The Proposed Design of the Monitoring System for Security Breaches of Buildings Based on Behavioral Tracking

[1]Abdul Monem S. Rahma, [2]Abeer Salim Jamil
[1] Computer Science Department, University of Technology, Baghdad, Iraq ,
[2] Computer Science Department & Information Systems Department, Al-Mansour University College (MUC) ,Baghdad, Iraq,

Abstract
This paper presents a video security system that uses multiple static cameras to track several people in indoor and outdoor environments. This system has a set of cameras that coordinate the tracking tasks among the cameras. Since each object in the scene can be tracked by a number of cameras, the system is composed of two blocks: the terminal agent and the mobile agent. The mobile agent is capable of efficiently tracking humans by integrating information from the neighboring camera and terminal agents, so they collaborate on the autonomous investigation of a disappearing tracked object or human. The challenge in this paper to solve the scalability problem by introducing a balance that reduces the processing required for each neighbor camera and improves the QoS by reducing the camera frame rate, the number of objects currently tracked by each camera. The experimental results show that the system can coordinate the cameras to track people, solve the scalability problem, and improve the Quality of Service (QoS) .

Key Words:
Security system, Human track, Terminal agent,Video stream, Mobile agent, Scalability

1. Introduction[1,2,3,4]

The intelligent video security is an active in computer vision that tries to detect, recognize and track objects over a sequence of images and it also makes an attempt to understand and describe object behavior by replacing the aging old traditional method of monitoring cameras by human operators. A computer vision system, can monitor both immediate unauthorized behavior and long term suspicious behavior, and hence alerts the human operator for deeper investigation of the event. The intelligent video security system can be manual, semi-automatic, or fullyautomatidepending on the human intervention.
semi-automatic, or fully-automatic depending on the human intervention. . In manual video surveillance system, human operator responsible for monitoring does the entire task while watching the visual information coming from the different cameras.
For security applications or for human-computer interaction, the fully automated real-time tracking of moving objects in images from a stationary camera can be very useful.
Intelligent visual security systems deal with the real-time monitoring of persistent and transient objects within a specific environment. The primary aims of these systems are to provide an automatic interpretation of scenes and to understand and predict the actions and interactions of the observed objects based on the information acquired by IP Cameras. The main stages of processing in visual security system are moving object detection and recognition, tracking, behavioral analysis and retrieval. These stages involve of machine vision, pattern analysis, and data management.

2. Related Work[4]

Work on Multi-Camera Tracking on Distributed Smart-Cameras focus on implementing a decentralized, autonomous, multi-camera tracking approach using an agent system. In the first step, a tracking algorithm suitable for implementation on an embedded vision device was created, creating the Smart Camera, a prototype of an intelligent camera that was developed at the Institute for Technical Informatics at Graz University of Technology in cooperation with the Austrian Research Center Seibersdorf. The algorithm is also able to communicate with its controlling agent, so it is feasible to launch the algorithm on another camera. The approach was tested in a real-world scenario in which it tracked a person between two smart cameras. The primary task, which involves one agent who is responsible for the object's surveillance over multiple cameras, may be fulfilled. The work shows that the tracking approach that uses agents is highly scalable, but it is temporally limited by the Java based-agent system. In contrast, based on its memory costs and execution time, the tracking task executed on the Digital Signal Processor (DSP) is an excellent value.

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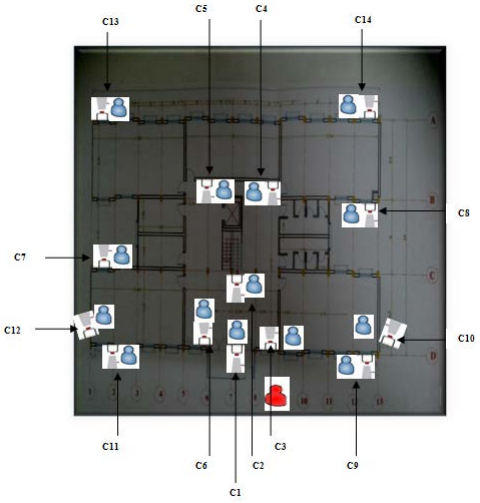
3. Problem Domain[4]

The main goal of this graduation project is to design an automatic suspicious behavior detection model using multiple cameras and implement part of it. The following two research questions form the basis of this goal.

Question 1: How can we use a video surveillance camera to replace the human eye?
Question 2: If reasoning is applied to the data from multiple cameras, to what extend can we automatically detect suspicious behavior?

To answer these research questions, the following sub goals are identified and used as a basis for this graduation project:

- Design a model of a system that is able to automatically detect suspicious behavior.
- Implement the video processing of a single video stream.
- Implement combining the information of multiple cameras to detect suspicious behavior.
- Perform experiments for both implementations and analyze the results.
- Give recommendations for future research.



4. The Proposed Tracking System

The proposed tracking system is essentially composed of two building blocks: the terminal agent and the mobile agent, and each of these building blocks has different assignments and functionality. The mobile agent is responsible for identifying tracked objects (i.e., human or other objects).In this proposal, we assume that the tracked objects create a complex structure, such as a human carrying other objects. This structure will be registered into the system before it is installed in the building.
When objects is registered, a dedicated mobile agent is created and bound to each object. Thus, the mobile agent is the software module responsible for identifying the object throughout the area that is monitored by the distributed camera system. The mobile agent in this system is able to interact with the database server, which contains a record that is updated every time the mobile agent tracks the object on each terminal node, as shown in Figure 1.

