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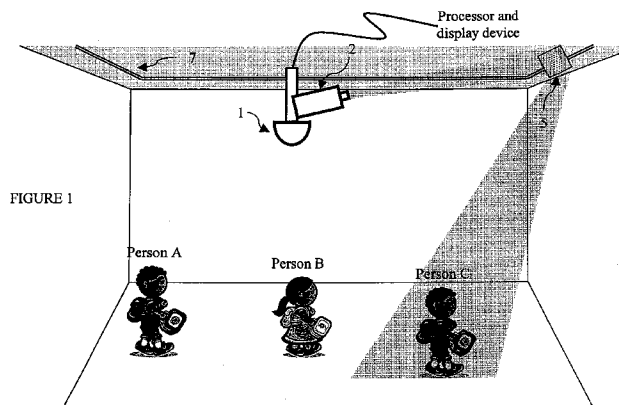
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(54) Title: A SURVEILLANCE SYSTEM



(57) Abstract: The present invention provides a surveillance method and system for capturing a target's image that is directly opposite from the camera. The system utilizes a wide-angle camera (1), a narrow-angle camera (2) and a mirror (5) wherein the mirror (5) is positioned to reflect a target image that is directly opposite to the wide-angle (1) and narrow angle camera (2). The narrow-angle camera (2) is used to capture the image that is reflected from the mirror (5).



A SURVEILLANCE SYSTEM

BACKGROUND OF THE INVENTION

- 5 This invention relates to an active video surveillance system, more particularly where a moving target can be tracked.

DESCRIPTION OF PRIOR ART

- 10 It is very common to find video surveillance system installed in places like shopping malls, public buildings, banks or even houses. Such system is used to monitor incoming and outgoing vehicles and people, as well as ongoing activities that are happening within the surveillance area and the recorded videos are retrieved and reviewed. Sometimes, one finds that the information that were recorded are either too small or blur such that any critical information cannot be extracted.

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US 20070019073 and US 7,292,264 describes a system that utilizes both wide-angle camera and narrow-angle camera.

- 20 US 7,006,950 describes a system that utilizes both wide-angle camera and narrow-angle camera. It is illustrated that the narrow-angle camera is placed directly in front of the target such that the target's face is captured.

US 2004/0189801 describes a system that utilizes both wide-angle camera and narrow-angle camera. The use of a mirror is also described in this document.

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US 6,970,576 discloses a surveillance system which utilizes normal resolution camera with wide to normal field of view and high resolution camera with narrow view.

- 30 None of these prior arts discloses a system and method that is able to capture a target's image that is in the opposite direction of the surveillance camera as well as capturing a target's image that is in the direction of the camera.

The object of the invention is to provide a surveillance system that allows the user to track a target's face within the monitoring view.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the set up of the system of the present invention

5

Figure 2 illustrates a top view of the system.

Figure 3 illustrates the interaction of the cameras with the mirror and target.

10 Figure 4 illustrates the two types of modes available in the present invention.

Figure 5 illustrates the flow diagram of the Normal Tracking Mode

Figure 6 illustrates the flow diagram of the Face Tracking Mode.

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SUMMARY OF THE INVENTION

This invention provides a surveillance system that comprises of a wide-angle camera for capturing a first image of a large area which includes a target object, a narrow-angle camera for capturing the image of the target, a processor which captures, records and process video images, a display device for displaying the frame images processed by said processor and at least a reflective device, positioned to reflect the target's image that is opposite from the wide angle camera.

20

The reflective device is preferably capable of panning and tilting, and can be arranged to engage with a rail such that the mirror is movable along the rail. This rail can be either a close loop rail or an open loop rail.

25

It is preferred that the wide-angle camera and/ or the narrow-angle camera is installed with a controller such that the camera is able to pan and tilt.

30

With this configuration, the surveillance method utilizes the reflective device such that it is positioned to reflect a target's face which is opposite to the wide-angle and narrow-angle camera and the narrow angle camera is used to capture the image that is reflected from the reflective device.

The mirror's docking position, panning angle and tilting angle are calculated from the target's moving direction and position.

- 5 The narrow angle camera's panning and tilting angles are calculated from mirror's docking position and tilting angle.

The zoom factor of the camera is calculated from the target's face blob size in the current frame.

