VEHICLE DENSITY ESTIMATION USING SEGMENTATION METHODS FOR TRAFFIC MONITORING

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***Abstract*—Traffic congestion is a serious problem people are facing in this century and this is increasing day by day. Due to fixed time of the signal the time is consumed even though there are hardly any vehicles crossing the road. Therefore it is needed to develop simple but powerful system for traffic management so that the transportation will be efficient. Vehicle detection or vehicle density estimation plays a vital role in traffic management system. To monitor the traffic density estimation is very important. So, we are proposing a system which is used to estimate traffic density on a road. In this paper the density estimation is done using two segmentation methods that are K-mean segmentation and region growing. Decision to allot the run time for vehicles on each road is taken on the basis of density estimation.**

***IndexTerms*—K-mean clustering, Region growing, Traffic, Vehicle detection, Density estimation, Traffic Monitoring.**

I. INTRODUCTION

In many countries of world, transportation via road is the very common mode of transportation. The numbers of vehicles are increasing day by day which causes the traffic jam on roads. In many metro cities this is the problem everyone is facing every day. Traffic congestion is serious problem of this century. Many researchers are working on this issue to implement the intelligent traffic management systems. When we consider any traffic management system or any traffic surveillance system, vehicle detection plays an effective and significant role. Vehicle detection is the main part of traffic monitoring system. There are so many methods in the computer vision that are used to detect the moving objects. Also some new improved methods are also involving now-a-days. These all methods have their own advantages, disadvantages and limitations. Some are used in some cases but fails in another. Some of these are combination of two or more techniques. In traffic management system there are two parts, one is day time traffic and another is night time. So in such cases the techniques used are different for each of them. Light illuminations are different in day time and night time also there are shadows of vehicles on road during the day time. Hence while designing of the traffic surveillance system one have to consider these all the factors so that the system will be efficient and robust in all the conditions including the climate change. Vehicle density estimation is applicable in many areas like traffic monitoring, vehicle tracking, number plate recognition, speed detection, stolen vehicle detection and many more.

Traffic flow analysis is the growing area and many new techniques are arising for improvisation of conventional traffic systems. In this paper we have proposed a system to allot the run time (to set duration of green signal) for vehicles with the help of vehicle density estimation using two segmentation methods; one is k-mean clustering and region growing.

II. LITERATURE SURVEY

Shengli Shi *et.al*,[1] proposed Vision-based Density Detection of Traffic Flow in Urban Intersection in the Daytime. They have used a background subtraction method to separate the vehicles from the background. To separate the gray or light black shadows vehicle colors are selected for reference.

Pranam Janney *et.al*, [2] proposed Advanced Framework for Illumination Invariant Traffic Density Estimation. Traffic density is given by the percentage of ROI occupied by the traffic in this paper. For representation of ROI, Invariant Features of Local Textures (IFLT) are used to generate local texture descriptors. Two staged framework consist of Offline training and testing. Invariant Features of Local Textures (IFLT) is a texture descriptor that is scale, rotation and illumination invariant.

MuhammetBalcilar*et.al*, [3] proposed a framework for Extracting Vehicle Density from Background Estimation Using Kalman Filter. In this they have extracted the traffic density using the method of Kalman filter based background estimation. They have initially marked the road as a mask. Then the background is updated and that is subtracted from the road masked image. Then the thresholding and the noise reduction mask is applied on the resultant. Finally the ratio of the total area occupied by the vehicle to the total area of the road is calculated to get the traffic density of a road.

Tahere. Royani*et.al*, [4] proposed a simple method for calculating vehicle density in traffic images. Here traffic density is calculated for multiple vehicle occlusions based on counting object pixels and assigning a distance index to each region of image. Scoreboard algorithm is used for the estimation of the stationary background. After background estimation the vehicle segmentation is used to separate the vehicles from the background and then thresholding is used. Then average filter is used to remove the noise.

R. Cucchiara*et.al*,[6] proposed a framework for recognizing vehicles in traffic videos for daytime and night time by methods for picture investigation and administers based thinking. On moving layouts used spatio transient analysis in daytime pictures, and for fog light used morphological analysis. And these are combined in night pictures which are performed by picture preparing modules. At night time, they identified the vehicles on the basis of headlights.

