Classification of Vehicles using Image Processing Techniques

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***Abstract*— In the present life style everything is turning into automatic. This research helps in identifying the vehicles and tells if it is a LMV or HMV. In toll collection plaza's this project can play a very important role in identifying the incoming vehicle and fix the toll rate as per the kind of vehicle. Classification of LMV and HMV is done using the image of the incoming vehicle captured and processed to find the kind of vehicle that is entering into the frame of a camera. The camera is placed where the front view of the vehicle is clearly visible with a static background. A picture is captured when the vehicle is at a defined distance. Once the image is captured, the same is processed and worked on to find the length and width of the vehicle. And thus we will be identifying it as a Light Motor Vehicle (LMV) or a Heavy Motor Vehicle (HMV).**

Index Terms*— Segmentation; background subtraction; region tracking; vehicle classification

I. INTRODUCTION

DETECTING and TRACKING vehicles is an important and emerging research area for intelligent transportation systems. Image processing plays an important role in detecting vehicles from a traffic surveillance videos. Traffic monitoring through image processing leads to better control of flow of traffic as well as to identify reckless users and speed violators.

Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. Vehicle classification is an efficient technique used for transportation systems such as toll stations, traffic Intersections, traffic congestion avoidance, terrorist activities inspection etc. Different toll stations define a standard for classifying vehicles. This standard is based on different types of vehicles like two-wheeler, four-wheeler, heavy-motor vehicles. There are some standard hardware based systems for detecting and classifying the vehicles coming near the toll stations like sensors, loop detectors etc. But the installation and maintenance charges are high, as the detectors are costly, can cause damage to the roads and would give limited information on the vehicles. Whereas using software based classification, installation and maintenance is very cost effective as the detection is done using video frames or through static photographs take from the cameras installed in front of the lanes of the toll section. Hence the technique of detecting vehicles using video frames is more advantages than other technologies.

Classification of the vehicles on the road in traffic has many advantages and uses. Some of them are listed below:

- Will be able to find the kind of vehicles that travel in that given area.
- A count can be kept on the particular kind of vehicle that passes in front of the eyes of the camera.
- Security and surveillance: can improve the security of a place and prevent unwanted attention.
- Traffic management: The prohibited vehicles in a particular road or an area can cause a lot of traffic problem and cause delay.

Now a day's the video camera or still cameras are installed in almost installed in every corner of the road and traffic intersection, so it is not a difficult job to capture the images of incoming vehicles and process on it. The surveillance cameras put in toll gates help in collecting the toll's as per the kind of the vehicle. The cameras can be setup in any place where there is a static background and only one vehicle is visible in the frame.

Classification of vehicles is a challenging problem and a process that is still going on. Difficulties in classification of vehicles can arise due to abrupt vehicle motion, changing background and scene, vehicles of non-standard size, vehicle occlusions, and camera motion. Classification of vehicles is usually performed in the context of higher-level applications that require the location of the vehicle at every frame. In this paper the incoming vehicle is differentiated into a light motor vehicle or a heavy motor vehicle depending on its length and breadth.

The rest of the paper is organized as follows: in section 2, brief descriptions of the literature survey are discussed. In section 3, vehicle classification techniques, a method for vehicle classification based height and width. In section 4, experimental results along with performance evaluation are

given in section 5. Finally conclusion and future enhancements are mentioned in section 6.

II. LITERATURE SURVEY

An Automatic vehicle counting system makes use of video data acquired from stationary traffic cameras, performing causal mathematical operations over a set of frames obtained from the video to estimate the number of vehicles present in a scene. It is just the ability of automatically extract and recognize the number of vehicles in each frame. Detection involves different steps in indentifying vehicles in video. Firstly background/Foreground Extraction has been done using different techniques as discussed in [1-2] by Sen-Ching S. Cheung and Chandrika Kamath ,like frame differencing, adaptive median filtering, median filtering, mixture of Gaussians, and Kalman filtering. Once foreground is extracted, apply morphological operations on it which eliminates isolated foreground pixels and merges nearby disconnected foreground regions. Using blobs (bounding boxes) as discussed in [3] were used to identify and track vehicles. Also, different feature extraction methods such as principal component analysis, wavelets, and Gabor filters have been used in vehicle detection.

