~[Claim 30]~~

~~The computer readable recording medium according to any one of claims 25 to 29, further causing the computer to perform processing of,~~

~~in a case where each of a plurality of the monitoring mobile objects monitors each of a plurality of the targets to be monitored, and the plurality of targets to be monitored join,~~

~~in the controlling processing, controlling one mobile object of the plurality of mobile objects to monitor the targets to be monitored after the joining, and controlling another mobile object is controlled to move to a standby facility in which the mobile body stands by.~~

~~[Claim 31]~~

~~The computer readable recording medium according to any one of claims 25 to 30, wherein~~

~~the plurality of mobile objects each include~~

~~an imaging means for generating imaging data by imaging, and~~

~~a communication means for transmitting the imaging data,~~

~~the computer-readable recording medium further causes a computer to perform~~

~~processing of extracting a feature amount of an object included in a video based on imaging data transmitted from the selected mobile object and a feature amount of the target to be monitored included in a video based on imaging data transmitted from the monitoring mobile object, and~~

~~processing of collating the feature amount of the object with the feature amount of the target to be monitored, and~~

~~in the controlling processing, controlling the selected mobile object to monitor the target to be monitored in a case where the feature amount of the object and the feature amount of the target to be monitored match each other.~~

~~[Claim 32]~~

~~The computer-readable recording medium according to any one of claims 25 to 31, further causing the computer to perform processing of,~~

~~in the acquiring processing, acquiring information indicating availability of the standby facility in which the mobile object stands by, and~~

~~in the controlling processing, moving the monitoring mobile object to an available standby facility located closest to the position of the monitoring mobile object based on the information indicating the availability of the standby facility.~~

~~[Claim 33]~~

~~The computer-readable recording medium according to claims 32, further causing the computer to perform processing of,~~

~~in the predicting processing, predicting a cruising distance of the monitoring mobile object based on the battery information of the monitoring mobile object and the movement capability information of the monitoring mobile object, and~~

~~in a case where the cruising distance is insufficient for a distance from the position of the monitoring mobile object to the standby facility to which the monitoring mobile object is to be moved,~~

~~in the controlling processing, moving a mobile object that is on standby in the standby facility located closest to the monitoring mobile object to another available standby facility, and the monitoring mobile object is moved to the standby facility located closest to the monitoring mobile object.~~

~~[Claim 34]~~

~~The computer-readable recording medium according to any one of claims 25 to 33, further causing the computer to perform processing of,~~

~~in a case where no target to be monitored is detected by the monitoring mobile object,~~

~~in the controlling processing, causing the monitoring mobile object to monitor a predetermined range including a position at which no target to be monitored is detected, and moving the monitoring mobile object to the standby facility in which the mobile object stands by in a case where the monitoring mobile object did not detected the target to be monitored within a predetermined time.~~

~~[Claim 35]~~

~~The computer-readable recording medium according to any one of claims 25 to 34, further causing the computer to perform processing of,~~

~~in the acquiring processing, acquiring information on a category of the target to be monitored, and~~

~~in the selecting processing, selecting a mobile object movable at a speed corresponding to the category of the target to be monitored from among the standby mobile objects whose monitorable time is equal to or longer than a predetermined value.~~