Algorithm to Detect Vehicles, Count and SegregationUsing SIFT for Non-lane Indian Roads

Mr.Siddalingesh G
Research Scholar, Prist University, Reg No 14151272
E-mail: siddug123@gmail.com

DR.LATHA PARTHIBAN
Department of Computer Science, Community College, Pondicherry University.
E-mail: lathaparthiban@yahoo.com

***Abstract*—Vehicle detection, counting and type segregation is an important part of Intelligent Transportation System (ITS). Accurate and real-time collection of traffic data is a key factor impacting ITS performance. Image-based solution for this task, comparing to other solutions, does not disturb traffic flow and can be easily implemented taking advantage of already established CCTV system at traffic signals. Number of algorithms have been developed so far on this topic. Motion blurs, changes in image resolution are still the challenges in developing a working algorithm, to name a few. The work presented in this paper focuses on developing algorithms to detect vehicles, count and segregated them based on their type. The vehicle detection and counting algorithm is based on Background Subtraction method and other image processing techniques. Testing of this algorithm shows promising results for images with low to medium vehicle density. For type segregation of vehicles, Scale Invariant Feature Transform(SIFT) is used for feature extraction. These obtained features are used to train Support Vector Machine (SVM) to classify vehicles..**

***Index Terms*— Intelligent Transportation System (ITS), Otsu's Threshold, Support Vector Machine (SVM), Scale Invariant Feature Transform (SIFT)**

I. INTRODUCTION

Vehicle detection, counting and type segregation is an essential component of intelligent transportation system. Increase in a large number of vehicles leads to many rise in traffic violation, heavy traffic jams, accidents etc. so to tackle with such problems intelligent transportation system gives attention to vehicle detection, counting and classification.

Inductive loop, sonar, microwave detector this are some of the most commonly used method for vehicle detection and counting and video or image based method attracted lot of attraction due to low cost and its ability to collect a large amount of information which can infer a high level of information easily. It is also easy to install and maintain.

India is ranked second in the most populous countries in the world. It needs a solution which should be different from developed countries. Increase in large number of vehicles is making the roads full which causes traffic jams. Traffic jams or congestion not only result in considerable loss in times but they also leads to more no of accidents and produce big impact on environment like noise and air pollution. Therefore it needs to choose a technique and method to extract the features to resolve the problems of detecting, counting and classifying vehicle.

A widely used technique for object detection and counting is called background subtraction. It is also referred as foreground detection. In background subtraction, difference between a background frame and current frame is taken and further processing is done on the difference image. A robust and clean background image is a necessary condition in this technique. For this reason, in case of vehicle detection on road, static background is needed for real-time on road vehicle detection and counting. Developing on this technique, the work presented in this paper focuses on accurately distinguishing the foreground image containing various types of vehicles from the background one which is without any moving objects. The background subtraction method is couple with Otsu's thresholding method to achieve better results.

Type segregation generally consist of two steps viz. feature extraction and classification. The feature extraction mainly deals with the visual information present in images, Scale invariant feature transform is used for feature extraction. Second step deals with classification in this step extracted feature are used to train Support Vector Machine.

Thermal imaging camera can be used to detect objects. These cameras usually detect radiation in long-infrared range of the electromagnetic spectrum (roughly 9,00014,000 nanometers or 914nm). Thermal imaging camera works equally well in the day and night. By using thermal vision camera, we have a chance to see through smoke and fog which gives a thermal camera an edge over other surveillance techniques. But the cost of thermal imaging is high as compared to normal vision camera. Besides, CCTV cameras are installed at the signals in almost all major cities in India

II. LITERATURE REVIEW

A. *Paper Survey*

In[7] Ye Li, Fei-Yue Wanghas presented a vehicle detection method based on And–Or Graph and Hybrid Image Template for complex urban traffic conditions. For object recognition from images And -Or Graph can be used which is an object representation model. Detecting and representing an image object Hybrid image template used. Proposed method by the authors does real-time vehicle detection and tracking algorithm that extract vehicles in various environments with various illumination conditions. It applies other features such as the bright and shadow region for robustness and improves the system stability. Only front view of vehicle is considered.