10

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

- Figure 1 illustrates the set up of the system of the present invention, comprising of a wide-angle camera (1) (or the like), a narrow-angle camera (2) (or PTZ camera) and a reflecting device (5) such as a mirror. It should be understood here that the wide-angle camera (1) can also be replaced with the use of an omnidirectional video camera or; a parabolic mirror installed on the ceiling with a camera installed underneath and looking into the parabolic mirror, such that the camera can see simultaneously in all directions.

- 20 The wide-angle camera (1) (or the like) is used for taking wide-angle images within the surveillance area. In this figure, it can be seen that there are three people within the surveillance area. When a more detailed view of a specific spot or a target within the surveillance area is required, the narrow-angle camera (2) is then used for this purpose by directing the camera towards the target and zooming into the required spot.

- 25 A reflecting device (5) such as a mirror is provided in front of the wide-angle camera, such the target's image that is opposite to the wide-angle's camera (1) is reflected. The reflecting device (5) is capable of panning and tilting. It is also preferable that the mirror (5) is designed to be able to roam around a surveillance area by engaging with a rail (7). Such a rail (7) can be provided on the ceiling of a surveillance area, as shown in Figures 1.
- 30 The use of the mirror (5) will be clearer with the ongoing description.

The surveillance system of the present invention provides two different operational modes of surveillance and the overall flowchart of the two operational modes is illustrated in Figure 4, namely the "Normal Surveillance Mode" and "FaceTracking Mode".

NORMAL SURVEILLANCE MODE

A summary of the general flow of this mode is illustrated in Figure 5.

- 5 In this mode, only the wide-angle camera (1) and narrow-angle camera (2) are used. The mirror (5) is not utilized in this mode.

The wide-angle area is used to monitor a surveillance area and the detailed image of the target within the surveillance area is captured directly from the target using the narrow-
10 angle camera (2). The narrow-angle camera (2) control parameters (i.e. the panning angle, tilting angle and zooming factor) are determined with the use of the wide-angle camera (1).

To determine the panning angle of the narrow-angle camera (2), the angle of the target referenced with the wide-angle camera (1) is calculated.

15

The target's distance from the wide-angle camera (1) is then determined, and this provides the tilting angle of the narrow-angle camera (2) to be calculated.

The zooming factor of the narrow-angle camera (2) is determined by the blob size of the
20 target shown on the screen.

Once the processor determines all these information, a signal is sent to the camera controller to pan, tilt and zoom the narrow-angle camera (2) on the selected target, and the image is captured and re-produced on a display screen. The captured image can also be
25 recorded in the processor.

All of the above calculations can be done by methods that are known in the art.

FACE TRACKING MODE

30 A summary of the general flow of this mode is illustrated in Figure 6.

This mode utilizes both the wide-angle camera (1) and narrow-angle camera (2) as well as the mirror (5).

The wide-angle camera (1) is used to monitor an area of interest. A target within the surveillance area is firstly selected. With the wide-angle camera (2), the target's moving direction and position is calculated using known methods. With both the target's position and moving direction known, a straight line can be projected from the target's position in the direction of the target's moving direction and the intersection point of this line with the mirror's rail (7) determines the mirror's docking position. This is illustrated in Figure 2. It can now be understood that the mirror's docking position is dependent on the target's moving direction and the docking position will change if the target's moving direction changes.

10

Once the mirror (5) is positioned, the best reflective view of the target's face is obtained by panning the mirror (5) until it is perpendicular to the target's moving direction. This is also illustrated in Figure 2.

15 With reference to Figure 3, as the target progresses towards the mirror (5), the mirror (5) should tilt toward the horizontal axis so that it is able to reflect the target's face. The target's position is therefore used to determine the tilting angle of the mirror. It should be understood that the mirror (5) is not limited to reflecting a target's "face". It is generally used to reflect any target's image that is substantially opposite from the wide-angle (1) and
20 narrow-angle (2) cameras.

Whilst this is ongoing, the narrow-angle camera (2) is directed at the mirror (5), so that it captures the reflected image. Both the narrow-angle camera's panning position and tilting angle are determined by the mirror's docking position and tilting angle.

25

Once the camera captures a reflected image, the blob size of the captured image in the current frame is determined. This enables the zoom factor of the narrow-angle camera (2) to be calculated and once the zoom factor is calculated, the narrow angle camera (2) is zoomed into the mirror (5), with the respective zoom factor, to capture the larger size of the target's face that is reflected from the mirror (5). The zoom factor is determined by
30 identifying the blob size in the current frame.

