International journal of advances in engineering and management (IJAEM)
Volume 3, issue 6 June 2021, pp: 1983-1987 www.ijaem.net ISSN: 2395-5252

Vehicle Counting and Classification

Dinesh Kumar, Sumit Mullur, Ammar Agarwala, Satyam Sontakke, Prof.Chaitanya Mankar
BE Student,Department of computer engineering, DPCOE Pune, Savitribai Phule Pune University
Professor, Department of Computer Engineering,DPCOE Pune, Savitribai Phule Pune University

----
Submitted: 05-06-2021 Revised: 18-06-2021 Accepted: 20-06-2021

ABSTRACT
In this work we are determining the quality of image processing technology to detect the moving vehicle from a road and classify and count them recorded by the static cameras or from videos to manage the traffic system. The vehicles are firstly extracted from the traffic scene by applying the adoptive background subtraction technique. After the background subtraction, using threshold and median filters, isolated image blobs are identified as individual vehicles. Once the blobs are identified, counting and classification of vehicles in a selected region are carried out.
The previous things shows that vehicle can be detect and classify in the group by image processing technique very efficiently. By optimal camera calibration, an accuracy better than 85% in moving & counting vehicles was observed. The old system which count the vehicle by sensors was not that much accurate and not good in different envioURment also the maintains was costly .This thing detect the vehicle moving towards the camera and detect the vehicle very efficiently.

I. INTRODUCTION

Traffic management has become very important in daily routine in cities and highways. today the growth of vehicle is very high and the traffic as well. Automatic vehicle detection from traffic scenes and extracting essential parameters related to vehicular traffic can help better management of traffic on busy highways and road intersections. Monitoring traffic flow and estimating traffic parameters can be carried out using sensors as well as through image processing techniques.With the advances in technology, monitoring traffic through image processing techniques yield a wide range of traffic parameters such as flow of traffic, speed of vehicles, number of vehicles, classification of vehicles, density of vehicles etc. Since the vehicles can be tracked over a selected segment of a roadway, rather than at a single point, it is possible to measure the "true" density of vehicles for each lane. Image processing techniques can also be applied to traffic video surveillance to detect the vehicles in motion, number plate identification, recognition of obstacles etc. Traffic monitoring through image processing techniques can lead to better control of the flow of traffic as well as to identification of reckless users and speed violators.

In the past, many research studies have been conducted on automated vehicle detection using image processing techniques. The focus of this project was to test the performance in identifying the moving vehicles from a traffic scene and to count and classify vehicles within a given time period.
he task of vehicle detection and counting is broken down into six steps: 1) Image Acquisition, 2) Image Analysis, 3) Object detection, 4) Counting, 5) Classification, 6) Display result.

II. RELATED WORK

A system for detection and classification of vehicles is described. It uses a self adaptive background subtraction technique to separate vehicles from the background. The resulting connected regions are then tracked over a sequence of images using a spatial matching method. The tracked regions are grouped together to form vehicles. also uses adaptive background detection method to identify vehicles. The vehicles are tracked based on contour extraction. Prewitt filter kernel is used for edge detection. The contour linking method used for connecting separated edge parts of the original object into one closed contour. A contour labelling method is used to mark and calculate vehicles within frames. In feature based tracking algorithm has been used. In adaptive background learning for vehicle detection and spatio-temporal tracking is described. A framework is proposed to analyze the traffic video sequence using unsupervised vehicle detection and spatio-temporal tracking that includes an image/video segmentation method, a background learning/subtraction method and an object tracking algorithm. a system on vehicle detection under day and night illumination is described.Offline camera calibration has been carried out to detect the parameters such as line correspondences for a projective mapping, detection region and multiple fiducially points for camera stabilization. Here, projective transformation is necessary as the features are tracked in world coordinates to exploit known physical constraints on vehicle motion. The transformation is used to calculate distance based measures such as position, velocity and density. Vehicle detection at day time is done by using consecutive three frame subtraction method by detecting moving points. The moving points are classified and labelled as vehicles.

The number of vehicles has increased tremendously over the past decade. There are over 1 billion active vehicles all over the world and 60 to 70 million vehicles in India. Managing such traffic moments, providing sufficient parking lots is not an easy task. Vehicle counting and classification on busy streets will help the authorities to obtain traffic flow statistics and help them to understand and study the traffic patterns so that the can manage traffic in the most efficient way. The paper presents a way to detect, count and classify vehicles using image processing techniques. Although there has been a significant amount of research related to this, there is always a scope of improvement. The task of vehicle detection and counting is broken down into six steps: 1) Image Acquisition, 2) Image Analysis, 3) Object detection, 4) Counting, 5) Classification, 6) Display result. The algorithms which will be used to perform these tasks will includes vehicle detection and counting algorithm and road marking detection algorithm. This can also be used to monitor high ways, detect accidents, unrighteous stoppage of vehicles on roads, the traffic rules violators. Classification of vehicles will be done in one of the following categories: a) Bicycles and motorcycles, b) motor cars, c) minibus and pickup vans, d) buses trailers, trucks. This data will help to figure out the priority and maximum users of a road and design traffic patterns that will be beneficial to maximum.