In[8] Yoginee B. Bramhe, P.S. Kulkarnihave used fixed and still camera installed on road for continuous surveillance. This fixed camera picked serial pictures and frame, in order to identify and detect the moving object correctly. It focuses on optimization of the video based traffic congestion monitoring system, mainly in image processing. The algorithms proposed in this paper work on videos with a normal background and stable videos from fixed camera. In this paper they have mentioned that by doing some modifications in the algorithm. That new algorithm can work for the video which having complex background as well as videos that are not stable.

In[3] Da Li, Bodong Liang, Weigang Zhang presents a video-based solution coupled with adaptive background subtraction method. They have used the background subtraction method where the input images are obtained using video cameras and blob tracking method is used to track the vehicles. In this paper, authors claim high accuracy in vehicle detection, counting and tracking. For detection of vehicles, in the work presented in this paper, combination of background subtraction, Otsu’s thresholding method and moving cast shadow detection method is used.

In[1]Ghada S. Moussa - Vehicle Type Classification with Geometric and Appearance Attributes In this paper they represent two types of classification approaches Geometric and Appearance based for multi-class and intra class classification. In multiclass vehicle vehicles classified into three categories Small, Medium, Large size vehicles. In intra class classified as car, truck, buses etc. for feature extraction in case of Geometric based appearance Scale Invariant feature transform used. In case of appearance based classification feature extraction is done by using well known bag-of-words paradigm (BOW). Feature extracted in both type of classification fed to Support Vector Machine (SVM) to classify vehicles to corresponding classes.

In[2] Narhe M.C., Nagmode M.S. achieves feature extraction using SIFT. Before feature extraction they used Background subtraction and segmentation. keypoint and local descriptors are determined by feature extraction. The extracted features are matched with SIFT feature database.

In[4] Ahmed Nidhal, DrUmiKalthumNgah, DrWidad Ismail have compared vehicles density on a road with a certain threshold value to calculate traffic density. Backlight feature has been used in this paper to detect and count vehicles. Since backlight is invariable to colour, day-night conditions and weather changes, the accuracy of this system can go as high as 99%. The accuracy number is hampered when motorcycles are present on the road.

III. PROPOSED METHADOLOGY

A. *Block Diagram for Vehicle Detection and Counting*

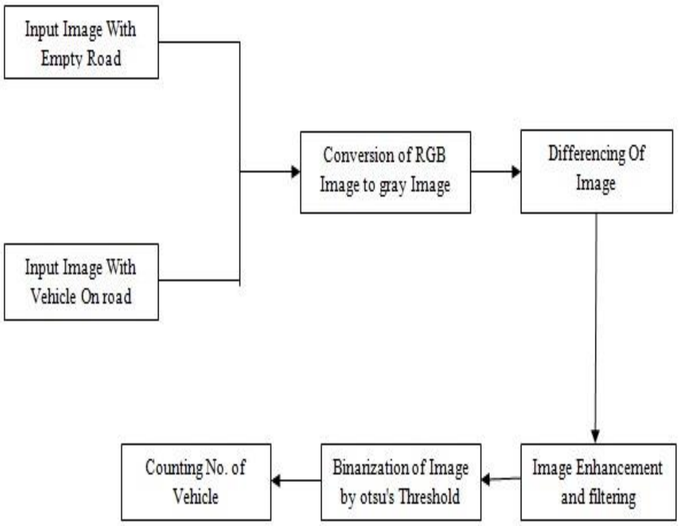

Figure 3.1 -Block diagram of vehicle Count and detection

Explanation: In vehicle detection and counting we take two images, one without Vehicle and the other with vehicles in it. The input image is then converted from RGB to Gray. After that find the difference of image. After differencing image enhancement andfiltering done to improve contrast and remove noise. Then the image is converted to binary. In last step countingdone.