An example of the working system is described below.

With reference to Figure 1, both the wide-angle (1) and narrow-angle (2) video cameras are used to monitor an area of interest. When a target such as Person A is moving towards both the wide and narrow angle cameras (1,2), i.e. the target's moving direction is towards both the cameras, the Normal Surveillance Mode is used in this condition. The narrow-angle camera (2) can zoom directly onto the target's face.

Once the target has moved past both the wide and narrow angle cameras (1,2), the target's moving direction would be away from both the cameras and the target's face would be positioned in the opposite direction of both the cameras. Person C in Figure 1 illustrates this position. Hence, both cameras are unable to capture the face of the target of interest, and the system then switches to the Face Tracking Mode and the mirror (5) is utilized to capture the target's face.

Having described the preferred embodiments of the present invention, it should be understood that modifications and variations can be made by persons skilled in the art in light of the above teachings and the changes which are within the scope of the invention may be made. An example of such a modification would be to provide an open-looped rail instead of a close loop rail. Other modifications include the use of two mirrors on the same rail or two separate rails.

CLAIMS

What is claimed is:

- 5 1. A surveillance system comprising:
 at least one wide-angle camera (1) for capturing an image of a large area which
 includes a target object;
 at least one narrow-angle camera (2) which captures the image of said target;
 at least one processor which captures, records and process video images and;
10 at least one display device for displaying the frame images processed by said
 processor;
 characterized in that the system further comprising at least one reflective device
 (5), positioned to reflect the target's image that is substantially opposite from at
 least one wide angle camera (1) and the at least one narrow-angle camera (2).
- 15 2. A surveillance system as claimed in claim 1, further comprising of a controller so
 that the reflective device (5) is capable of panning and tilting.
- 20 3. A surveillance system as claimed in claim 1, further comprising at least a rail (7)
 and a controller such that the reflective device (5) can be moved along the rail (7).
4. A surveillance system as claimed in claim 3, wherein the rail (7) is a closed loop
 rail.
- 25 5. A surveillance system as claimed in claim 3 wherein the rail(7) is an open loop rail.
6. A surveillance system as claimed in claim 1 further comprising of a controller so
 that the wide angle camera is capable of panning, tilting and/or zooming.
- 30 7. A surveillance system as claimed in claim 1 further comprising of a controller such
 that the wide-angle camera (1) and narrow-angle camera (2) is capable of panning,
 tilting or zooming.

8. A surveillance system as claimed in claims 2, 3, 6, and 7 wherein the said controller is a general controller for controlling the panning, tilting of the wide-angle camera (1), narrow-angle camera (2) and reflective device (5), the zooming of the wide-angle (1) and narrow angle camera (2) and the movement of the reflective device (5) on the rail (7).
9. A surveillance system as claimed in claims 2, 3, 6, 7 and 8 wherein the controller is responsive to the said processor.
10. A surveillance method for a surveillance system comprising the steps of:
capturing an image of a large area including a target object with a wide-angle camera (1);
determining the target's position;
determining the target's moving direction;
determining an intersection point of the target's moving direction with a point on a rail (7) having a reflective device (5) movably engaged on the rail (7);
determining the panning angle of a narrow-angle camera (2) based on the intersection point;
moving a reflective device (5) to the intersection point; and
capturing the image reflected from the reflective device (5) using a narrow-angle camera (2).
11. A surveillance method for a surveillance system as claimed in claim 10 further comprising the steps of:
determining the reflective device's panning angle such that it is substantially perpendicular to the target's moving direction; and
panning the reflective device (5) to the determined panning angle, wherein the step of determining the reflective device's panning angle is executed after determining the target's moving direction.
12. A surveillance method for a surveillance system as claimed in any claims 10 - 11 further comprising the steps of:
determining the tilting angle of the reflective device (5); and

tilting the reflective device (5) to the determined tilting angle; wherein the step of determining the tilting angle of the reflective device (5) is executed after the step of determining the target's moving direction.

- 5 13. A surveillance method as claimed in any claims of 10 – 12 further comprising the steps of:

determining the narrow-angle camera's (2) tilting angle; and

moving the narrow-angle camera (2) to the determined tilting angle; wherein the step of determining the narrow-angle camera's (2) tilting angle is executed after the
10 step of determining the panning angle of the narrow-angle camera (2).

