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Detection Method to Continue Tracking of Automatic Human Tracking System

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***Abstract*—In this paper, We propose detection method for automatic human tracking system. The detection method is "Ripple detection method". the Ripple detection method has a feature that the discovery time becomes shorter and usual tracking can resume more quickly, if the target person exists near where the agent lost. We have implemented the Ripple detection method in the automatic human tracking system. As a result, it have became possible to continue tracking when a target was lost.**

***Keywords*—Mobile Agent, Human Tracking System**

I. Introduction

In recent years, a video surveillance system is utilized by companies and public offices. Existing video surveillance system is efficient in locating suspicious people. However existing systems has limited capabilities, thus enhancement is still required. On one case it can not locate a numerous number of people at a time and automatically locate a particular person. In a conventional video surveillance system, the users are involved in heavy workload. Since the user will be mostly involved in switching from one video camera to the other, the number of suspicious people to locate is limited. Identifying a person from a numerous surveillance position also increases the workload of the user. In such cases it demands the user to carefully identify the person. We are developing the automatic human tracking system as one plan which solves such problems by using mobile agent technologies [1][2][3]. There is an advantage that the load is distributed to each server by using the mobile agent. The automatic human tracking system tracks a target by using a tracking method. This tracking method has a problem that tracking of a target stops when the automatic human tracking system loses the target.

In this paper, as a solution for this problem, we propose a method which can search and re-detect the target is lost. And, we implement this method in the automatic human tracking system.

II. Overview Of Automatic Human Tracking System

The system configuration of the automatic human tracking system is shown in Fig. 1. It assumes that the system is used in a building, the user captures an image of a face and a body of a person by a video camera, the user registers the image into the system and roaming person with unregistered image can be recognized. This system is composed of agent monitoring terminal, agent management server, video recording server and feature extraction server with video camera. The agent monitoring terminal is used for registering the person, for confirming the current location staying the agent, and for displaying video of the captured person. The agent management server records the agentfs tracking information, provides the information to the terminal and requests video image to the video recording server by an operation from the terminal. The video recording server records all video images and provides the images to the terminal by request from the agent management server. The feature extraction server sets up by the video camera, analyzes the person image and extracts the feature information from the image. An agent tracks the person by using the feature information and the neighbor nodes information.

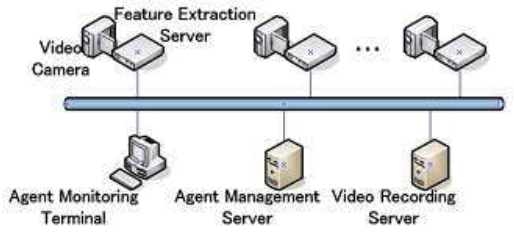

Fig. 1. System configuration of the automatic human tracking system.

The processing flow of the proposed system is the following:

1) The video recording server records video images from all video cameras at all time.
2) The user selects the person on the screen of the agent monitoring terminal, and extracts the tracked person's feature information as electronic.
3) A mobile agent is generated for the person and registered as the mobile agent information including the feature information into the system.
4) The mobile agent deployed on the first feature extraction server begins pursuing the person.
5) When the mobile agent finds the person, the mobile agent notifies the agent management server of the information such as the video camera number, the discovery time, and the mobile agent identifiers first to the Agent

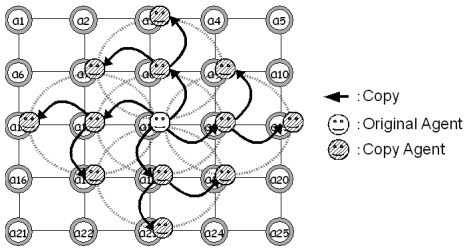

Fig. 2. How to widen the search range of Ripple detection method.

management server.

6) When the person moves to the area of the next video camera, the mobile agent transfers to the next video camera near the person.
7) If the mobile agent finds the person, the mobile agent notifies the agent management server of the information as stated on step (5).

The mobile agent repeats the above process from step (5) to (6) until the person goes out of a building.

III. Tracking Method

A mobile agent begins to track the target, after deployed on the feature extraction server. When the target moves to the area of the next camera, the number of neighbor cameras which a target can capture is limited. These feature extraction servers connected with such a camera are the neighbor nodes. The agent tracks the target, after deploying copied agent on the neighbor nodes. The processing flow of tracking method is the following:

1) The agent deploys agent's copy on the neighbor nodes.
2) The agent stays until capturing the target, and other agents which have not captured the target are deleted.
3) The agent that captured the target repeats from step(1).

The target behind other persons and luggage might not be captured by the image processing in the neighbor nodes. At that time, target can not be tracked by this tracking method. To solve this problem, it is necessary to search a target quickly by widening the search range when the target is not captured.

IV. Detection Method

The detection method is used to re-detect a target when the automatic tracking system loses the target. We propose detection method. This is "Ripple detection method". Ripple detection method is shown in Fig. 2. By this method, when the target cannot be discovered in a definite period of time, suppose that it is considered that the target was missed. This definite period of time is called the missed time in this paper. Ripple detection method widens a search like a ripple from where an agent lost a target to give top priority to re-detect. This method has a feature that the discovery time becomes shorter and usual tracking can resume more quickly, if the target exists near where the agent lost.

V. Examination

Examination environment is shown in Fig. 3. A simulator is used for the examination. There are 40 cameras in this

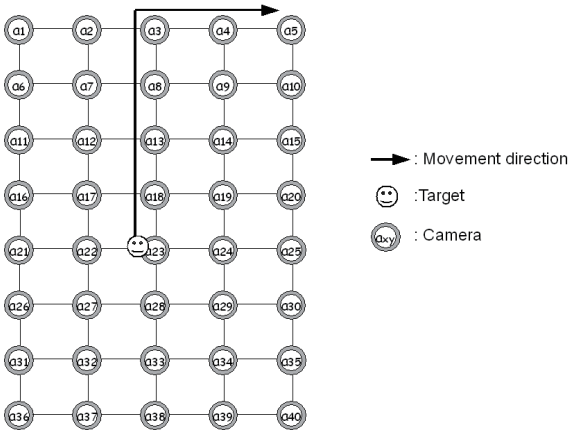

Fig. 3. Examination environment for detection method.

environment. The conditions of the examination are shown as follows.

- Cameras are equally arranged at a fixed interval, 20m.
- A target's feature information is constant.
- Only one target is searched.
- Walking speed of the target is constant.
- The target moves by order of a_{23}, a_{18}, a_{13}, a_8, a_3, a_4 and a_5.
- The missed time is 9 seconds.

In the examination, walking speed of the target is prepared using 2 patterns $2m/s$ and $3m/s$. And the search case of target is prepared using 2 patterns. First pattern is the target behind other persons and luggage is not captured by the image processing in a_{13}. Secound pattern is the target behind other persons and luggage is not captured by the image processing in a_8 and a_{13}. These 4 patterns were used in the examination. As a result, the Ripple detection method succeeded in tracking by all patterns.

VI. Conclusion

In this paper, we have proposed and implemented the Ripple detection method. As a result, it have became possible to continue tracking when a target was lost. However, when a discovery time is long, the Ripple detection method uses many resources of a system. In future work, we will propose and implement a detection method which uses a little resources of a system.

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