VEHICLE DETECTION AND COUNTING

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ABSTRACT

Video Surveillance is a very important aspect in computer vision because these systems do not disturb traffic during installation and they are easy to modify. Vehicle detection and counting is very important in traffic monitoring, military applications, toll collection etc. The input video clip is taken, frames are extracted and background is estimated. By this estimated background the next frames are subtracted to detect moving objects. In that moving objects vehicles are detected, classified and counted for traffic estimation. Experiments are carried out by taking the input video in varying environments. Experiments are implemented with Microsoft Visual studio 2010 C++ software with OpenCV .

Keywords: Background Subtraction, Classification, Frames Extraction, Segmentation, Vehicle Counting.

I. INTRODUCTION

Intelligent Transport System (ITS) is gaining very importance now a days, because everywhere we can find CCTV cameras which are used for security purpose and to keep track on the whereabouts on that region. Traffic monitoring is also very important because of increasing traffic accidents [1]. Therefore Vehicle detection and counting is very important in traffic congestion, keep tracking of vehicles and to control the traffic signal duration.

Automatic vehicle counting can also be used to allot the empty slots in parking systems by counting the number of vehicles entering and leaving the parking area or in bridge monitoring systems. The major problems in video monitoring systems are changing light intensities especially at late evenings and at night, weather changes like foggy atmospheres, rain, smoke etc[2],. Motion based vehicle detection can be done in different techniques such as, optical flow estimation method, Gaussian mixture model method, frame difference method and background subtraction method. After detecting only the vehicles it can also be used for classification for types of vehicles. The background subtraction is most popular because of its simplicity in implementation for vehicle detection. Here background is estimated by taking the initial two or three frames of a video and then the next frames are subtracted with this estimated background to get the moving objects in a video. The challenging part of the method is the estimation of the background because shadow, camera vibrations, change of illumination may occur and noise can get introduced. After detecting the moving vehicles it is counted by using the detection line drawn in video. The problems that can occur in counting is occlusion of two or more vehicles. Counting error can be reduced by taking care of camera angle or by taking the width of the moving objects.

In this paper simple background subtraction method is taken to detect the moving vehicles. After detecting the moving objects only vehicles are considered and it is classified and counted for traffic monitoring.

An important step in Vehicle detection is background estimation, region and feature based tracking algorithm with features to track correct objects continuously. After tracking objects their behavior and properties are recognized for analyzing traffic parameters [2].

The number of vertices per individual vehicle from the camera configuration is deduced first. Contour description model is used to describe direction of the contour segments with respect to its vanishing points, from which individual contour description and vehicle count are determined. Finally, a resolvability index to each occluded vehicle is assigned based on a resolvability model, from which each occluded vehicle model is resolved and then the vehicle dimension is measured [4].

Moving vehicles can be detected by image sequences automatically by moving object segmentation method. CC cameras are mounted at some distance from roadways; occlusion is common in traffic surveillance systems. The segmentation and recognition method uses the length, width of objects to classify vehicles as vans, utility vehicles, sedans, mini trucks, or large vehicles. Detected moving objects is recognized and counted with their varying features with the recognition and tracking methods [6].

The paper is organized as the brief review about the methods i.e. System Overview in Section 2, Experimental Results in Section 3, Conclusion in Section 4.

II. SYSTEM OVERVIEW

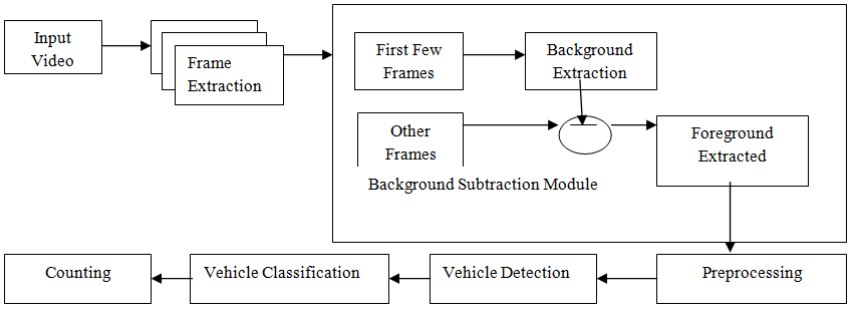

Figure 1: Block Diagram of Vehicle Detection and Counting

Fig 1 shows the block diagram for Vehicle detection and counting. From the input sequence of images, first the segmentation of moving objects from background has to be done. Image subtraction from the input sequence and background is done, which gives the changes in two frames. This method can be used only for moving objects in the input sequence, not for the objects which are idle for some time in the video.

In this work, the background subtraction method is used to segment the moving object in the scene. Background is estimated based on first few input video frames. Thresholding is used to segment the moving object from difference between the background estimated image to the current image. Morphological operations are done after the segmentation to reduce noise this is called preprocessing. After detecting the moving vehicles the bounding boxes are drawn around the vehicle. These detected vehicles are classified into car, bike or heavy vehicle. The number of vehicles is counted.

2.1 Background Estimation

The video is taken as input by reading the video from the video file present. Frame are extracted from the video, by using these frames the first few frames is taken and the average of those frames are registered as a background.