14. A surveillance method as claimed in claims 10 – 13 further comprising the steps of:
determining the target's face blob size in the current frame;

determining the zoom factor of the narrow angle camera (2);

- 15 and zooming the narrow-angle camera (2) to the determined zoom factor; wherein
the step of determining the target's face blob size is executed after the step of
capturing the image reflected from the reflective device.

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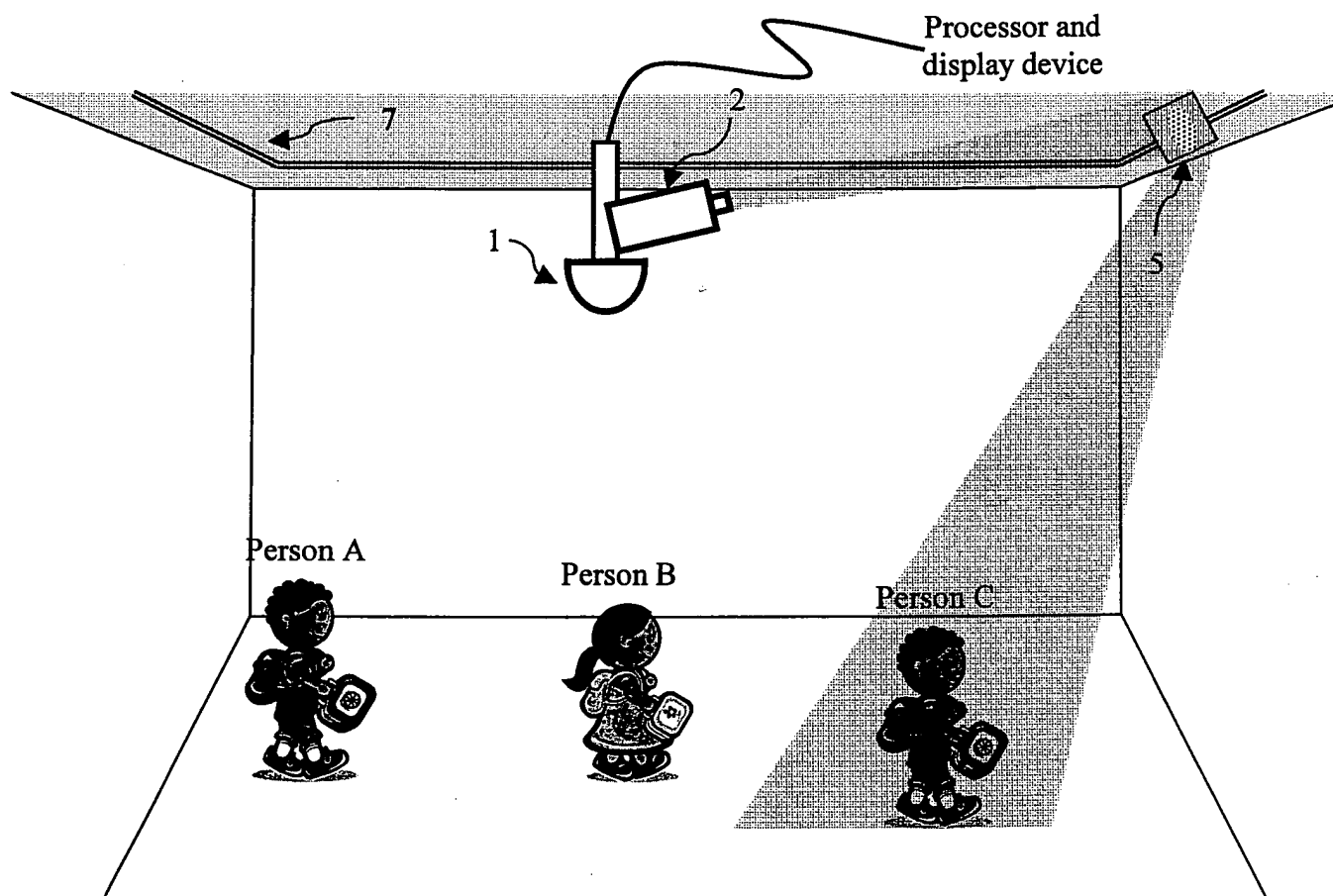


