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Implementation of Multi Person Tracking Using Kalman Filter

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Abstract: **The mechanism of locating multiple objects over a sequence of frames (videos) is referred as multi object tracking. The task of detecting and tracking of moving objects in surveillance video sequence forms a basis for the top level intelligence application and has many challenges. The proposed system portrays detection and tracking. Detection is done with the help of foreground detector which involves background subtraction. kalman filter is also used for prediction(tracking) of the object's motion. By combining the background subtraction model with the kalman filter, the algorithm is not only used for object tracking but also for the purpose of predicting the motion of the tracked object in case of partially occluded object if the object is disappeared in the scene because of full occluded.**

Index Terms: Kalman filter, Multi person tracking, back ground subtraction, Gaussian Mixture Model.

I. INTRODUCTION

Multi Person Tracking is a key component for many applications like video surveillance and automatic driving, which attracted some special attention moreover general tracking of object. The main aim of multi person tracking is to determine the present state of multiple persons observed by conserving their identifications over time under various appearances.

Multi person detection and tracking involves identification of person in image and locate. Multi person tracking is classical presently, but in computer vision it is difficult task. The long term occlusions, target interactions, complicated dynamics, noisy and imprecise measurements all contributes to the complexity of multi person tracking.

The tracking approaches are used in applications such as automatic surveillance, video indexing, monitoring, human computer interaction and behavior analysis. Tracker can provide information like object centre, area, shape and orientation of an object based on the domain of tracking.

In this approach detection takes place with the help of foreground detector that involves background subtraction. Background subtraction is a simple and easiest technique for object segmentation. Moving objects are detected by comparing the difference of the current image with the reference background image.

Kalman filter is used for the tracking of moving objects. The most common used dynamic model is a constant velocity (CV) model which assumes that during a sampling interval velocity is constant. The Kalman filter works on noisy input streams continuously to produce analytical ideal estimate. There are multifarious applications of Kalman filter. Some of the applications are navigation, guidance, vehicle control, especially spaceship and rocket.

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II. RELATED WORK

Much work has been done in real time towards obtaining the best possible background model which also works in real time. Very first of these algorithms without any foreground object as a base background model would be to use a static frame and to obtain the foreground this use a simple threshold based frame subtraction method [3]. This is not completely suited for real life situations because normally there is a lot of movement through shadows, cluttered areas, slow moving objects, objects overlapping in the visual field, lighting changes, and effects of moving elements in the scene, and objects being introduced or removed from the scene.

This method could deal with long term scene changes, slow changes in illumination, repeated motion from background clutter and occlusion. The results obtained from mixture of Gaussian method were very noisy [3]. They introduced kalman filter for estimation of the motion of the object being tracked. GMM tracks the object and the Kalman filter predicts the object's motion whenever there are occlusions either partially or fully in some cases [1,3].

Consequential amount of work has already been described in the field with own unique tracking technique each system has employed [2]. Among the proposed techniques are: Feature matching, Background subtraction, Optical flow, Mean-shift, Particle Filters, etc.

For moving object detection background subtraction method is used whenever there is static or stationary background in the picture which can be considered as a reference model. Many earlier works on people detection and tracking technique depend on the background subtraction [1]. Background subtraction techniques generally determined foreground objects from the video and then group it into different categories like human and non human depending on shape, color, contour, or motion and others in a pixel wise manner.

For tracking purpose, there basically two approaches exist, either by using optical flow, or using background subtraction method. Methods based on detectors of pre trained bounding box are not applied because it is difficult to design a universal detector which can detect all possible pedestrians [5]. Object may be missed. Without limitation the use of Optical flow and background subtraction is not possible, because although objects are not usually misdirected, they are regularly fragmented into two parts or more than two parts. By setting in and out ROI regions this approach increases its accuracy to reconfirm objects trajectory and by segmenting region when occlusions are detected [4]. The main aim is to build the software which is able to detect the pedestrians and predict their trajectories, during which process MOT plays an important role. In this report, one can inspect the foregoing work and propose the method for improved combination of detection and MOT algorithms.

III. SYSTEM DESIGN

The block diagram of proposed system is as shown in the figure. The system contains five main blocks namely Input image, Preprocessing, Detector, Kalman filter and Output.

Image is captured at a pre determined interval which may vary depending on area of application.

The main aim of preprocessing is to improve the image data that removes unwanted distortion or enhance features of the image for further processing.