IV. PROPOSED ALGORITHM

A. *Getting the input Image:-*

Imread( ) reads the image from graphics file. Image can be either Grayscale or RGB Image. Here we read two images one with clean background and other image with vehicle present in it.fig 4.1 shows images with clean background (left) and one with vehicle in it

Figure 4.1 Image with clean background and containing vehicle.

B. Converting color (RGB) image to gray Image:-

Rgb2gray ( ) converts both the images to grayscale images.

Figure4.2 - Conversion of rgbimages to gray images

C. Foreground Detection:-

Set threshold value to 15. Find the difference of two images using absdiff( ) based on threshold. If the difference between two images is more than the threshold value then assign it as one otherwise assign zero. Following figure 4.3 shows the result obtained after taking difference of two images.

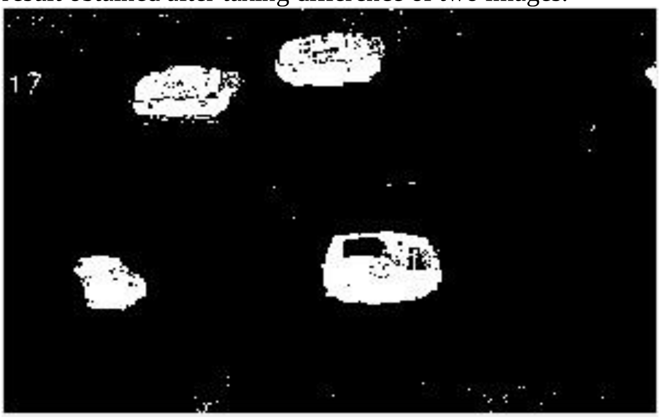

Figure 4.3- Image after difference of two images

D. Image Enhancement:-

The main aim of Image Enhancement is to provide interpretability or perception of image to provide better input for automated image processing techniques. It accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for analysis and display. The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily Generally the output obtained after differencing of image have poor contrast. Contrast is a very important factor in any subjective evaluation of image quality. Contrast is formed by the difference in luminance reflected from two adjacent surfaces .contrast is the difference in visual properties that make an object distinguishable from other object and background. To improve contrast of output image obtained Imadjust( ) is used. The following fig 4.4shows the result after the enhancement of image after foreground detection.

Figure 4.4- Image after enhancement

E. Filtering of Image:-

Images are often susceptible to random variation in intensity, illumination or have poor contrast and can't be used directly. Salt and pepper noise, impulse noise and Gaussian noise are the most common type of noise present in an images. When random occurrences of both white and black intensity values present in an image is a salt and paper noise. Only random occurrences of white intensity values in an image is an impulse noise. Noise is the result of errors in the image acquisition process that result in pixel values which do not reflect the true intensities of the real scene. In image processing filters are mainly used to suppress either the high or low frequencies in the image, *i.e.* smoothing the image, or the low frequencies, *i.e.* enhancing or detecting edges in the image. In this algorithm we have used wiener2 filter. The image obtained after filtering is as shown in fig 4.5