FIGURE 1

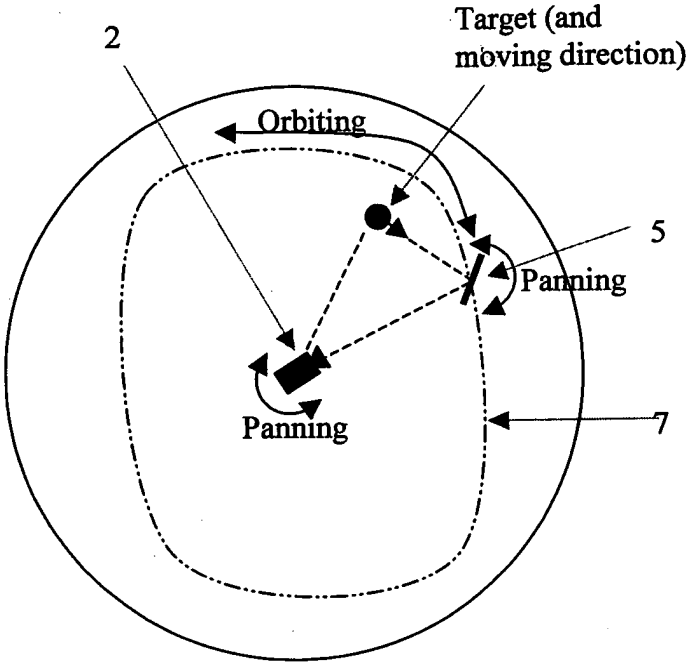


FIGURE 2

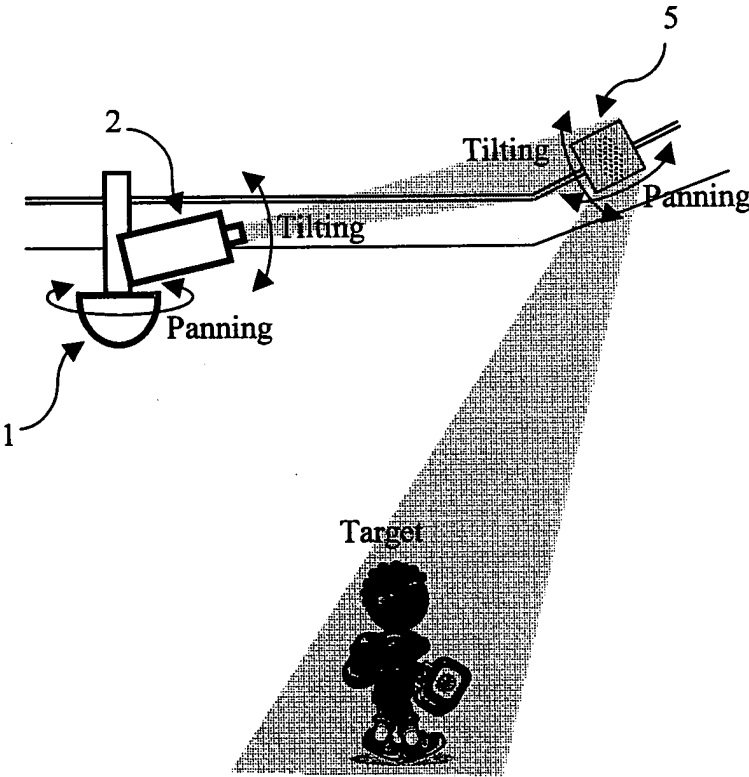


