Moving Object Tracking using PTZ Camera in Video Surveillance System

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***Abstract*—Tracking people or moving objects across a PTZ camera and maintaining a track within a camera is a challenging task in applications of video surveillance. The goal of object tracking is segmenting a region of interest from a video scene and keeping track of its motion, positioning and occlusion. The object detection and object classification are preceding steps for tracking an object in sequence of images. Object detection is performed to check existence of objects in video and to precisely locate that object. Then detected object can be classified in various categories such as humans, vehicles, birds, floating clouds, swaying tree and other moving objects. Object tracking is performed using monitoring objects' spatial and temporal changes during a video sequence, including its presence, position, size, shape, etc. Object tracking is used in several applications such as video surveillance, robot vision, traffic monitoring, Video in painting and Animation. This paper presents a study on moving object detection and tracking techniques using PTZ Camera.**

Keywords—Video Surveillance System, Object Detection,Gaussian Mixture Model, Kalman Filter, Object Tracking, PTZ Camera Controller..

I. INTRODUCTION

Video surveillance is an active area of research. Object detection and tracking in video surveillance systems are commonly based on background estimation a subtraction. The primary focus of today's video surveillance systems act is the application of video compression technology to efficiently multiplex or store images from a large number of cameras onto mass store devices (video tapes, discs).

Object detection is to locate objects in the every frame of a video streams. It is the first step in video surveillance and it detects the moving objects after that objects are classified and tracked. There are challenges in moving object detection such as noise, lighting changes, dynamic background, occlusions and shadows. Tracking is defined as, "Locating a moving object or multiple objects over a period of time" and it shows the trajectory or path of an object in image sequence over time by locating its position in every image". There are two major components of a tracking system target representation and localization. So, for tracking the objects in video the first step is to detect the objects.

Pan-tilt-zoom (PTZ) cameras are one of the advanced security cameras in the market. These cameras have the ability to cover a very far field and can acquire high resolution of images. These cameras are deployed mainly for perimeter surveillance applications where the security guards have to monitor the intruders from a long distance. Although there are intrinsic advantages of using pan-tilt-zoom cameras, their application in automatic surveillance systems is still scarce. The difficulty of creating background models for moving cameras and the difficulty of optical geometrical projection models are key reasons for the limited use of pan-tilt-zoom cameras.

II. OBJECT DETECTION AND TRACKING

The goal of object detection is to detect all instances of objects from a known class, such as people, cars or faces in an image. Typically only a small number of instances of the object are present in the image, but there is a very large number of possible locations and scales at which they can occur and that need to somehow be explored. Object detection systems construct a model for an object class from a set of training examples.

Object tracking can be applied in many areas like automated surveillance, traffic monitoring, human computer interaction etc. Challenges in the tracking include noise in frames, complex object motion and shape, occlusion, change in illumination etc**.**

III. PTZ CAMERA CONTROLLER

Each camera movement is controlled by a command in the form of a single packet consisting of 3 to 16 bytes. To ensure that each command is transmitted and executed correctly, an ACK signal (Reconnaissance) is transmitted back to the controller as shown in Fig. In the case of running more than two commands, the command queue is possible to overflow and eventually ignore subsequent commands unless

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the ACK signal is transmitted back to the controller in a timely manner.

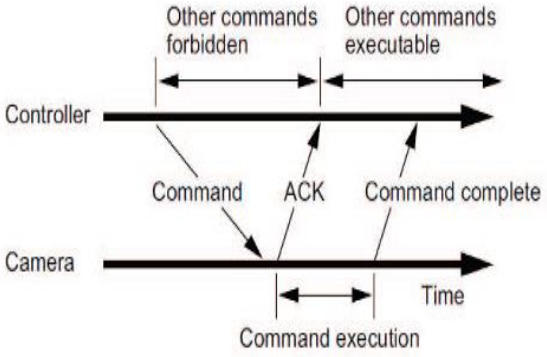


Fig 1. PTZ Camera Controller [3]

IV. LITERATURE SURVEY

In paper [1], an object tracking method is proposed and applied to human upper body tracking by IP PTZ camera in online application. Human body tracking determines the location and size of each human body for each input image of a video sequence. It can be used to get images of the face of a human target in different poses. The proposed method detects in every frame, candidate targets by extracting moving objects using optical flow, and sampling around the image center. The target is detected among candidate target samples using a fuzzy classifier.

In paper [2], they present an effective approach for active tracking with a PTZ camera. A new framework for active Tracking of non-rigid objects is presented. The background subtraction with Gaussian Mixture Model is adopted for object detection and the region covariance is adopted for the object descriptor. Then, while tracking the target, a local search method with motion compensation is proposed for active tracking and acceleration. A near real-time system is established combined with the tracking algorithm and PID controller mentioned above. The performance of the proposed method is evaluated by indoor and outdoor video sequences. Experimental results illustrate the proposed method feasible and validate the efficiency and accuracy of our system.