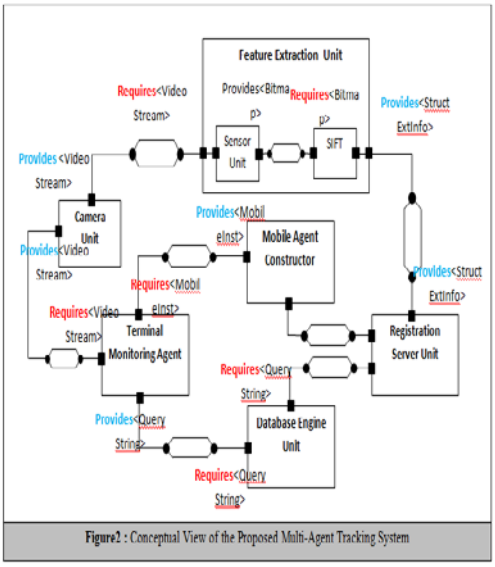


Figure2 : Conceptual View of the Proposed Multi-Agent Tracking System

After motion detection, the system tracks the moving objects from one frame to another using an image sequence that compares the current video frame with previous frames or with the background. The process of locating the moving object in a sequence of frames is known as tracking. Tracking can be performed using the feature extraction of the object and detects objects in a sequence of frames. The system applies the following hypotheses:

H1: The knowledge base of normal and abnormal behaviors is expanded over the deploying time;
H2: Scalability is increased due to smarter decisions;
H3: Terminal agents' collaboration autonomously investigates disappearing tracked objects or humans;
H4: The mobile agent is capable of efficiently tracking humans using integrated information from its neighbors.

5. Human Tracking

These features play an important role in tracking an object. Tracking can be categories into two types: region-based

tracking and contour-based tracking [1].Region-based tracking features a blob detected by two consecutive images, and if both match, these two frame objects are related. In contour-based tracking, if the boundary/contour energy of the blob detected in both frame matches, it is declared that the same object is present in both images.
In this paper, static background images are used because region tracking is very efficient when the stationary background is used[2].Therefore, to track human beings, the region-tracking method is used. Region tracking stores the features of the whole object, so it is able to match the features of an object in one frame with the features of the same object in the next frame. However, this procedure requires a significant amount of time for comparison. To reduce this wasted time, another approach, region tracking, may be applicable. The region method only matches most of the previous frame's region with most of the current frame's region. Hence, less time is required to match the whole image[5,6,7].

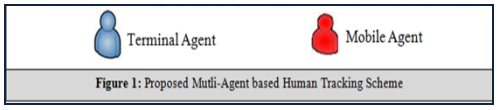


Figure 1: Proposed Mutli-Agent based Human Tracking Scheme

6. Experimental Results

We implemented the tracking system in a real environment. The goal is to use the system to analysis the behavior of the tracked people in a large environment.

6.1. The Environment

The environment consists of a lobby, offices, and corridor. We have mounted 12 static cameras throughout the tracked environment: one (six camera indoor) , two (8 camera outdoor) , . Figure 2 shows the camera positions. The IP cameras overlap each other and cover most of the ground plane in the scene. All the cameras are calibrated to get correspondence between points on the floor (ground plane) and points in the image.
We considered several scenarios in which people were walking throughout the environment. Each scenario is recorded in ten video files, and each video file contains the sequence of the frames from each camera view.
The recording frame rate is 5 frames/sec. These files are the input for the tracking system.

6.2. Evolution of the Result

We examine the system's ability to track multiple people using multiple cameras in the following scenarios:-

Scenario 1: The system uses multiple cameras to track the number of persons in the scene. The persons are being tracked by a camera2.When the one of the person moves out of camera 1's view, so it can no longer see the person clearly, the system will switch the tracking to the camera 4 that shows the person more clearly, preventing the system from losing the object, as shown in Figure 3.

Scenario 2: The system can track a group of people (crowed) in a scene using multiple cameras. When a group of people are crowed in a single space, the system begins to analyze the behavior of these people, count the number of people, and detect the motioning the environment. This is shown in Figure 4.

figure 4:Crowd of people outside building

Scenario 3: The system uses multiple cameras to track two people in ascend (out door). camera 1 can track Person1, but cannot track person 2 , the system switches the task of tracking person 2 to camera 9 to avoid the problem. . This is shown in Figure 5.
After applying the three scenarios, we can observe the four hypothesis are improve by the knowledge base

regarding behavior track is expanded over developing time, scalability is increased. Terminal agent collaboration produces an autonomous investigation for tracked objects that disappear, so human and mobile agents are able to efficiently track humans using the integrated information from neighboring cameras.

7. Conclusion

In this paper, we presented a security system to track multiple people using multiple cameras. For the system, we used a terminal agent to monitor people who were observed in a scene and to collect information about those people. This information was used by a mobile agent to determine the behavior of the people being tracked in the scene.

figure 5:View Camera of outdoor

After applying the three scenarios can be observe the four hypotheses are improved during the examination the system and solve the problem of scalability due to the implementation of intelligent agent by reducing process on each camera and improve the QoS by reduce camera frame rate, the number of objects currently tracked by each camera.

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Abeer Salim Jamil received B.Sc. in Computer Science from Technology University in 1997 and M.Sc. from Computer Science from Technology University in 2004 and PhD student (research level) in Computer Science from Technology University. Currently she is a Lecture in Computer Science & Information Systems Department/ Al-Mansour University College (MUC).Her research interests include Computer vision , Artificial Intelligent , Behavior Analysis , Multi - Agent System Design, Software Engineering, Multi Camera Track and Security.

Abdul Monem S. Rahma received M.Sc. from Brunel University and PhD from Loughborough University of technology, UK in 1982, 1984 respectively.
Currently, he fills the position of Dean and works as a professor at Computer Science Department, University of Technology, Iraq. He supervised 28 PhD and 57 M.Sc. students. His research interests include image processing, biometrics, computer security, and graphics.