FIGURE 3

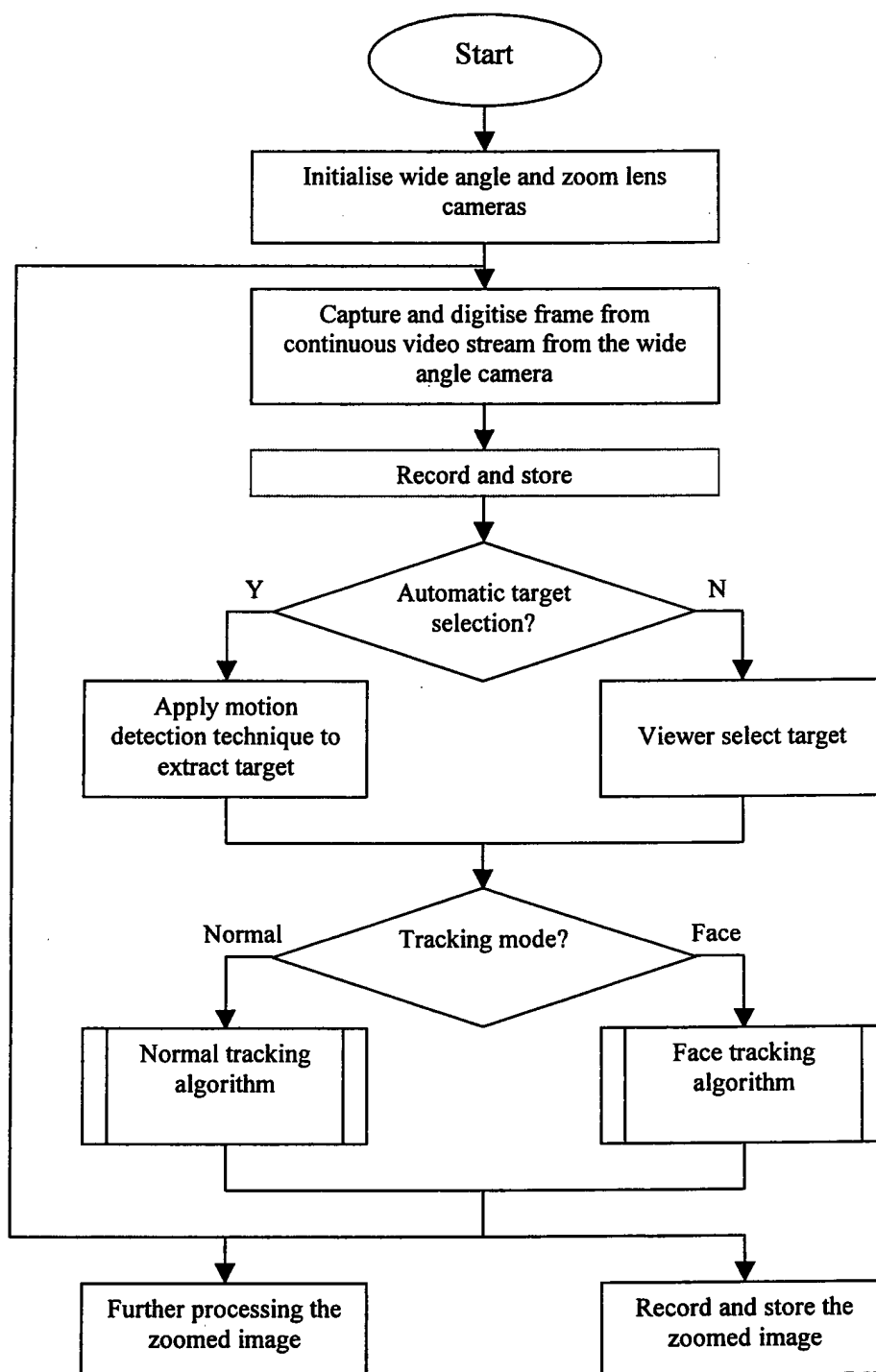


FIGURE 4