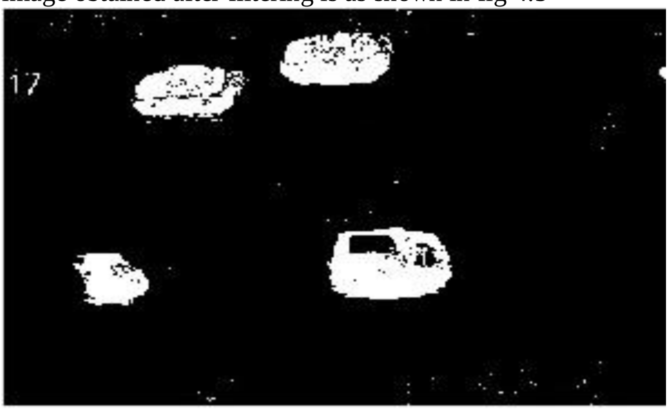

Figure 4.5- Image after filtering

F. Image segmentation

Image segmentation is basically dividing an image into multiple parts. It mainly refers to separation of background and foreground. It is typically used to identify object in it. There are various type of segmentation. The level to which in this algorithm we have the subdivision is carried depends on problem solving. Segmentation must be stopped when the object of interested have been differentiated from other object. Thresholding is one of the approach to segmentation that enjoys a high degree of attraction particularly in application where speed is a factor. In this algorithm we have used Threshold (otsu's) based segmentation. otsu's threshold is aimed at finding minimum value for global threshold

G. Otsu's Threshold

Otsu’s algorithm assumes that the image on which thresholding has to be done contains bi-modal histogram and two classes of Pixels (e.g. background and foreground) then it determines the most suited threshold dividing those two classes. Otsu's method is very popular to calculate threshold value, in image segmentation algorithm and is not affected by the image contrast and brightness, that's why it has been largely feature in digital image processing. But the otsu's method has some drawback like it assumes that histogram is bimodal (i.e. two classes). The method breaks down when two classes are very unequal. The method does not work for variable illumination.

H. Binarization of image

im2bw ( ) converts grayscale image into a binary image based on the threshold value which is obtained by Otsu's thresholding method. The pixel which have less value than threshold treated as background and vice-versa.

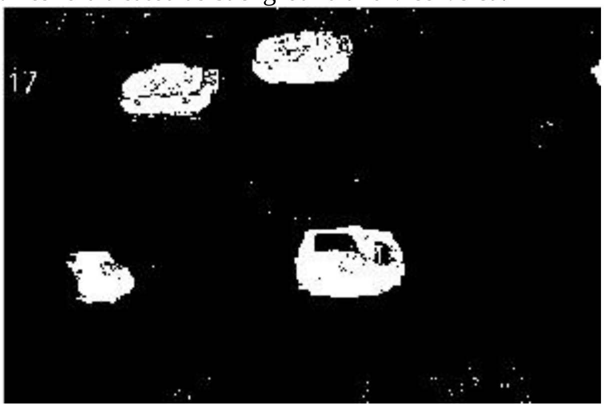

Figure 4.6 - Binary image

I. Filling of holes in image

The imfill( ) function performs a flood-fill operations on binary images.Imfilloperation changes connected background pixels to foreground pixels in case of binary image. Stop when it reaches object boundaries. The connectivity you specify determines the boundary of fill operation. To fill holes in image commonly used operation is flood-fill. Holes is nothing but a dark region surrounded by bright regions. In other words we can say that 0s surrounded by 1s in a hole. fig 4.7 shows image after filling

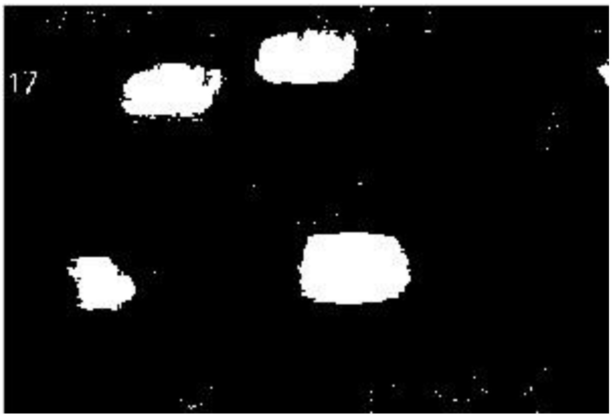

Figure 4.7-image after hole filling

J. Area opening of binary image

To Remove Small object from a binary image which are not a part of targeted object which are present in a image due to noise. Bwrearopen removes a small binary objects that have fewer than some value pixels producing another binary image. The image obtained after area opening shown in fig 4.8

Figure 4.8 Image after area opening

K. Connected-Component Labeling

For identifying object in a binary image. The bwlabel or the bwlabeln functions used which perform connected-componentlabeling, the bwlabel function supports 2-D inputs only; the bwlabelnfunction supports inputs of any dimension. These functions return matrix, called a labelmatrix. A label matrix is an image, the same size as the input image, in which the objects in the image are distinguished by different integer values in the output matrix. bwlabel can identify the objects in this binary image.