III. METHEDOLOGY

This section presents the essential steps in project implementation, starting from a video clip of a traffic scene and ending in vehicle classification and counting. The work was carried out with freely available video clips of traffic scenes.

- **Background Detection**

To extract stable background image, adaptive background detection method was used [3]. This method uses mean value of pixels within a range of frames to detect the background. If the variance of a given pixel is below a predefined threshold, then the pixel is considered to be stable. The background image is updated according to the equation given below.

$$B_{t+1} = B_t + S_t \times M_t$$

Here, Bt is old background image, St is a mask which varies between 0 and 1 depending on the variance and Mt is mean value of pixels.

Fig 1: Stable background image

Fig 2: Image under investigation

- **Camera Calibration**

Camera calibration plays an important role in the identification process. Camera calibration is carried out to transform the image coordinates to world coordinates [5]. This is essential for the vehicle

classification. It is also important if one wishes to extract the speed of the vehicles. In this work following assumptions were taken.

1.Road is straight 2.Road is flat

- X axis of the road space correspond to the direction perpendicular to the traffic flow and the Y axis is parallel to the traffic flow.

The transformation that has been carried out from the image space to world space is the projection transformation. Assume that the width and the length of the selected area in road space (which are known) are w and h respectively. The equation to find the projective transformation matrix that maps the image space coordinates (ax,ay; bx,by; cx,cy; dx,dy) to their corresponding road space coordinates

is;

$$\begin{bmatrix} A & B & C \\ D & E & F \\ G & H & I \end{bmatrix}\begin{bmatrix} ax & bx & cx & dx \\ ay & by & cy & dy \\ 1 & 1 & 1 & 1 \end{bmatrix} \quad \begin{bmatrix} 0 & w & w & 0 \\ 0 & 0 & h & h \\ 1 & 1 & 1 & 1 \end{bmatrix} =$$

To optimize the results of projection transformation matrix, least squares optimization method was used. The projection transformation was used as the initial guess and the best projection matrix was found by using the following objective function [5].

$$\sum_{i=1}^{4}\left(\frac{Axi+Byi+C}{Gxi+Hyi+1}-ui\right)^2+\left(\frac{Dxi+Eyi+F}{Gxi+Hyi+1}-Vi\right)^2$$

- **Lane Calibration**

Since the goal of the project is to identify the vehicles in each lane separately, the lanes must be defined and the centreline of each lane must be identified. User is allowed to select the region of interest by selecting the centre of lanes first and then the starting and ending points on each lane to define the tracking region. The screen space coordinates were first transformed into road space coordinates and then projected onto the lane line.

Fig 3:
Selected centreline on each lane

Vehicles were tracked alone the centreline on each lane within the user define tracking area.

Fig 4: Current frame and extracted pixels on lane lines

- **Vehicle Tracking**

A lots of technology have been developed to track moving objects in tracking regions such as tracking points, tracking centroids,etc. Here the bottom coordinates of the identified objects have been used to track moving vehicles .

when we read any new frame, beginning of the centreline of interest has been examined and if a positive value (here it is 1) is seen, the algorithm considers it as the bottom coordinate of a vehicle. If a positive value was seen in the previous frame and it has now changed, it suggests that the vehicle is in motion in the selected region of interest. By detecting the column vector having top to bottom positive stream of values the vehicle could be detected. Figure 5 illustrates the stated algorithm.

By calculating the length of the positive column vector which is the difference between the top and the bottom pixel values of the positive stream of numbers and convert it to the world coordinate space, minimum length of vehicle could be verified. Vehicles that do not satisfy the minimum length requirement were rejected. If a new vehicle is found, it is added to the vehicle array of the lane.

For each vector in the vehicle array, algorithm starts from the last known position of the bottom of the vector and search forward along the centreline to find the next position of the vector in the next frame. If the search ended up in reaching the end of the region, the vehicle is considered to be exited from the region of interest. This process is repeated for all defined centerlines.

- **Vehicle Classification**

Classification is done by categorizing the vehicles into three classes according to the size of the vehicles, namely, large, medium and small. Since it is easy to find the length of vectors, the length has been taken as the parameter to classify vehicles according to the defined sizes. The following table shows the classification used in this work.