III. PROPOSED SYSTEM

The block diagram of the system using segmentation algorithm is given below,

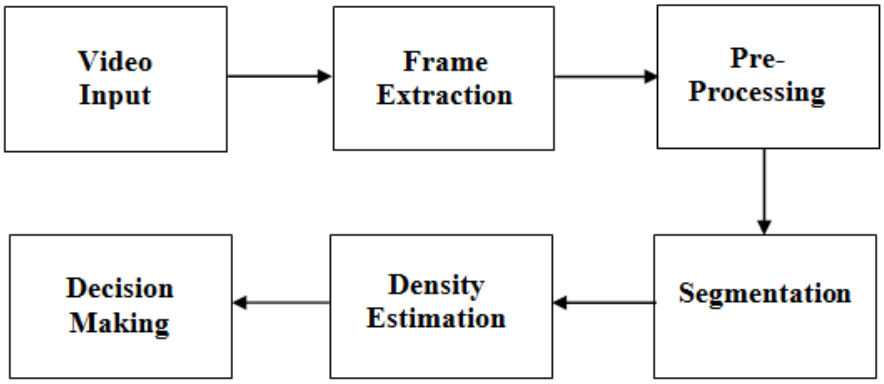


Figure 1: Block Diagram of the system using segmentation

Segmentation

Image segmentation is the classification of image into different groups. For segmentation, two methods are used in this project that is given below:

1. K-Mean Clustering
2. Region Growing

1. K-Mean Segmentation

The clustering analysis is used to group data such that similar objects are in one cluster and objects of different clusters are separated in different clusters. The K-means algorithm mainly consists of three steps:

(a) Initialization: Choose the k, first set of K is called centroids
(b) Check every pixel of the image and assign it to its nearest centroid
(c) Move the centroid toward the centre of its assigned pixels.

Perform steps 2 and 3 until no centroid shifts in one iteration. Algorithm will stop when shift is below a threshold. The following gives k-means clustering algorithm, for 2D case.

2. Region Growing

Region growing is region-based image segmentation method. For growth of the region the seed pixel is compared with all the neighbouring pixels along with threshold. The pixels which are greater than threshold are taken into a single region. Region growing process is continued until all the pixel values are grouped in any one of the region. First seed points can be a single pixel or group of pixels it can be called cluster.

- Initially group of small areas are merged with respect to similarity constraints iteratively
- Choose random seed pixel and compare that with neighbouring pixels
- Starting from seed pixel, add neighbouring pixels that are similar. This will grow the region and increase the size
- If the growth of one region stops then choose another seed pixel that does not belong to any region and start again
- Continue the process until all pixels of image belong to some of the region

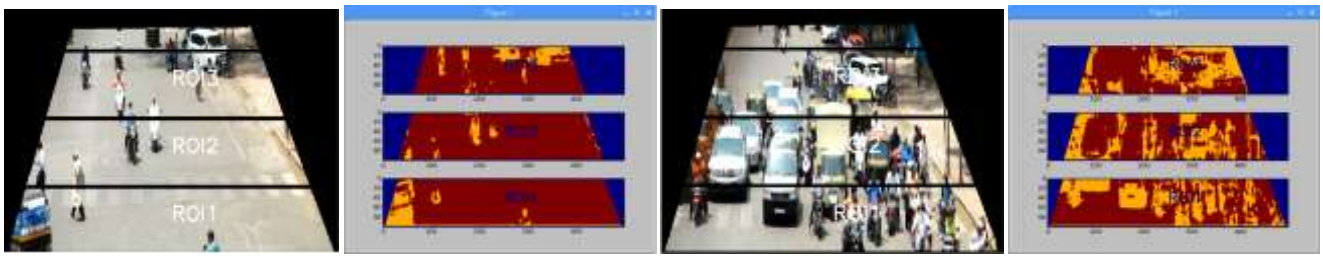
IV. Operation Of System

Videos of the traffic are provided as an input to the system. For real time implementation we can mount cameras on the road and capture the videos. But here we have collected the videos and perform the algorithm on them. To analyse the traffic density and allowing the run time for each road we have given the four different videos as input to the system. After applying the video input the next task is to extract the frames from the videos. Frame extraction will make the further processing easier. Then store the frames into any folder so that we can analyse that if required. After the frame extraction the next thing is pre-processing. For pre-processing thresholding is used. Then in segmentation, K-mean clustering and region growing is used to estimate the density of the vehicles. Prior to this the area of interest is mark and further that area is divided into three regions of interest namely ROI1, ROI2, and ROI3. First the total pixels are counted in each ROI. The k-mean clustering and region growing give the pixels occupied by the vehicles. For k-mean clustering, 3 clusters are considered. The ratio of pixels occupied by the vehicles to the total pixels is taken for each ROI. And on the basis of occupancies the run time for the each road is decided. For that we have take the threshold for each ROI and that is if area is filled with 50% that of ROI by the vehicle then consider it as fully filled region and if give some time to that region according to density and at the end take summation of time for all ROI and that will be the total run time allotted for that particular road.