V. SEGREGATION OF VEHICLE

A. Block Diagram for Type segregation of Vehicle

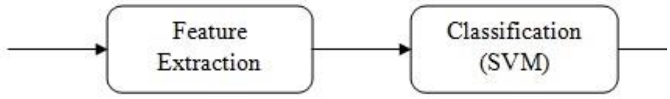

Figure 5.1 The block diagram for vehicle segregation

Block diagram for segregation of vehicle mainly consist of two parts viz. feature extraction and classification. For feature extraction, scale invariant feature transform (SIFT) is used and for classification, Support Vector Machine (SVM) is used.

VI. SCALE INVARIANT FEATURE TRANSFORM (SIFT)

David Lowe in 1999 introduced The Scale Invariant Feature Transform (SIFT) algorithm. Image matching is used to match the key points in two images which are invariant to scale change. The method proposed by David Lowe uses features which are invariant to image scaling, translation, affine, rotation or 3D projection and partially invariant to illumination changes. SIFT is a stable method for image blur and affine transformation to a certain degree. Also, using this method a single feature can be compared and matched to number of images with high accuracy. The SIFT algorithm has four major steps[2].

1) Scale-Space Extrema Detection
2) Keypoint Localization
3) Orientation Assignment
4) Keypoint Descriptor Generation

A. Scale-Space Extrema Detection

Keypoint extraction is done in this step. Extracted keypoints are not affected by any changes in the scales of images in context. Hence, it is required to look for all possible differences in the images leading to key points. A function, L(x,y,σ) is the scale-space of an image which is obtained from the convolution of an input image I(x,y), with a some variable scale-space Gaussian function G(x,y,σ) as shown in equation (1).

$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y) \quad (1)$$

where * is the convolution operator in x and y.

For the detection of stable keypoint locations, David Lowe has proposed the scale-space extrema in difference of-Gaussian (DoG) function, D(x,y,σ) as shown in equation (2).

$$D(x,y,\sigma)= L(x,y,k\sigma)- L(x,y,\sigma) \quad (2)$$

To calculate extrema, two images are subtracted by a scaling factor K. The above process is repeated by changing values of K for several octaves. The process shown in fig 6.1

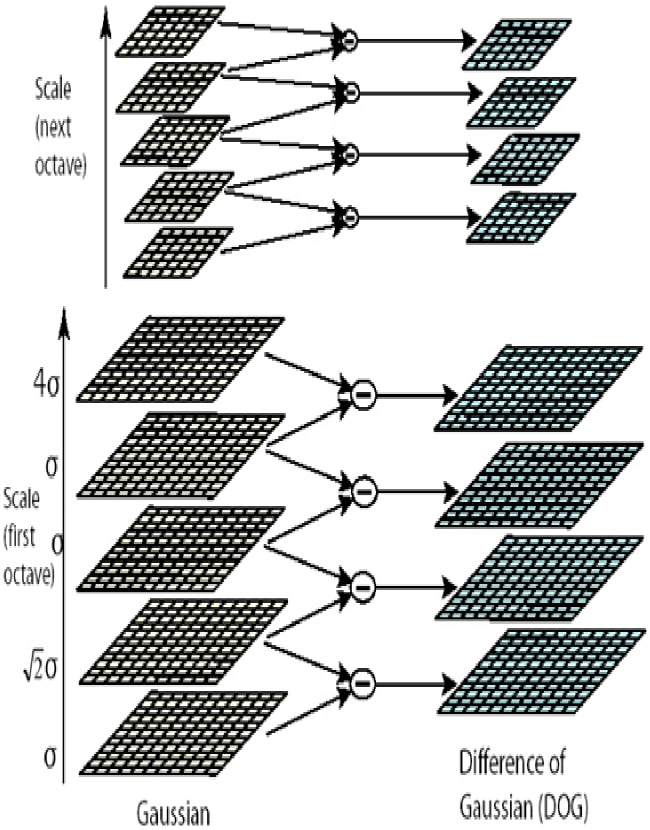

Figure 6.1-Visual representation of DOG[2]