Large	Trucks, Buses,Heavy motor vehicle
Medium	jeep, car,tempo
Small	Three wheelers,bike,scooty

Table 1: Classification of vehicles

For each new vehicle that enters into the line on the region of interest, the length of vector has been calculated and subjected to the minimum length requirement. Classification was carried out for those vehicles that pass the length requirement.

IV. RESULTS AND DISCUSSION

Since the success of the project depend on providing a proper line of site for the camera view, placing the camera on an overhead bridge directly over the flow of traffic route was necessary to minimize the vehicle occlusion. Due to security situation in the country, tests were carried out (to debug the developed algorithms and to evaluate the performance) with freely available video clips on internet, one with vehicles moving away from the camera view and another with vehicles moving towards the camera view (see Figure 6).

Fig 6: Video which are going to used for the test of system

The accuracy of the results depends on the camera calibration which takes place to find the projection matrix between the image coordinate and the world coordinate, lane selection and the tracking region. The system has been tested with several camera calibrations to find the optimum results. Figure 7 illustrates results of two camera calibrations for the video clip 1.

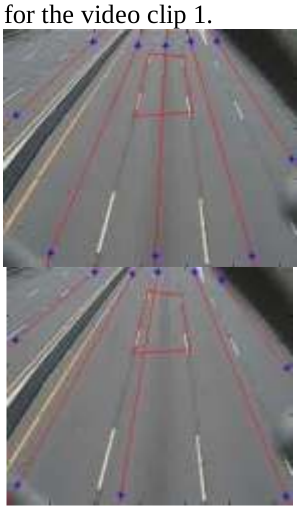

Fig 7: Camera calibrations (1) Optimum calibration (2) Improper lane selection

In order to reach the desired goal, the video clips were subjected to a series of independent tests that were discussed earlier to carry out vehicle identification, tracking, classification and counting.

For the video clip 1, manually counted results and counting results of the developed system (CCT system) for each lane is given in Table 2. Here, in lane 1, vehicles are moving towards the camera and in lane 2, lane 3, lane 4 and lane 5, vehicles are moving away from the camera view.

Calibration	Lane 1	Lane 2	Lane 3	
Manual	08	12	22	
CCT System	22	12	18	

Table 2: Comparison between actual counting and CCT system counting

It can be seen that except for lanes 4 and 5, other 3 lanes produce results within 10% of the manual counting. As expected, errors increase when the lanes are skewed in the camera view. The developed system tends to produce errors especially when the vehicles do not travel within the selected lanes and when tall vehicles (such as containers) tend to be in the side lanes often covering two lanes in the camera view.

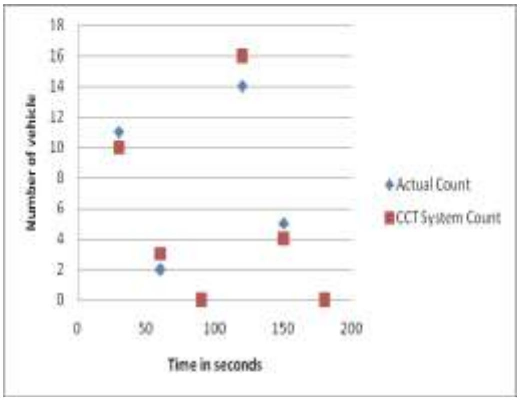

Fig 8: Comparison of counting results

In order to check the performance of the CCT system with the traffic flow rate, data were collected for time intervals of 30 seconds. Figure 8 shows the results obtained for different time intervals for lane 1 and lane 3 for video clip 1.

V. CONCLUSIONS

The result of building this auto system to count and classify the vehicles in motion .The system is easy to track the mocing vehicle using image processing technique with hig acuracy this system has ability of handling video seen with 15 frame per second in real time.

The accuracy of this system is totally depend upon the type of webcame used.

The results obtained through the developed system show that with further improvements it can be used in real- time to count and classify vehicles on busy traffic routes. Especially, if an obstructed view of the traffic movement can be obtained, the system can perform quite accurately.

ACKNOWLEDGMENT

The results strongly depend on the camera calibration used. If the camera calibration is not optimal, it can easily affect the system performance.

Fig 10: GUI interface of the developed system.

REFERENCES

[1]. https://www.researchgate.net/publication/234136865_Vehicle_Counting_and_Classification_from_a_Traffic_Scene
[2]. https://ieeexplore.ieee.org/document/9194678
[3]. https://ietresearch.onlinelibrary.wiley.com/doi/epdf/10.1049/iet-its.2015.0157
[4]. https://core.ac.uk/download/pdf/83533829.pdf
[5]. https://www,github.com