SEGMENTATION OF MOVING OBJECTS IN DYNAMIC TEXTURE SCENE USING KALMAN FILTER

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Abstract:
In this paper segmentation of moving objects in dynamic texture scene using kalman filter is introduced. The video segmentation of moving objects is one of the important topics in video surveillance and computer vision systems. In the past, k-means clustering segmentation is a method to segment the moving objects. But that technique cannot identify the moving objects accurately in videos. In this paper detection of the moving object using threshold based kalman filter. The threshold based kalman filter has good performance under dynamic texture scene in real time applications. The experimental results show that the threshold based kalman filter is efficient and robust for the dynamic environment compared to k-means clustering.

Index terms : k-means clustering, Thresholding, kalman and Object detection.

I. INTRODUCTION
Detection and tracking of objects has been an important research topic in computer vision domain. The paper [1] presents an active contour-based method to track multiple cars using a background model to implement motion-based image segmentation. The method of active contours encloses detected blobs (vehicle) segmented from the background. However, the system is too slow for real-time applications. In [2] an approach based on model-based for vehicle detection and classification that takes into account multiple views of a vehicle. Fist predict the existence of vehicle using 1D vehicle templates, then do further verification using 2D-sparse wireframe vehicle templates, finally estimate the presence of a vehicle through the correlation between the 3D-wirdframe vehicle model projecting and the image projection. This approach suffers from heavy computation cost.

Many study or method has been applied such as neural network has been applied to model the dynamic background [3],[4],[5]. Support Vector Machine (SVM) method also used to model the dynamic background [6],[7]. The weakness of neural network and SVM are these method need to train the background image. A few frames will be taken as training background image and this will be delay the detection. Furthermore, these methods require space of memory and slow process.

The performance of video object tracking algorithm depends on moving object detection and tracking of moving objects in successive frames. The organization of this paper is as follow. Section II presents k-means clustering segmentation. Proposed method is introduced in section III. Simulation results are reported in section IV and conclusions are presented in V.

II. K-MEANS CLUSTERING
The aim of k-means clustering analysis is to group data in such a way that similar moving objects are in one cluster and moving objects of different clusters are dissimilar. The K-means algorithm basically consists of three steps:
1. Initialization: K chosen, an initial set of K so-called centroids, i.e. virtual points in the data space is randomly generated,
2. Every virtual point of the data set is assigned to its nearest centroid.
3. The position of the centroid point is updated by the means of the data points assigned to that cluster, i.e the centroid is moved toward the center of its assigned points. The k-means clustering algorithm is commonly used in computer vision as a form of video segmentation.

To segment objects in video to follow given steps
1. Implement the K-means method to segment the grey-level video.
2. Test on few frames. Illustrate your results by showing the segmented frames where the regions are displayed in different grey values.
3. Extent your algorithm to color frames.
4. Initial centroid positions have an influence on the result.
5. Calculate centroids of each object using distance.
6. To improve the result, we propose to take into account the color of each pixel and its position. The color video is then represented in a 2D space (R,G,B, line, column). Implement and test the K-means method to segment the frames with this new representation.

III. KALMAN FILTER
The Kalman filter is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process, in a way that minimizes the mean of the squared error. The filter is very powerful in several aspects: it supports estimations of past, present, and even future states, and it can do so even when the precise nature of the modeled system is unknown.

The distance between the \( i \)th pixel and \( l \)th cluster is

\[
D(i,l) = \sqrt{\sum_{j=1}^{d} [I(i,j) - \mu(l,j)]^2}
\]

After than apply initial Mask \((IM)\) can be defined as:

\[
IM(i,j) = \begin{cases} 
1, & \text{if} \ |fg(i,j) - bg(i,j)| \\
0, & \text{otherwise}
\end{cases}
\]

Where \(fg\) is the foreground frame and \(bg\) is the background frame
The block diagram of kalman filter as shown below

In Kalman filter, to estimate the state \(x\) of a discrete-time controlled process that is governed by the linear stochastic difference equation

\[
X(k)=A X(k-1) + BU(k-1) + W(k-1)
\]

\[
Y(k)=C X(k)+ v(k)
\]

Where \(B\) is the control input model for each frame \(U\) and \(W\) is the Gaussian noise.
The measurement value of $Z(k)$ at frame, $k$ is depend on the observation model, $H$ and observation noise, $V$ is given by

$$Z(k) = H X(k) + V(k)$$

The approach of Kalman filter in vehicle segmentation is to iteratly update the dynamic background and determines the foreground. Kalman filter is used to estimate the internal state of the image given with the sequence of noisy observations. From the estimator, the updater must model the image according to the frame work of the kalman filter.

The predict phase equations are: a priory states

1) The predicted image at frame $k$ is

$$I(k) = F_k I(k-1) + B_k U(k)$$

2) The covariance at frame $k$ is

$$P_k = F_k P_{k-1} F_k^T + Q_k$$

The predict phase uses the state estimate from the previous frame $k-1$ to produce an estimate of the state at the current frame $k$.

Update Phase:

The update phase equations are: a posteriori states

The innovation or measurement is

$$Y_k = Z_k - H_k I_k$$

The covariance is

$$S_k = H_k P_k H_k^T + R_k$$

The kalman gain is calculated by

$$K_k = P_k H_k^T (1/S_k)$$

Note: The formula for updated estimate and covariance is only valid for the optimal kalman gain.

The updated image at frame $k$ is:

$$I_k = I_{k-1} + K_k Y_k$$

The updated covariance is:

$$P_k = (I_k - K_k H_k) P_{k-1}$$

The predict phase uses the state estimate from the previous time step to produce an estimate of the state at the current time step. This predicted state estimate is also known as the $a$ priori state estimate because, although it is an estimate of the state at the current time step, it does not include observation information from the current time step.

In the update phase, the current $a$ priori prediction is combined with current observation information to refine the state estimate. This improved estimate is termed the $a$ posteriori state estimate.

When Kalman filter method approached to dynamic background, the moving detection is more accurate compare to consecutive frame segmentation.
IV. EXPERIMENTAL RESULTS

In this Paper, a real-time kalman filter technique which can detect moving object on dynamic texture videos was implemented using MATLAB.

![Vehicle count 1](image1.png)

**Fig.1:** vehicle count=1, area=868, centroid=65.49

![Vehicle count 11](image2.png)

**Fig.2:** vehicle count=11, area=1057, centroid=102.57

Figure 1 shows the segmentation of moving object1 (vehicle count1) with specified area and centroid values similarly Figure 2 shows the segmentation of moving object2 (vehicle count2) with specified area and centroid values.

V. CONCLUSION

In this paper, Segment the moving objects using kalman filter. This technique detects moving objects accurately. This algorithm is efficient and robust for the dynamic environment with new moving objects in it. This system has been successfully used to identify moving objects in outdoor environments; this system achieves our goals of real-time performance over boundless experience of time lacking human intrusion. Future work is to resolve the cases when an object is totally occluded and an object is grouped with others.

REFERENCES


BIBLOGRAPHY

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