To obtain candidate keypoint, it is compared with closest 8 neighbourhoods in an image. Once the extrema point is found, it is again compared with 26 neighbours to find final extrema. This is depicted in Figure 6.2.

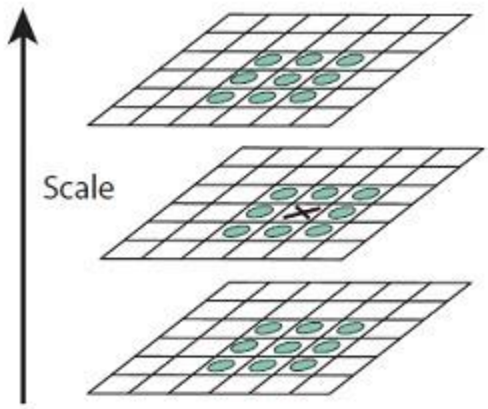

Figure 6.2 -Local extrema detection in DOG[2]

B. Keypoint Localization

After the keypoint has been located, it is to be checked whether the keypoint lies in low contrast or edge region of the image. Such keypoints have to be eliminated. For this, Taylor series expansion of the scale-space function is used. The Taylor series expansion of difference of Gaussian function is given as,

$$D(x) = D + \frac{\partial D^{x}}{\partial x} + \frac{1}{2} x \frac{\partial D2}{\partial x2} x \quad (3)$$

Where D and its derivatives are evaluated at sample points and x = (x, y, σ)^T is the offset from these point.

C. Assigning an Orientation

In this step, each keypoint is assigned an orientation based on local image properties. A histogram of all the extema points obtained is prepared by quantization process of the orientations in 36 bins covering 360 degrees of the orientation range. After this, the bins which are having highest magnitude are retained. Rest bins can be neglected. Around 15% of the points are assigned multiple orientations which act as significant points in image matching. Lastly, curve fitting is used to fit a parabola to the 3 histogram values which are closer to each peak and these have to be interpolated for better accuracy [6].

D. Keypoint Descriptor

The above operation gives location, scale, and orientation to each keypoint, which provides invariance to these parameters. For is image sample, L(x,y) at this scale, the gradient magnitude m(x,y), and orientation ϴ(x,y), is calculated using equation (4) and (5)

$$\mathbf{m(x,y)} = \sqrt{\left(L(x+1,y) - L(x-1,y)\right) + \left(L(x,y+1) - L(x,y-1)\right)} \quad (4)$$

$$\mathbf{\Theta(x,y)} = \tan^{-1}\left((x,y+1) - L(x,y-1) / (L(x+1,y) - L(x-1,y)\right) \quad (5)$$

Keypoint is currently located at the center of 16x16 sample region. The samples obtained are subdivided into 4x4 sub-regions in 8 directions.

At last, vector normalization is applied. We can find the key points of an image in other image and match them together. One image is the training sample and the other image is the world picture that might contain instances of the training sample. These two images have features associated with them across different octaves. Key points in all octaves of a one image match with all keypoints in all octaves in other image, independently. Feature matching takes place with the help of nearest neighbour algorithm based on Euclidian distance.