A rear-vehicle detection system of static images based on monocular vision is presented in [7], which segments the region of interest (ROI) by using the shadow underneath the vehicle and determine the edges and later accurately localizes the ROI by vehicle features such as symmetry, edges and the shadow underneath the vehicle, etc. Finally, it completes vehicle detection by combining knowledge-based and statistics-based methods.

A survey on vision-based on road vehicle detection and shape recognition algorithms using fuzzy logic, contour matching, sensor fusion, support vector machine, probability distribution, hidden markov model are discussed[12]. These methods save the information very fast and consumes less time for the systems to react in case of an emergency.

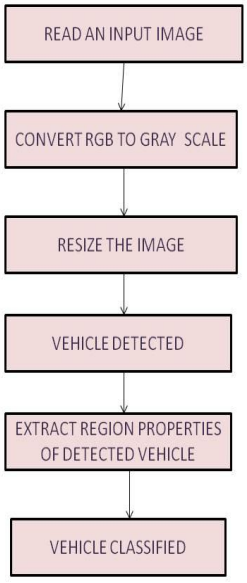
III. VEHICLE DETECTION

Traffic management and information systems rely on a suite of sensors for estimating traffic parameters. Currently, magnetic loop detectors are often used to count vehicles passing over them. Vision-based video monitoring systems offer a number of advantages. In addition to vehicle counts, a much larger set of traffic parameters such as vehicle classifications, lane changes, etc. can be measured. Besides, cameras are much less disruptive to install than loop detectors. Numerous approaches have been introduced for object and vehicle detection based on shape, color, texture or combination of any of these features on both still image and moving images. There are different image processing techniques in detecting and tracking vehicles in traffic surveillance videos. The paper[4] proposes an efficient video based vehicle detection system based on Harris-Stephen corner detector algorithm. The algorithm was used to develop a standalone vehicle detection and tracking system that determines vehicle counts and speeds at arterial road- ways and freeways. The proposed video based vehicle detection system was developed to eliminate the need of com- plex calibration, robustness to contrasts variations, and better performance with low resolutions videos. The algorithm performance for accuracy in vehicle counts and speed was evaluated. The performance of the proposed system is equi-valent or better compared to a commercial vehicle detection system. Using the developed vehicle detection and tracking system an advance warning intelligent transportation system was designed and implemented to alert commuters in ad-vance of speed reductions and congestions at work zones and special events.

IV. PROPOSED METHOD

A. *System Overview*

The proposed system has four stages in identifying and classifying the incoming vehicles viz, reading a image, background subtraction, bounding the identified image with bounding box and measuring the properties of the detected vehicle like height, length, width etc.,for the region extracted within the bounding box and finally determine the type of vehicle.



B. *Vehicle classification algorithm*

The image of the vehicle is captured using a video or a still camera. The image should be in such a way where the vehicle in the image is completely and clearly visible. Only the front face of the vehicle should be clearly visible, there can be very less occlusions of the vehicle in the image. The image is operated in matlab and processed to find only the vehicle present in the image by removing all the unwanted background in the image. The background of the image needs to be removed so as to make it easy to work on the image. By subtracting the background of the image only the required region in the image is obtained.

Each vehicle after being detected further classified based on vehicles height and width to indicate the type of the vehicle being passed in each lane at Toll Booths. In this system there is no interference of humans to identify the vehicles, all that is needed here is a camera that capture the images and a computer that processes the image using

matlab. There are places where humans cannot always keep a watch on the incoming vehicles, so this system will help in identifying the vehicles and can classify them. There are chances where the human who are assigned the work to identify or count the vehicles may miss their sight and miss the vehicles coming, where as this system will not only definitely identify the incoming vehicle but also classify the same as LMV or HMV.

Once the length and breadth of the vehicles are found in the image, a threshold value is defined to classify it as a LMV or a HMV. A particular threshold values are defined for a LMV and HMV, if the length and breadth of the bounding box falls in the threshold value of a LMV it is determined as an Light Motor Vehicle. If the length and breadth of the bounding box falls in the threshold value of HMV it is determined as a Heavy Motor Vehicle. If the length and breadth's of the vehicle in the image does not fall in any of the threshold values due to variation of the constraints, then the type of vehicle cannot be determined.