Detection takes place with the help of foreground detector that involves background subtraction. Background subtraction is a simple and easiest technique for object segmentation. Moving objects are detected by taking the difference of the current image with the reference background image.

Kalman filter is used for the purpose of continuously tracking the object in the case of partial or full occlusion of the object being tracked.

Kalman filter is used for the tracking of moving objects. KF is also known as Linear Quadratic Estimation. The most familier dynamic model is a constant velocity (CV) model which assumes that during a sampling interval velocity is constant. This model has been used in several applications because of effectiveness and simplicity. Kalman filter is used for the purpose of continuously tracking the object in the case of partial or full occlusion of the object being tracked. Final step is output.

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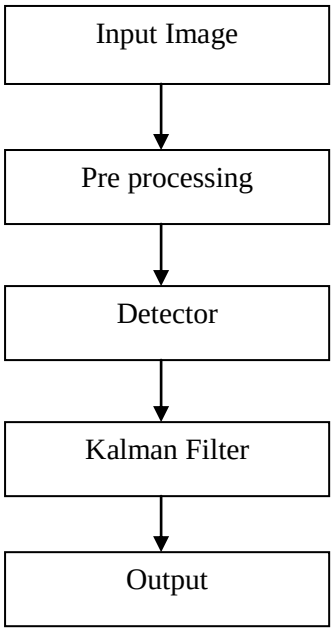


IV. SYSTEM IMPLEMENTATION

The system implementation consist of video input, read frame and preprocess, Detector, Kalman filter track locator, assign detection tracks, update assigned tracks, update unassigned tracks, delete lost tracks, create new tracks, MOT tracking output. Video input block takes the video input which is to be tracked for multiple objects. Read frame and preprocess block reads the frames from the video input and performs foreground detection to segment moving objects from the background analysis to find the connected groups of foreground pixels which are likely to correspond moving objects. Background subtraction is a simple and easiest technique for object segmentation. Moving objects are detected by taking the difference of the current image with the reference background image. The foreground object is formed by the person while leaves though having motion associated with them are treated as background due to its repetitive behavior. For segmenting out objects of interest in a scene for applications such as surveillance Background subtraction is a class of technique. Using Gaussian mixture model the video can be modeled for pixel intensity values.

The equation to generate a background frame is given by

$$B = F1$$

The method requires first frame F1 to contain static objects.

Kalman filter is used for the tracking of moving objects. Kalman filter process involves two phases' prediction step and correction step.

Prediction step S (t) = F(t)S(t-1)+b(t), Kalman filter concludes this step by calculating covariance matrix

$$P(t) = F(t)\,P(t)\,F(t)\,\text{^-1+Q (T)}$$

After prediction step the Kalman filter exploits new measurements during correction in correction step.

Computation of Kalman gain:

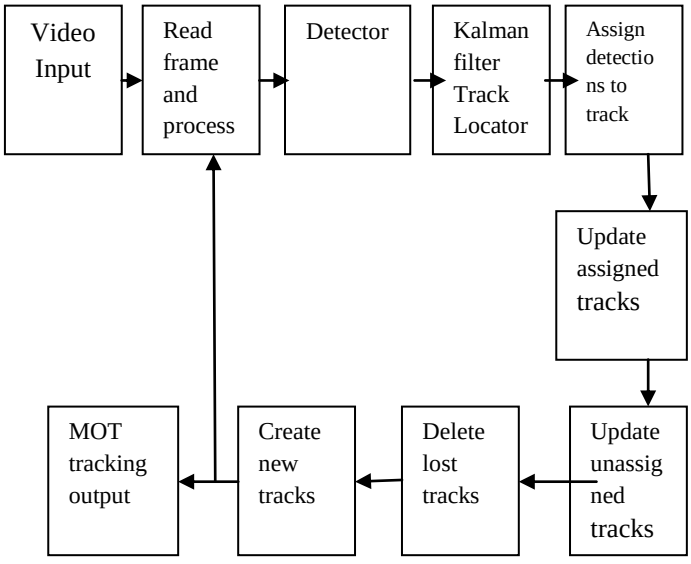
$$K(t) = P(t)\,H(t)\text{^ T (H(t) P(t) H(t)^T + R (t))^-1}$$

Here R is measurement noise covariance

Using kalman gain one can update the state estimate and new estimate computation is:

$$X(t) = (I\text{-k (t) H (t) P(t)}$$

The error can be reduced if measurements are accurate. Kalman filter track locator block contains Kalman filter to predict the centric of each track in the present frame, and update its bounding box accordingly. Assign detections to track block Assigning object detections in the current frame to existing tracks is done. Update assigned tracks block updates each assigned track with the corresponding detection. Update unassigned tracks block marks each unassigned track as invisible, and increase its age by 1. Delete lost tracks block deletes tracks that have been invisible for too many consecutive frames. It also deletes recently created tracks that have been invisible for too many frames overall.