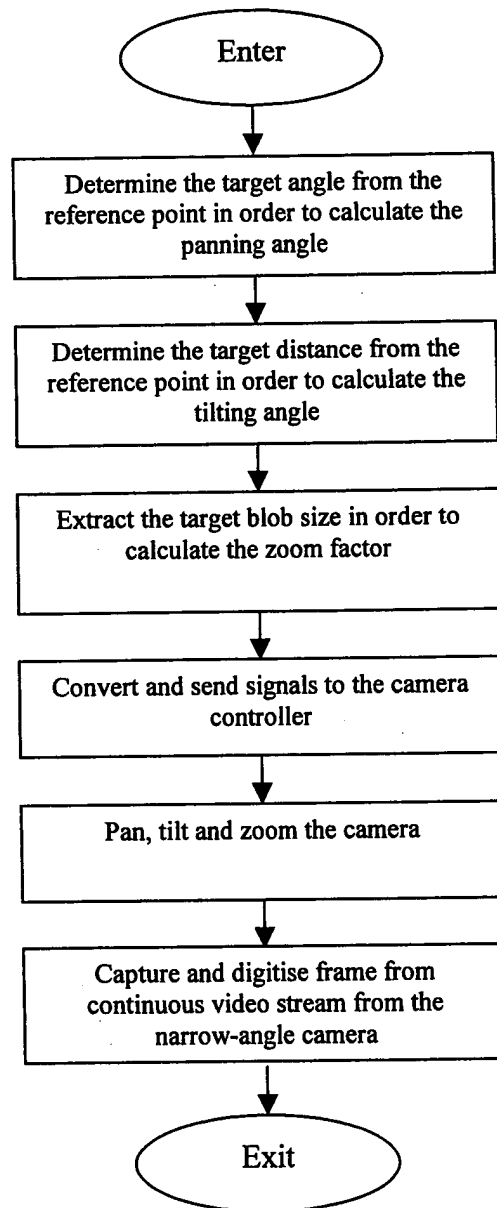


FIGURE 5

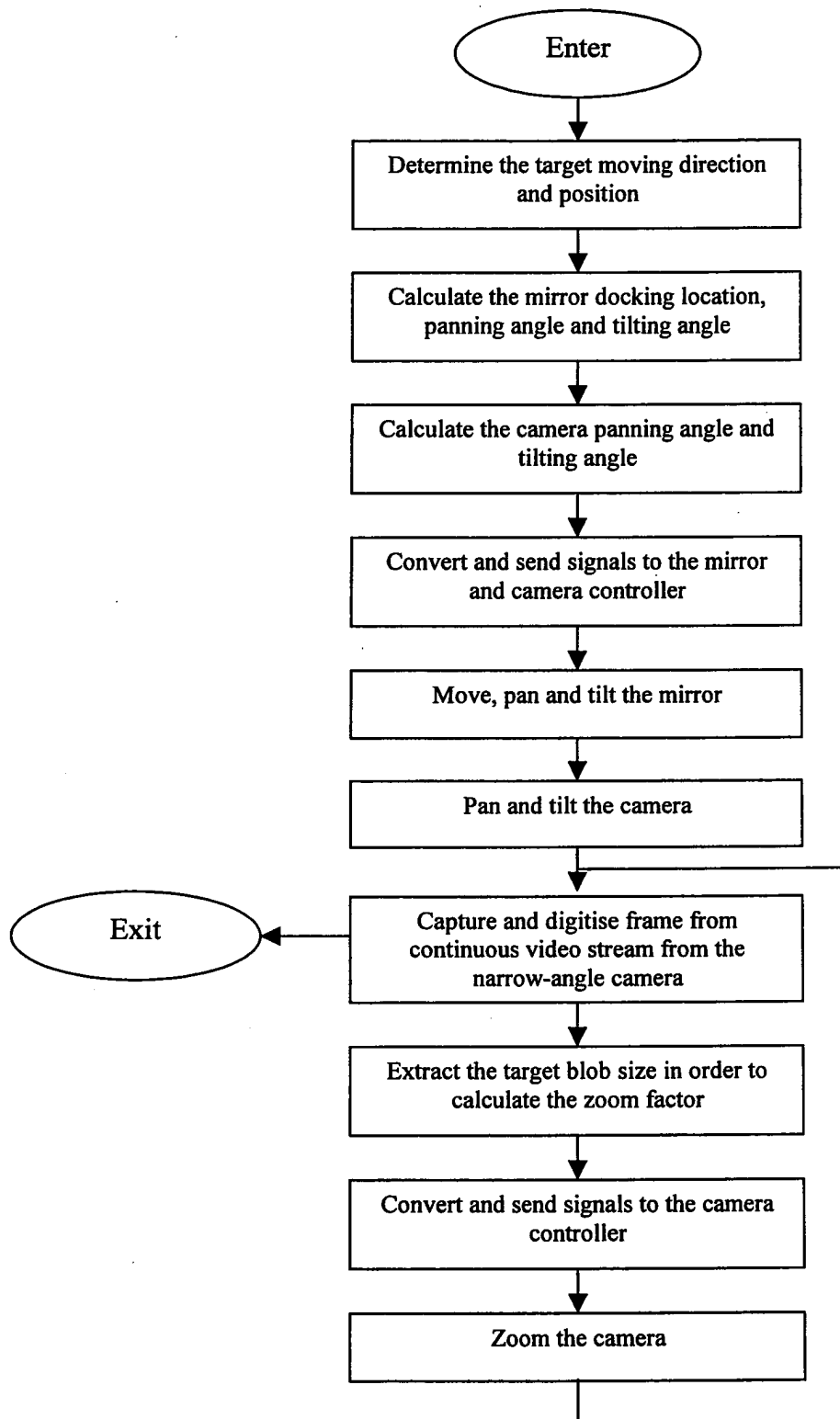


FIGURE 6