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Research Article

MULTI OBJECT 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.

Keywords: Kalman filter, Detector, Back ground subtraction, Gaussian Mixture Model.

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. 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 technique for object segmentation, mainly under those conditions with a relatively static background. Moving objects are detected by taking the difference of the current image with the reference background image. Background subtraction is a simple method there are many variations of background methods available such as Gaussian Mixture Model. Kalman filter is used for the tracking of moving objects. The most common 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 various applications of Kalman filter. Basic applications are navigation, guidance, vehicle control, especially spaceship and rocket. The Kalman filter works on noisy input streams continuously to produce analytical ideal estimate.

Related work

Video surveillance for multiple objects is one of the most dynamic research topics in computer vision. It has far range spectrum of capable homeland security requisitions. Video management and interpretation systems have turned out to be very handy as of late. Surveillance cameras are economical and wherever nowadays.

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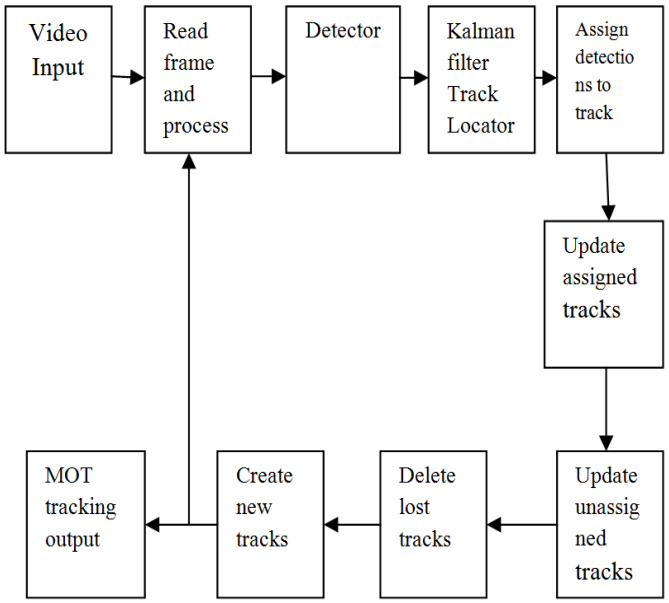
The main objective of automatic video surveillance system is getting information regarding monitored region activities and to take action as per the system interpretation. A new outline for identifying and separating vehicles in traffic surveillance scenes is introduced. This framework includes finding moving object exhibit in complex street scenes by executing a complex background subtraction method (Chetan Bukery *et al.,* 2017). As tracking is difficult task so researchers have interest in it. The main part of tracking is obtaining relevance of targeted object and its parts in successive frames. Initially foreground extraction is crucial task. Generally several objects like buildings, shops, road, trees, etc are included in background of scene. Video is Visual multimedia source that combines a sequence of images, individual image known as a frame. Due to number of frames displayed in fraction of seconds, it looks like continuity in content to human eyes. Generally every image processing method can be used for particular frames. Furthermore, many parameters of successive frames are firmly related to each other. Identification of the particular areas of interest is commonly initial stage in various image processing applications such as detection of object, feature surveillance and applications related to robotics, etc. In order to detect and track objects skillfully they utilize GMM and Kalman filter/particle filter (Harihara Santosh and Mohan, 2015). Foreground is detected from moving objects in video frames and there after objects are tracked from detected results. These objects have similar intensity values pixels but different intensities with each other. Foreground is extracted from background using the GMM method. Kalman filter is capable in different perspectives, it figuring out previous state, present state and even future states. Also it can estimate exact nature of unfamiliar demonstrated framework. 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 (Abdul Lateef Yussiff *et al.,* 2014). 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 (Harihara Santosh and Mohan, 2015; Abdul Lateef Yussiff *et al.,* 2014). 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 (Merven *et al.,* 2009).