In paper [3], a configuration of an automatic real-time face tracking system is proposed. The proposed system is considered as a cost-effective solution for online education platforms which performs competitively compared to costly conventional systems. The main contribution of this paper is the low-cost and flexibility in implementation, namely, mobility. Simulation results show that the proposed system minimizes the reaction time of the camera regarding movement to provide a smooth and natural motion regarding the transition between movements.

In paper [4], they proposed a PTZ Camera based human positioning tracking system with several analyses, which is Called CPTS, is developed. The key components of a fully automated system can track and positioning the human in a real-time, indoor surveillance environment. The motion vector out of moving object can be found with dynamic background, it affords the change of camera parameters to control the camera movement. Experimental results have demonstrated that CPTS would be a feasible solution, and make tracking and positioning accurately. The performance and easily implement is merit of this algorithm. Through that we can provide scalability in the IP-surveillance system.

In paper [5], they design a PTZ tracking system which can track a moving target in large complex scenes. The features applied to track are three-dimensional background–weighted histogram of the target model and could be updated online which makes the system tolerate change of illumination. The PTZ module keeps the target in the center area of the camera's FOV by controlling pan and tilt speeds according to the target moving. Experimental results show that the proposed algorithm can realize stabile and real-time tracking in complex scenes. But the system is still affected by the complete occlusion or the interference which has the similar histogram with that of the target.

V. PROPOSED WORK

Detection and extraction of moving object is an important step for many applications including video surveillance, traffic monitoring, human tracking and other applications. There are three common approaches to detect moving objects, which are optical flow, temporal difference and background subtraction. Technique for extracting moving object is a bit different when using a PTZ camera as compared to static camera. The PTZ camera has zoom and pan control and it can rotate 360 degrees on its axis. The background of each frames are also different in term of position and location, while using a static camera, the background of each frames are same.

In Proposed System, we present different object detection and tracking Methods. The Following criteria should be fulfilled in this method:

1. It should provide smooth camera movement like human camera man.
2. It should operate in real- time and deal with the moving object.
3. It should be robust against the lighting changes, partial occlusion in large complex scene.
4. It should be useable in all kinds of environment without parameters changing.

When the tracking target moves out of the center area of the camera's FOV, PTZ camera is controlled to make the target in center area again based on the position data of the target.

If the tracking is failed, system will turn to detect the moving blob nearby the target position in the last frame, and then transfer the frames for tracking Object.

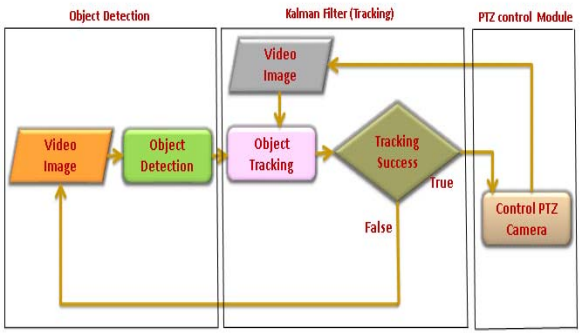


Fig 2. Object Detection and Tracking System using PTZ Camera

A. Flow Chart:

In fig 3 define the flowchart of proposed algorithm. In proposed method there are basic four steps for detect moving object in video surveillance.

- **Step 1: Read Video**
  In this step it read video from video surveillance system.

- **Step 2: Background Modelling & Foreground Extraction(Detection)**
  In that it is also divided into subpart:
  a) Background Removing using Gaussian Mixture model
  b) For Motion Detection apply appropriate threshold value for complex image to binary image
  c) Detect actual moving object.

- **Step 3: Tracking using PTZ Camera**
  1. Detected Object
  2. Attain target centroid and area
  3. IF (it is within the threshold value)
     Attain target centroid and area again
  4. ELSE
     Send the rotation/zoom command
  5. Attain target centroid and area
  6. IF
     (It is within the threshold value) Send the Stop command
  7. ELSE
     Go to step 4 and Repeat