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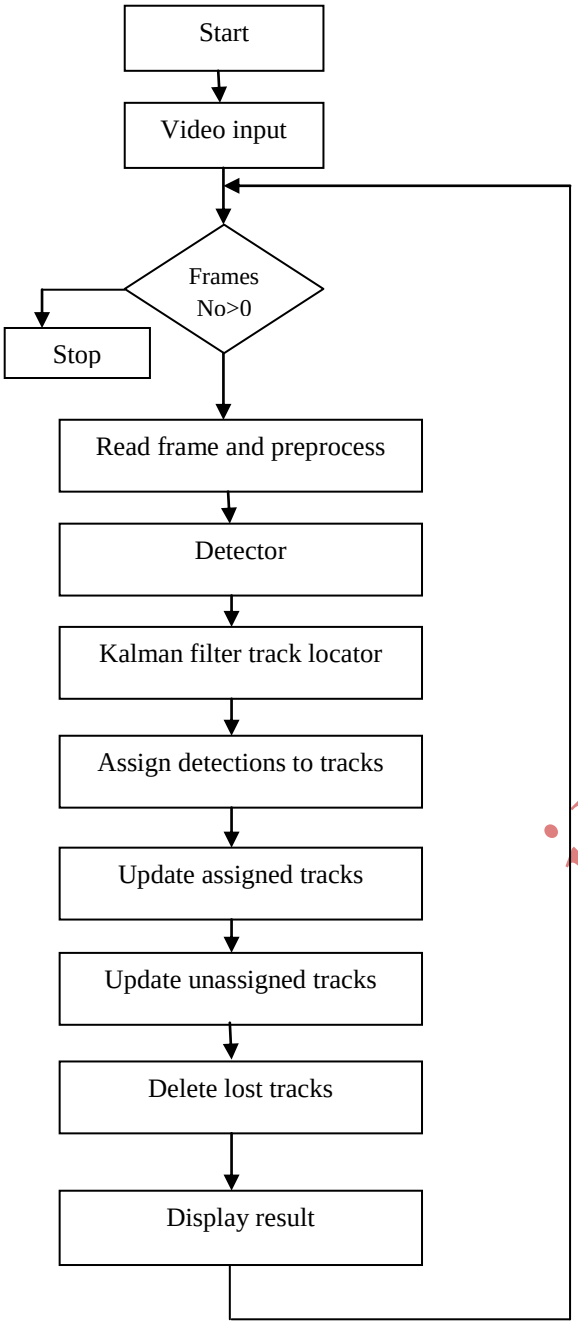
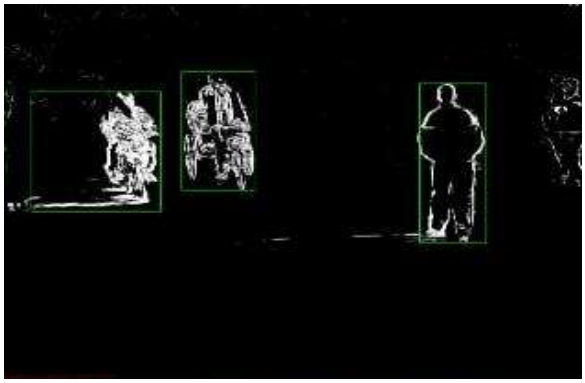
Create new tracks block Create new tracks from unassigned detections. MOT tracking output block displays the results of multiple object tracking draws a bounding box and label ID for each track on the video frame.



Flowchart

V. EXPERIMENTAL RESULTS

Detection accuracy using Foreground detector



Classification Accuracy	94.46%
ROI Detection Accuracy	88.04%

VI. CONCLUSION

The tracking in this method is solely based on motion with the acceptance that all objects move in a straight line with constant speed. When pedestrians are occluded by the other objects.

The probability of tracking errors can be reduced by using more composite motion model, such as constant acceleration or by using multiple Kalman filters for every object. One can include other cues for associating detections over time, such as size, shape and color.

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