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) ^-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)^ T (H(t) P(t) H(t)^T + R (t))^-1
Here R is measurement noise covariance

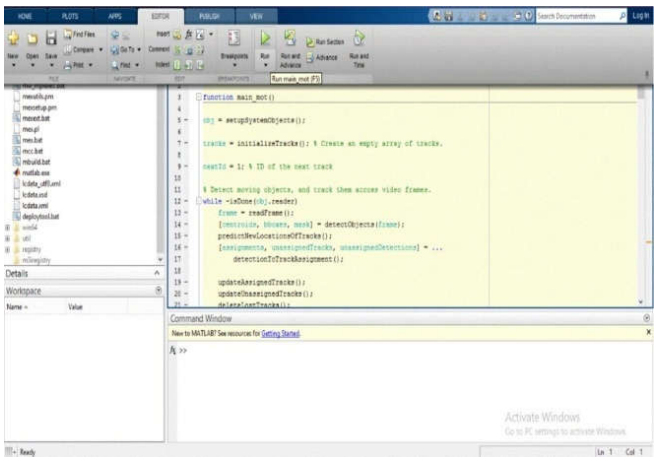
Using kalman gain one can update the state estimate and new estimate computation is:

X (t) = (I-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. 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.

Software requirements

Simulation using Matlab 2017. Computer vision with MATLAB for object detection and tracking uses image to detect, classify and track objects or events in order to understand a real world scene. MATLAB can unify multiple domains in a single workflow. With MATLAB on can think of programming in one environment. It offers tools and functions for deep learning, and also for a range of domains that feed into deep learning algorithms, such as signal processing, computer vision and data analytics. The software used in this project is MATLAB. MATLAB ("Matrix Laboratory") is a tool for numerical computation and visualization. The basic data elements are a matrix, if any need of a program that manipulates array based data. It is generally fast to write and run in MATLAB. MATLAB is a high performance language for technical computing.



Applications

- Security policies
- Traffic information

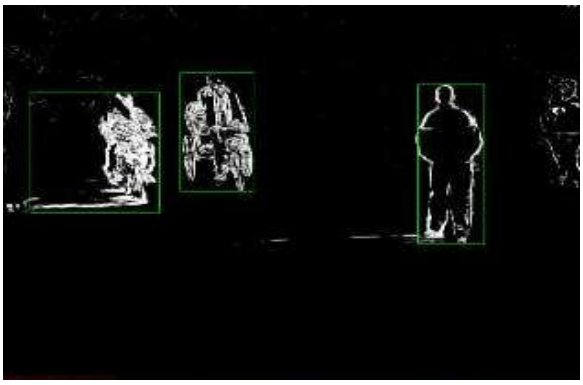
- Surveillance
- Mobile robot

Advantages

- Ability to track multiple objects.
- Discover all the movements while tracking
- More accurate in tracking of a particular object
- Occlusion handling.

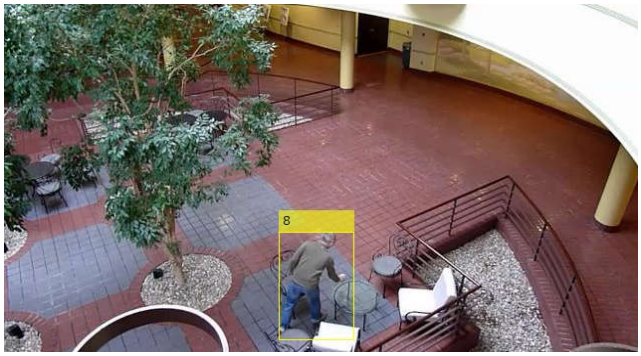
Experimental Results

Detection accuracy using Foreground detector



Classification Accuracy	94.46%
ROI Detection Accuracy	88.04%

Tracking results are based on observation from few videos. Tracking Accuracy is approximately above 90% if objects move in a straight line with constant speed. Tracking accuracy is approximately 50% if objects don't move in a straight line with constant speed.



Conclusion

The tracking in this method is solely based on motion with the assumption that all objects move in a straight line with constant speed, when the motion of any object significantly deviates from this mode, it produces tracking errors. 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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