Background Estimation Using 3 Parameter Based Running Average Method

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Abstract: **In this paper, we have discussed the background estimation using "3 parameter based running average method", and then used background subtraction followed by an appropriate thresholding operation to detect the moving object. Our main aim is to do the background modeling to get moving object. In this process, detection of moving object directly depends on background model. Numerical experiments confirm our theoretical results.**

Index Terms— Background estimation, motion detection, running average and temporal difference

I. Introduction

To detect the moving object is the first step in number of applications like highway traffic monitoring, tracking of multi target from video data, automatic visual surveillance in dynamic scenes, cloud tracking etc. First important task for any video surveillance application is to detect the moving object and then only we can think of tracking which requires the location and shape of object in every frame. From application point of view, video analysis is high level task and it is required to identify three key steps which are as follows:
(i) Detection of moving object.
(ii) Tracking of the detected object from frame to frame.
(iii) Analysis of the object tracks to recognize their behavior.

In literature, various moving object detection techniques have been proposed i.e. Gaussian mixture (GM) model [5], It is one of the approach that has been used to classify the background pixels. Using GM model, we can detect the motion and ignore normal background variation too. In Gaussian approach, each pixel is modeled as mixture of Gaussian. And any pixel intensity value which does not fit in to one of the modeled Gaussian distribution is assumed to be a part of foreground. Temporal differencing (TD) technique has been discussed in [4] & [7]. In TD approach, first frame is assumed to be a background and next frame will act as a current frame, and it is sensitive to noise and variations in illumination. But TD method fails to segment the foreground objects if they stop moving.

If an object stays still for more than a frame period, it becomes part of the background. TD method has two advantages: (i) Less computational requirement and (ii) highly adaptive in nature. Running average (RA) is an approach to estimate the background, see in [7]. RA technique is fast and less memory consuming method in which we calculate the weighted sum of current background and current frame for next iteration, i.e.

$$B_{(x,y,t+1)} = \beta * B_{(x,y,t)} + \alpha * F_{(x,y,t)},$$

where α is the learning rate and $\beta = (1 - \alpha)$.
RA method dynamically updates the background image which is adaptive in nature and it depends on the value of α. We can't take the value of α as too high because it may cause artificial 'tails'.

In this paper, we focused mainly on background estimation using "3 Parameter based running average method" and then background subtraction and then after thresholding operation is used to detect the foreground. Here, we assumed that entire video clip is available.

Paper is organized as follows. In section II, the proposed algorithm is described. In section III, results are given. In section IV, finally conclusion is made.

II. Proposed method (3 Parameter running average)

A. Overview

In this section, we discussed our proposed method "3 Parameter running average". Detection is required for every tracking scheme for which background modeling is the primary need. Three consecutive frames are required to estimate the background using our proposed method. In this technique, Two different factors M_1 (difference between second and first frame) and M_2 (difference between Third and second frame) are calculated. There are two initial backgrounds B_0 and B_1 that need to calculate with the help of the above mentioned factors M_1 and M_2. Once we have B_0 and B_1 then only 3 Parameter running average method will
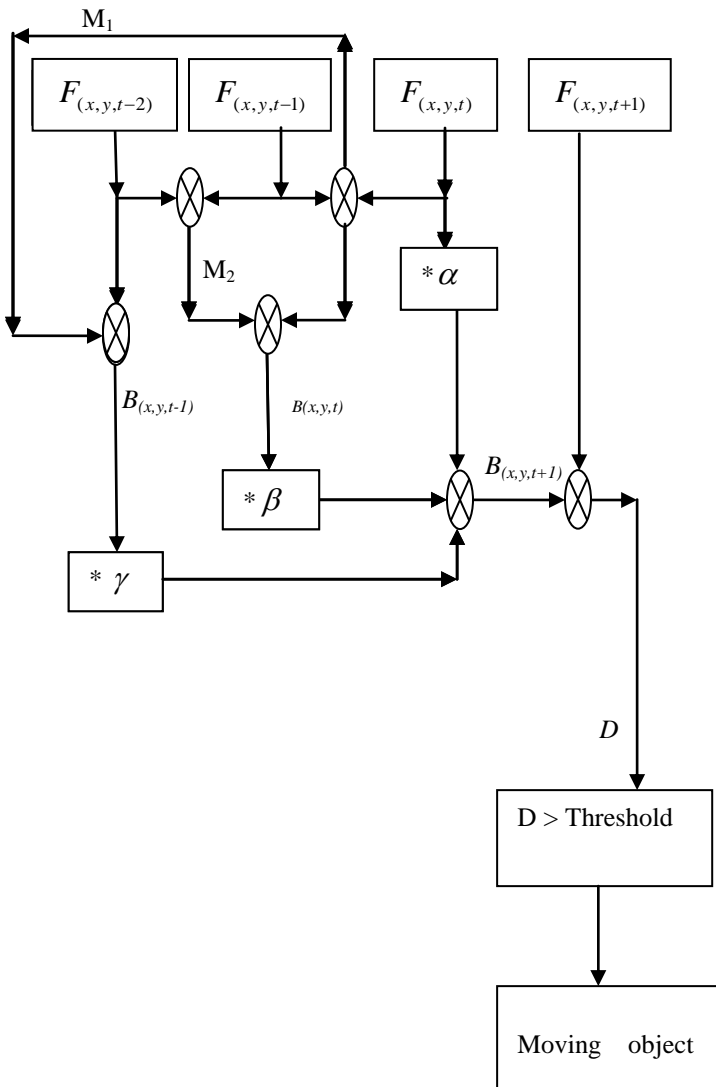
Applicable to update the background effectively (i.e. $B_{(x,y,t+1)}$) as follows:

$$B_{(x,y,t+1)} = \alpha * F_{(x,y,t)} + \beta * B_{(x,y,t)} + \gamma * B_{(x,y,t-1)}.$$

Our observations are:

- $\alpha + \beta + \gamma = 1$,

- $\alpha > \beta > \gamma$ and

- The value of α neither be too high nor be too low.

B. *Block Structure*

C. *Basic Steps*

1. Take video input.

2. Read at least 4 frame like $F_{(x,y,t-2)}$, $F_{(x,y,t-1)}$, $F_{(x,y,t)}$ & $F_{(x,y,t+1)}$.

3. Calculate two factors namely M_1 & M_2.

4. Calculate initial backgrounds B_0 and B_1 ($B_{(x,y,t)}$ & $B_{(x,y,t-1)}$).

5. Estimate new background $B_{(x,y,t+1)}$.

6. Take the absolute difference (D) between new frame ($F_{(x,y,t+1)}$) and new background ($B_{(x,y,t+1)}$).

7. Apply appropriate threshold.

8. Get the moving object.

D. *Background Subtraction*

The background subtraction technique includes two steps:
(i)   Update the background appropriately and
(ii) Suitable subtraction between current frame and updated background.

E. *Thresholding*

Threshold pays a vital role in image segmentation, but choosing its value is still challenging. If the threshold value is too large, we will lose much of the details of an image and if we choose a too low threshold, it will introduce lots of noise. Once we lost the details of an image then there is no way to recover it. That's why we always in favour of choosing low threshold and after that use appropriate filter to eliminate the noise effect.

III. Results

We used MATLAB to implement our proposed method.
Fig (a), fig (b), fig (c) and fig (d) are four consecutive input frames and result from our proposed method is given in fig (e). Results Based on RA and TD are shown in fig (f) and fig (g) respectively.
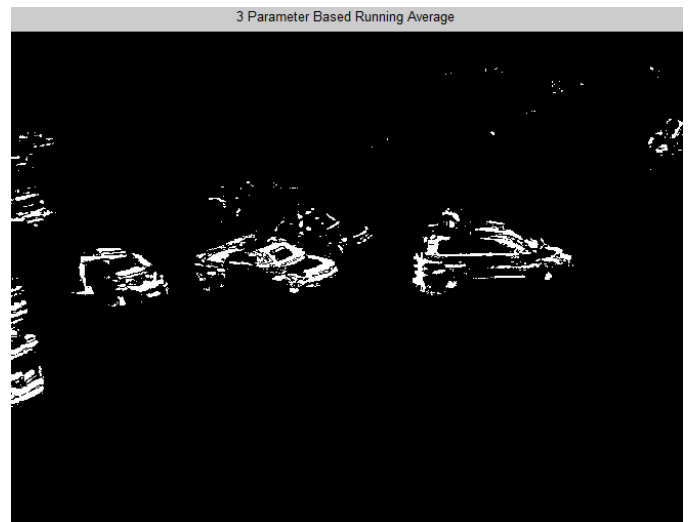
Fig (a)

Fig (b)

Fig (c)

Fig (d)

Fig (e)

Fig (f)

Fig (g)

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IV. Conclusion

In this paper, we discussed background estimation using 3 Parameter based running average technique, first and then detection of moving objects using background subtraction. We are getting better results as compared to TD and RA methods. It can be extremely useful in many applications like traffic flow measurement, visual surveillance, behavior detection during sport activities and many more.

References

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