V. Results And Discussion

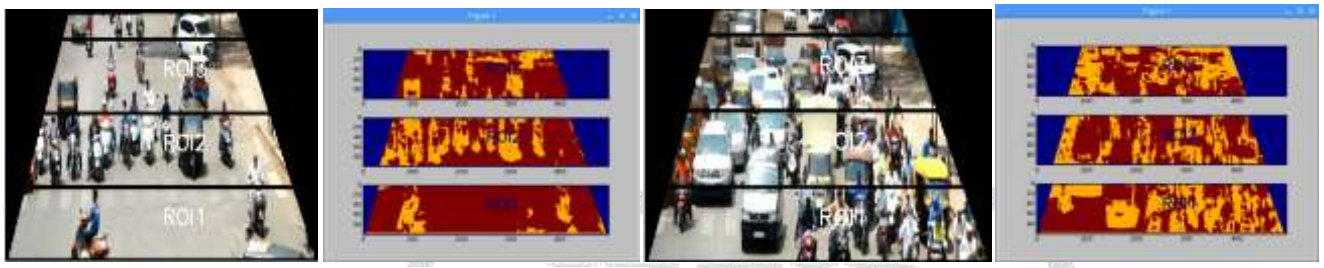
The results for K-mean clustering are given in figure 2. For this different cases are taken such that in each case the traffic density will be different. In this, figure 2(a) and figure 2(c) are the frames captured from the first and second video respectively. In every frame the area of interest is selected and one rectangle is marked on that and this area is further divided into three regions of interest like ROI 1, ROI 2 and ROI 3. Figure 2(b) and figure 2(d) are showing the vehicle density map using k-mean clustering segmentation method for the first and second video respectively for the ROI 1, 2 and 3.

Case 1:

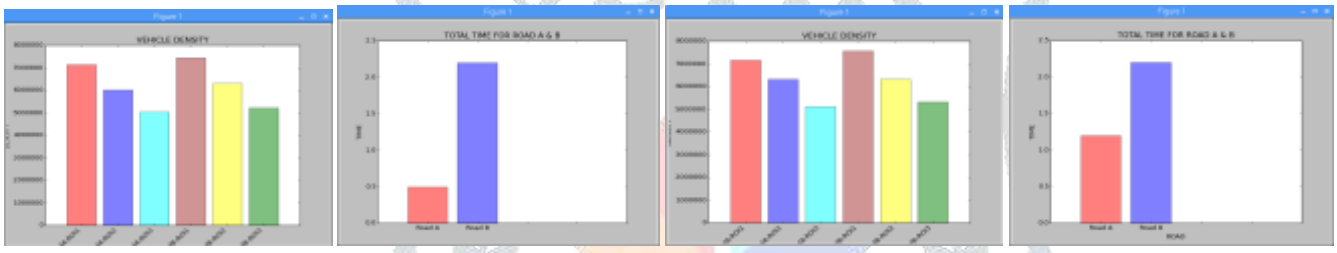


(a) Frame from video 1 (b) Density Map: Road A (c) Frame from video 2 (d)Density Map: Road B

Case 2:



(e) Frame from video 1 (f) Density Map: Road A (g) Frame from video 2 (h) Density Map: Road B



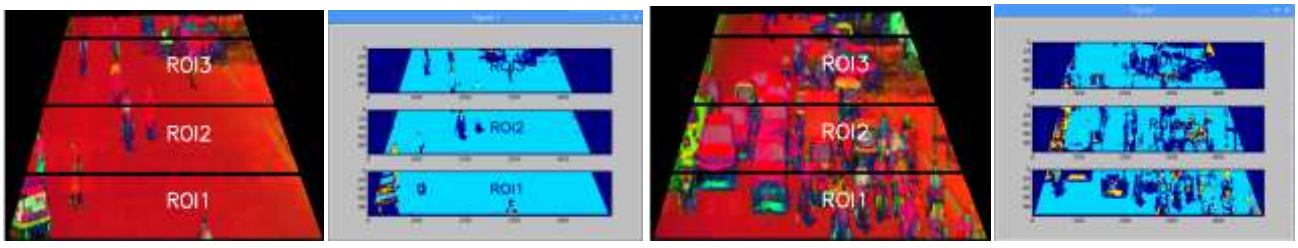
(i) Vehicle Density Plot (Case 1) (j) Time for Road A and B (Case 1) (k)Vehicle Density Plot (Case 2) (l) Time for Road A and B (Case 2)