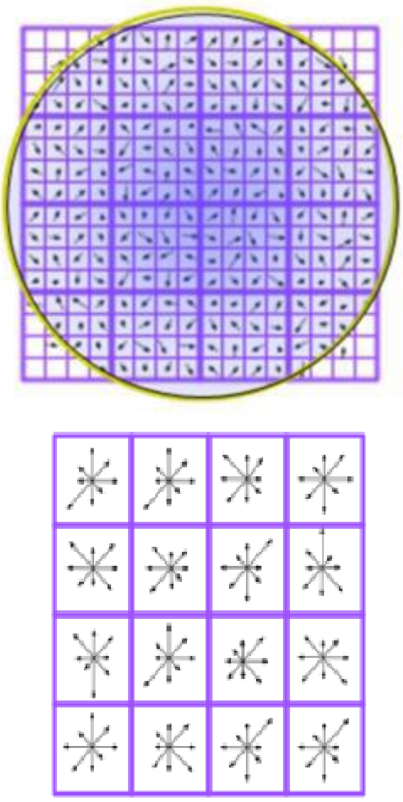

Figure 6.3- Key point descriptor[2]

VII. CONCLUSION

Algorithms being developed for ITS depend on accurate and real-time vehicle data obtained using detectors. Vehicle detecting and counting using visual sensors is an important part of an ITS which was the focus of this study. In this paper, a novel approach is taken for foreground detection based on a threshold value, building upon the currently available background detection method. In vehicle detection, vehicle foreground is accurately separated from the background image by using the proposed method. In this paper, two algorithms are proposed for vehicle detection and counting The proposed algorithm, accurately detect the vehicle but there is a problem while counting. This probably happens because at time of morphological opening vehicle object get divided into multiple parts because in case of morphological opening operation trivial task is to select proper structuring element..

REFERENCES

[1] Ghada S. Moussa " Vehicle Type Classification with Geometric and Appearance Attributes" International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol: 8, No: 3, 2014.

[2] *NarheM.C, Dr.Nagmode M.S. "Vehicle Classification using Sift" International Journal of Engineering Research &Technology (IJERT) ISSN Vol:3 Issue6,June-2014.*
[3] *Da Li, Bodong Liang ,Weigang Zhang " Real-time Moving Vehicle Detection, Tracking, and Counting System Implemented with OpenCV" 4th IEEE International Conference on Information Science and Technology, 26-28 April 2014.*
[4] *Ahmed Nidhal, Dr UmiKalthumNgah, Dr Widad Ismail "REAL TIME TRAFFIC CONGESTION DETECTION SYSTEM" Intelligent and Advanced Systems (ICIAS), 2014 5th International Conference. 3-5 June 2014*
[5] *Venkata Naresh Mandhalai, V.Sujatha ,B.Renuka Devi" Scene Classification Using Support Vector Machines" 2014 IEEE International Conference on Advanced Communication Control and Computing Technologies.*
[6] *David G.Lowe "Distinctive Image Feature from Scale-Invariant Keypoints" January 5, 2014.*
[7] *Ye Li , Fei-Yue Wang," Vehicle detection based on And–Or Graph and Hybrid ImageTemplates for complex urban traffic conditions" Transportation Research Part C 51 (2015) 19–28*
[8] *Yoginee B. Bramhe,P.S. Kulkarni"An implementation of Moving Object Detection, Tracking and Counting Objects for Traffic Surveillance System"*
[9] *R. C. Gonzalez and R. E. Woods, Digital Image Processing Pearson Education, 2002.*

Mr.Siddalingesh G had completed his both BE in Electronics and Communication and completed his M.Tech from VTU, Belgaum. He is presently research scholar at PRIST University. His areas of interests include Digital communication, Image Processing and Digital Signal Processing. He has published many paper in national and International Journal

Dr.LathaParthiban has obtained her B.E in Electronics and Communication Engineering from University of Madras, M.E. in Computer Science and Engineering from Anna University, Chennai and has obtained her PhD from Pondicherry University. Her experience spans over 19 years in various Engineering colleges and her research interest includes Data Mining, Image Processing and Cloud Computing. She has published papers in 36 international journals and presented papers in 43 international and national conferences. She has also published a book in the area of computer aided diagnosis.