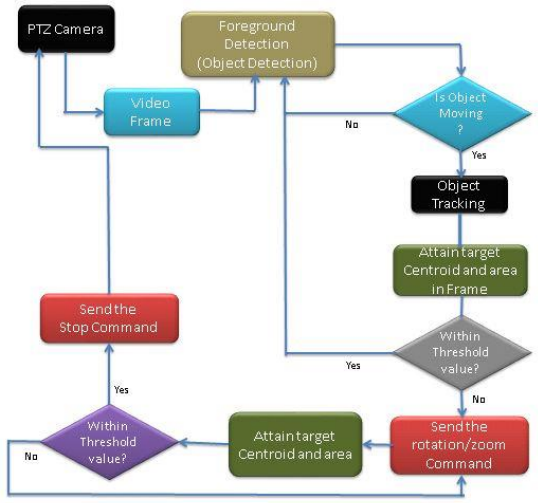


Fig 3. Flowchart of proposed algorithm

B. Experimental Parameter:

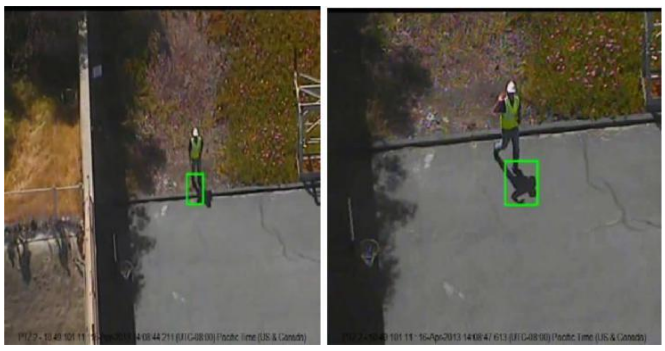
For detecting the moving object the frames are captured from the video surveillance system. We will use MATLab R2014a. For evolution of algorithm, we will use the TPR (True Positive Rate) and FPR (False Positive Rate) as evaluation parameter. Following is the equation of TPR and FPR.

$$TPR=\frac{N_{tp}}{N_{tp}+N_{fp}},\ FPR=\frac{N_{fp}}{N_{fp}+N_{tn}} \quad \text{.....eq. (1)}$$

Where N_{tp}, N_{fp}, N_{fn} and N_{tn} are the number of objects identified as true positive, false positive, true negative and false negative.

VI. IMPLEMANTATION RESULT

In this section we define some experimental results of the tracking of moving objects using the proposed algorithm and using this algorithm we find that the algorithm proposed is 92.056%. This precision is calculated using equation (1).



(a) (b)

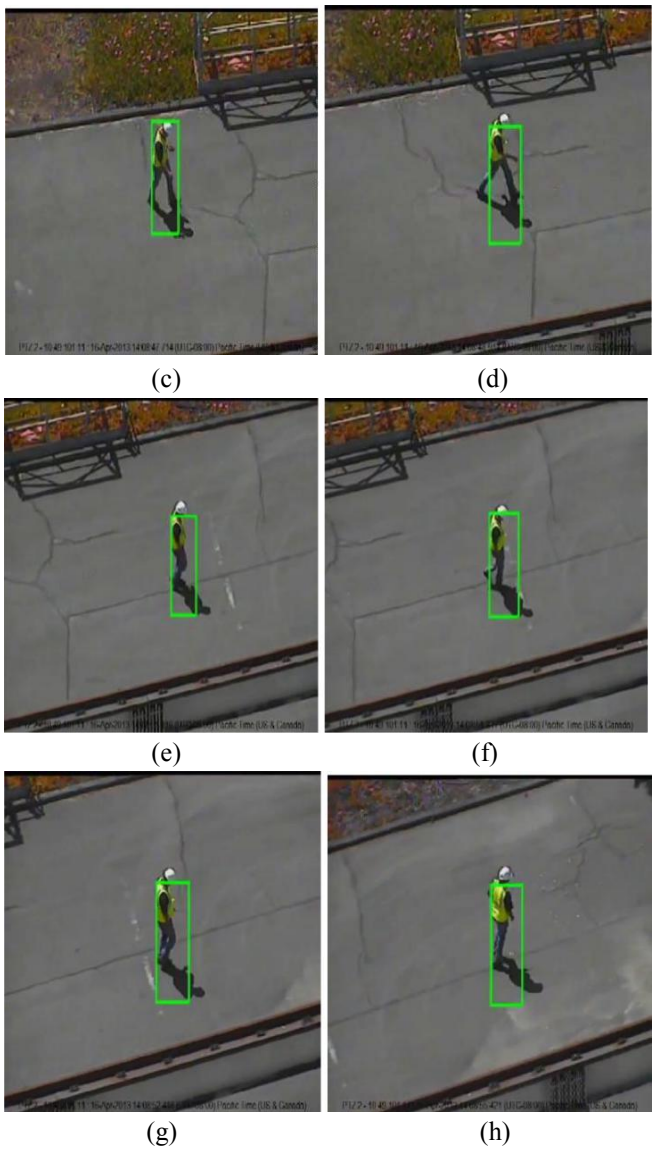


Fig 4. Tracking of a Person

In Fig.4 (a),(b),(c),(d),(e),(f),(g) and (h) shows the tracked object in Frame 187, 219, 222, 234, 258, 263, 269 and 299 Respectively.

VII. Conclusion and Future scope

In this work we have presented a visual surveillance system with detection and tracking of moving objects. Tracking objects from any moving object has been successfully implemented using the Kalman filter. The system operates on indoor videos as well as outdoor environment taken using static camera as well as moving camera called PTZ camera under moderate to complex background conditions. This implemented module can be applied to any computer vision application for the detection and tracking of moving objects. This work can be expanded to track several moving objects. The complete system with detection and tracking capabilities can be used for domain applications such as security, human computer interaction, scene analysis and activity recognition, event detection etc. And will be adding camera zoom and increase the robustness of the motion prediction to prevent the target from being out of the FOV camera.

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