International Journal For Technological Research In Engineering
Volume 2, Issue 9, May-2015 *ISSN (Online): 2347 - 4718*

MOVING OBJECT TRACKING AND COUNTING BASED ON FEATURES IN SURVEILLANCE VIDEOS

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Abstract: ***Identifying moving objects from a video is a fundamental and critical task in many applications of computer vision. A common approach is to perform background subtraction, which identifies moving objects from a portion of video frame that differs significantly from a background model. This research begins with a background subtraction algorithm for detecting moving objects from a video and also track, count and classify those objects based on features. We have considered approaches varying from simple technique that is frame differencing for foreground detection and morphological operation for shadow suppression and also for noise removal.***
Keywords: motion detection, object tracking, video surveillance, background subtraction, counting, computer vision.

I. INTRODUCTION

Object tracking from a video is an active research topic in computer vision applications like surveillance, monitoring, robot technology, gesture recognition, object recognition etc. Moving object detection is the main task in any visual surveillance system and is an important task in the field of national security. There are different techniques for object detection such as background subtraction, frame difference, optical flow etc. Video surveillance has been used from long ago to monitor the security sensitive areas such as banks, departmental stores, highways, crowded public areas, national borders etc. many algorithms and also different methods have been proposed for this purpose. But the complexity increases with the problems encountered in the video. Chih-Chang Chen [1] proposed a dynamic background subtraction module which is used to model light variation and then to determine pedestrian objects from a scene. R. Cucchiara [2] and others used sakbot system for moving object detection technique through statistical and knowledge –based background update and also used HSV color information for shadow suppression. Osama Masoud and Nikoloas P.Papanikolopoulos [3] proposed a new method for tracking and counting pedestrians in real-time using a single camera. This method uses three levels of abstraction such as raw images, blobs and pedestrians for tracked persons. In [4] the paper modeling each background pixel as a mixture of Gaussians using an online approximation to update the background model. That is each pixel is classified based on whether the Gaussian distribution which represents it most effectively is considered part of the background model. In the early generation, C. Wren etal [5] proposed a Pfinder method which is a person finder method and it is related to body-tracking of a human in the scene without occlusion. This method uses a multi-class statistical model of color and shape to obtain a 2-D representation of head and hands in a wide range of viewing conditions. Nishu Singla [6] presents a new algorithm for detecting moving objects from a static background scene based on frame difference. Dayananda Jamkhandikar [7] presents a framework for efficient and tracking of an object in real time using color. It is also scale and rotation invariant. Prithviraj banerjee and Somnath Sengupta [8] presented a system that aims to tracking an object using a novel combination of an adaptive background modeling algorithm and a HDS system. Prajna Parimita Dash, Santhosh aitha, Dipti Patra [9] proposed an ohta (color model) based covariance method for tracking an object. In this method covariance matrix is used as the region descriptor. Also the performance of this technique is compared with other techniques i.e., covariance matrix with RGB features and histogram. M.Besita Augustin, Mrs. Sujitha Juliet, Mr. S. Palanikumar [10] describes a method for accurately tracking persons in indoor surveillance video stream obtained from a static camera with difficult scene properties including illumination changes and solves the major occlusion problem using the color feature information to accurately distinguish between objects. This paper views in the following sections, in section 2 proposed systems is discussed. Sect. 3 discusses about experimental results. Finally concludes by summarizing the entire research work in Sect. 4.

II. PROPOSED METHODOLOGY

In this work, the input video consists of several numbers of frames and these frames are converted into a gray color format. Then the method of background subtraction is used to detect the foreground objects because it is simple to implement and give high accuracy.

A. Background Subtraction Method

Background subtraction is a technique for foreground detection and it is widely used approach for detecting moving objects in videos from static cameras. Here the background subtraction uses the frame differencing method.
Firstly the background frame is estimated by adding the first few frames and taking average of it and hence the updated background is given as

$$B(m, n) = 1/N \sum X_i(m, n) \quad ; i=1......N \qquad (1)$$

Where, N=total number of frames, Xi (m, n) = pixel gray level value on (m, n) and B (m, n) = background pixel gray level value calculated from previous frames. Hence we get the background image. In this way the differential image is computed by subtracting the background image from the current frame.

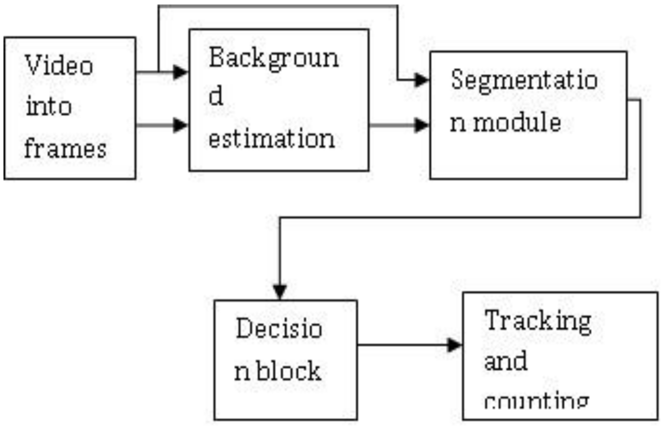

Fig 1: Block diagram of the proposed system

B. Segmentation

A motion detection algorithm begins with the segmentation part where foreground or moving objects are segmented from the background. The simplest way to implement this is from a frame differencing method. Frame difference is computed by finding the difference between the consecutive frames or subtracting every frame from the video clip with the background frame. The resultant subtracted image is converted to binary image format. Simultaneously a threshold is applied to the differential image to detect foreground objects.