Figure 2: Results of K-Mean Clustering

Figure 2(i) shows the vehicle density map for both videos of roads ROI wise. First three bars representing the 3 regions of first video and next 3 bars are representing the ROI of second video. In this plot the X axis is representing the ROI and Y axis is representing the pixels (density).Figure 2(j) is the final result showing the allotted time for road A and road B that is first and second video. This time is the summation of the time allotted for each ROI in each video. This time is given in Minute. This is same for second case. But in each case the vehicle density is different so that the density map, allotted time for each ROI and total allotted time for each road is different as we can see in the figures.

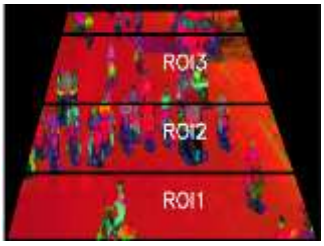
The results for region growing are given in figure 3. For this different cases are taken such that in each case the traffic density will be different same as ink-mean clustering.

Case 1 :

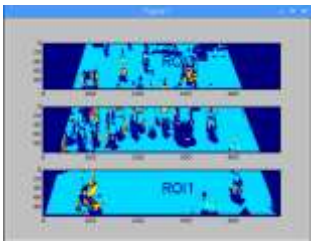


(a) Frame from video 1 (b) Density Map: Road A (c) Frame from video 2 (d) Density Map: Road B

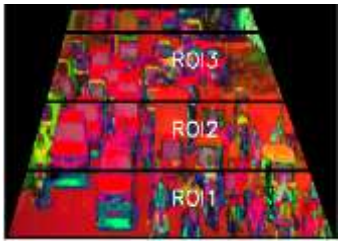
Case 2:



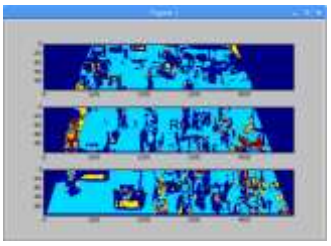
(e) Frame from video 1



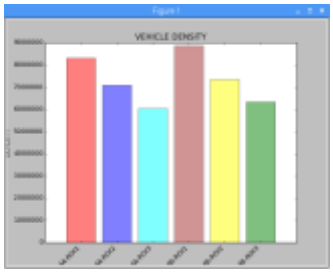
(f) Density Map: Road A



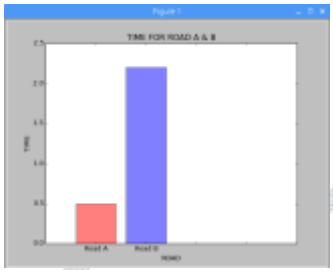
(g) Frame from video 2



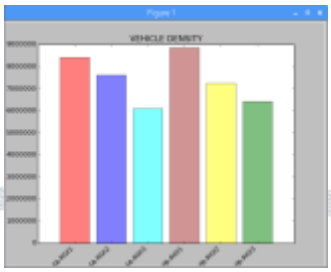
(h) Density Map: Road B



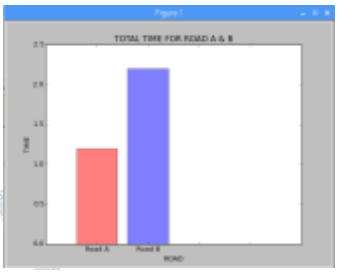
(i) Vehicle Density Plot (Case 1)



(j) Time for Road A and B (Case 1)



(k)Vehicle Density Plot (Case 2)



(l) Time for Road A and B (Case 2)

Figure 3: Results of Region Growing

The execution time for k-mean clustering and region growing is also calculated and summarized in table 1. From table 1, region growing method takes smaller time to execute comparing to k-mean clustering method hence region growing method is fast.

Table 1 Comparison of execution time for two methods

Method	Execution Time (Sec)	
	Case 1	Case 2
K-mean Clustering	43.4106	125.754
Region Growing	36.443	123.975

VI. Conclusion

This paper contains the approach towards vehicle density estimation and decision making to allot run time (Green signal). K-mean clustering and region growing are the two methods used for the density estimation. Among these two methods region growing is the efficient method and takes less time to execute compare to k-mean clustering. The advantage of this system is processing time of the system is less. The results show that the method can be implemented in real time situation also.

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