2.2 Background Subtraction

From the registered background, the other frames of the video are subtracted which gives the moving object. Some Preprocessing steps are done to extract only the moving vehicle. After background subtraction erosion,

dilation and canny edge detection is applied to view the objects clearly. The mask of the moving object is taken; this can be used for classification also.

2.3 Preprocessing

Erosion and Dilation are done to view the object clearly. By erosion and dilation the boundary region of vehicles can be clearly seen. Then mask of the image can be taken for vehicle detection and classification based on the shape features.

The Dilation process is performed by laying the structuring element *B* on the image *A* and sliding it across the image in a manner similar to convolution. Dilation adds pixels to the boundaries of objects in an image by finding the local maxima and creates the output matrix from these maximum values as shown in equation (1):

$$A \oplus B = \left\{ Z \mid (\hat{B})_Z \cap A \neq \varphi \right\} \quad (1)$$

The erosion process is similar to dilation, but here pixels are tuned to white, not black. Erosion removes pixels on object boundaries in an image by finding the local minima and creates the output matrix from these minimum values as shown in equation (2).

$$A \ominus B = \left\{ Z \mid (B)_Z \subseteq A \right\} \quad (2)$$

Mask: A mask is a black and white image of the same dimensions as the original image (or the region of interest you are working on). Each of the pixels in the mask can have therefore a value of 0 (black) or 1 (white). When executing operations on the image the mask is used to restrict the result to the pixels that are 1 (selected, active and white) in the mask. In this way the operation restricts to some parts of the image.

2.4 Vehicle Detection

After Preprocessing vehicle is detected. For the detected vehicles bounding boxes are drawn around the vehicle. The centroid is of the vehicle is detected and it is represented by circle on the vehicle.

2.5 Classification

Vehicle Classification is done by using the height and width ratio i.e aspect ratio, area of the vehicle. The area, height and width differs in bike, car and heavy vehicles so the classification is done based on this. Fig 2 shows the block diagram for vehicle classification.

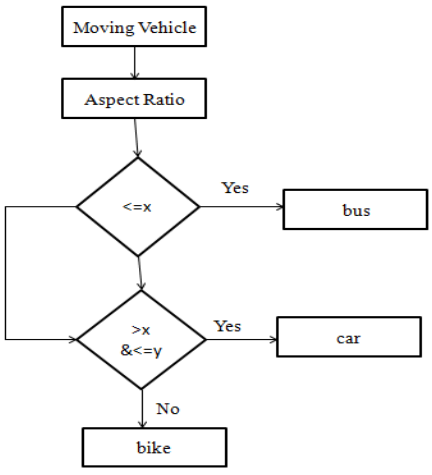

Figure 2: Vehicle Classification module

2.6 Counting

First the line is drawn as region of interest. After detecting the moving vehicle its position and centroid is detected. Whenever this centroid crosses the region of interest that is the line drawn the counter is incremented means the vehicle count is noted.

After all these steps the features of the vehicle can be extracted and classified into categories of vehicles such as car, bus, motorbike, non vehicles etc.,

Feature extraction can be done by Histogram Oriented Gradients (HoG), Principal Component Analysis (PCA). Classification can be done by using the Support Vector Machines (SVM), Latent Support Vector Machines, Neural Networks. Vehicle detection, classification and counting the vehicles with respect to their classes can be used in many areas for surveillance.

III. EXPERIMENTAL RESULTS

The experiments are conducted in Microsoft Visual Studio 2010 C++ with openCV libraries.

Fig 3.shows snapshot of a video which is taken as input and is converted into grayscale for further processing.

3a **3b**

Figure3: a) Input video b) Grayscale Conversion of input

Fig 4 shows the background extracted by taking the first few frames of the video

Figure4: Background Extracted from the Video

Fig 5 shows the foreground after the frames from the video are subtracted with the background.

Figure5: Result of Background Subtraction

Fig 6 shows the morphological operations applied for better visibility of vehicle. Erosion and Dilation is applied.

a) **b)**

Figure6: a) Erosion and b) Dilation Applied on Subtracted Image

Segmentation is done to get only the moving vehicle and avoiding all the static parts in video is shown in Fig 7.

Figure7: Results of Segmentation

Fig 8 shows the results of vehicle detection. The detected vehicle is represented by a bounding box.

Figure8: Results of Vehicle Detection

Fig 9a shows the detection line drawn to count the vehicles, when a vehicle crosses the line the counter is incremented that is shown in fig 9b.

a) b)

Figure9: a) Result of Drawn Detection line and b) Counting the Vehicle After it Crosses the Detection Line

Fig 10 shows the result of classification according to its aspect ratio and area.

Figure10: Results of Classification

IV. CONCLUSION

Vehicle Detection and Counting is necessary to establish an enriched information platform and improve the quality of intelligent transportation systems. In the background subtraction, moving vehicle extraction and detection, the improved background subtraction method is implemented to remove the negative impacts from camera vibration, shadow and reflection, sudden illumination changes and more gradual changes. A solution for Vehicle Detection, Classification and Counting which can be used in traffic monitoring, parking area allocation is proposed. A technique that can distinguish whether the object is vehicles or other. The experiment is carried out in Microsoft Visual Studio 2010 C++ with openCV libraries. The implemented method is easy to implement at very low expenses. Experiments give the good accuracy.

Future work is to detect 3D moving object to improve classification Performance.

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