The difference equation is given by:

$$D(m, n) = |G(m, n) - B(m, n)| \quad (2)$$

Detection rules are as follows:

$$\text{If } D(m, n) > TH \quad (3)$$

Then there is a moving object, else a background. Point where G (m, n) indicates that the current image pixel value, B (m, n) that corresponds to the location of the background image pixel value; TH is the threshold value, the current selection of TH mainly by experience. The threshold used for this detection should be accurate because accuracy of TH has direct impact on the quality of thresholding.

C. Post Processing

The results obtained from the segmented binary image are taken for tracking and counting of moving object. It is possible that the image will contain some noise even though the object is detected in the foreground. This noise should be removed by the morphological operation to get the correct output. Thus the morphological operation i.e. dilation and erosion operation is performed on the detected objects. Thus the foreground objects eventually become bigger and the holes in the object due to noise will become smaller or disappear.

D. Feature Extraction

The group of cells that constitute to a single target is called as a blob. This group of cells can be found out by connected component labeling. The different features related to the blob are derived to get more information about the detected foreground object

These features contains,

1. Number of blobs: It represents the number of objects present in that particular frame.
2. Size of blob: It is the total number of pixels for the foreground objects. Only objects having size above a certain threshold (e.g. 200 pixels) are kept for tracking to eliminate small objects.
3. Centroid of blob: Centroid of blob is equal to the mean of all the foreground pixels composing the Whole object.
4. Average color of blob: The average color of a blob can be calculated as:

$$\text{Avg Color} = \frac{\sum \text{R-components}}{\text{Length of objects}} + \frac{\sum \text{G-components}}{\text{Length of objects}} + \frac{\sum \text{B-components}}{\text{length of objects}} \quad (4)$$

By observing these features, we get an idea about the objects in a video clip. These features are useful in tracking and counting the objects in a video scene.

E. Tracking and Counting object

After detecting the foreground objects, the main task is to track those objects in a video scene. The main aim of this algorithm is to track the entire deformable object successfully in the video. These objects should be tracked without any disturbance in a complete video. The main difficulty in tracking is the discontinuity in the detected objects. Such as due to movement of human in the video, it is possible that some parts of the human appear separate. Also during background subtraction process, some errors occur. Thus legs or hands could appear as separate objects from the body. It can also be caused by any noise or shadows present in the video. Due to this, parts of a body in a single object could be tracked separately in a video. So that error will occur in counting also. In order to improve the results in such situation, a separate rectangle has been plotted with object detection. This is done by using the subplot function in matlab. Thus one rectangle will cover whole body of an object detected in method of background subtraction. Hence each object will get tracked completely in a video clip.

Then counting of objects is performed by using necessary variables and conditions. These conditions find out the previous and current value of pixel in the detected image. If object is present that pixels will be represented by 1. Other pixels are represented by 0. Thus a condition such as, if pre = 0 and cur = 1, is used in processing and counting.

III. EXPERIMENTAL RESULTS

In order to analyze robustness and effectiveness of the implemented system, experimental results under different conditions are considered in this system. The first video is taken from an open database for research i.e., CAVIAR database. Generally, it is difficult to track the multiple objects in a single frame. But the proposed system tracks the people in video. The counting of people is also performed correctly which is as shown in fig2.

FIG 2: Counting of objects the first video

In the second and third video the objects are classified as light vehicles and heavy vehicles based on the features in the traffic area and they are also counted which is shown in fig3 & 4.

FIG 3: Classification of objects in the second video

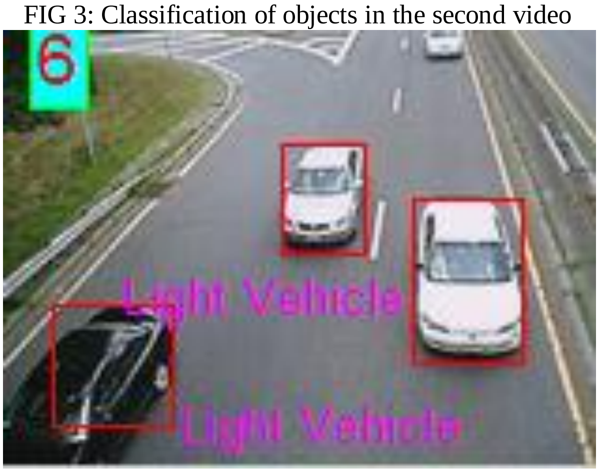

FIG 4: Classification of objects in the third video

IV. CONCLUSION

Moving object detection, tracking and counting of these objects are difficult procedures in the presence of shadows and illumination. The proposed system performs very well in these scenarios. This system uses a method of background subtraction to detect the foreground objects. These results are processed for further use, that is different features related to the objects are extracted. Then tracking and classification of objects is performed according to the size of each object and finally count the total number of objects as shown. The experimental results show that this method is easy and simple to implement. It is robust and very effective tracking system. The tracking and counting is successfully performed in the presence of noise such as shadows, illumination and occlusion. This system can achieve better accuracy resulting in the absence of shadows. Also it can count multiple numbers of peoples, vehicles present in a video. This system can be efficiently used to monitor people in public places like banks, hospitals, government offices, shopping malls, highways etc.

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