V. EXPERIMENTAL RESULTS

The images considered for this project are all of 'jpeg' format. All the images considered are of RGB type. Tests were conducted on various samples of images. There are about more than 50 images that were tested on this algorithm.

Fig.1 and Fig. 4 shows the original images of the vehicles coming to the individual lanes of the toll booths. Fig. 2 and Fig. 5 shows the detected vehicle identified by the bounding box obtained after converting the rgb image to gray scale image.Fig.3 and Fig. 6 shows the message boxes being displayed after classifying the vehicle based on height and width of the bounding box.

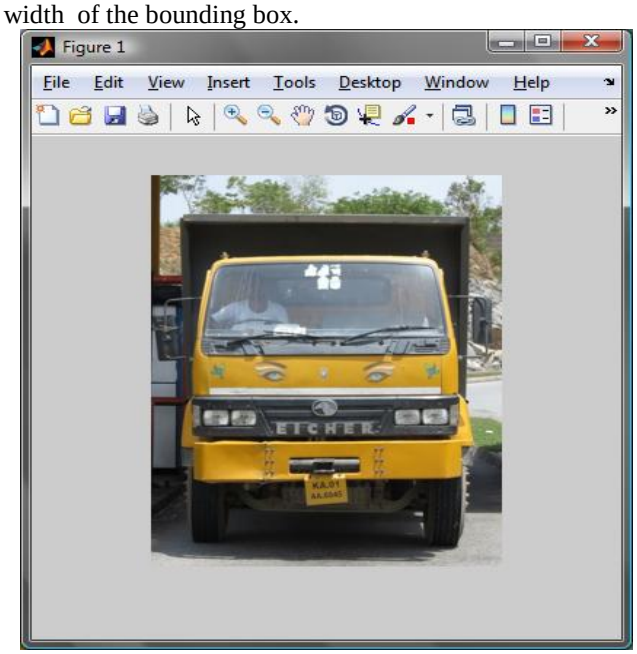
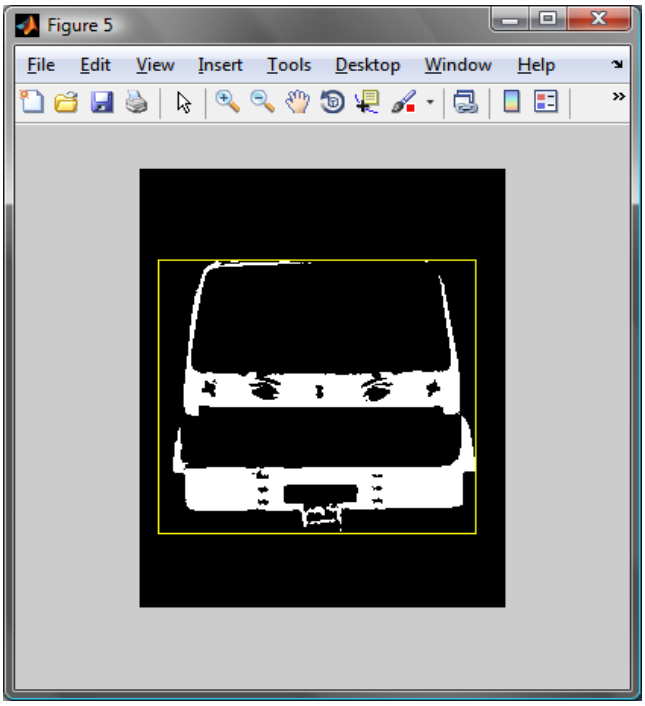


Fig: 1 Original Image



.Fig 2:Bounded Image

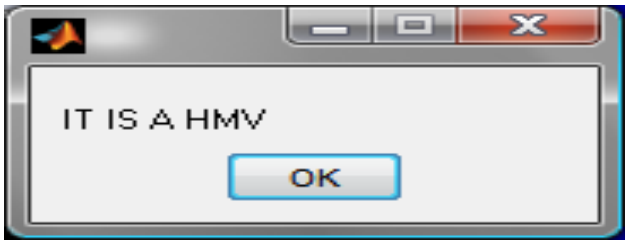


Fig 3 : Message Box

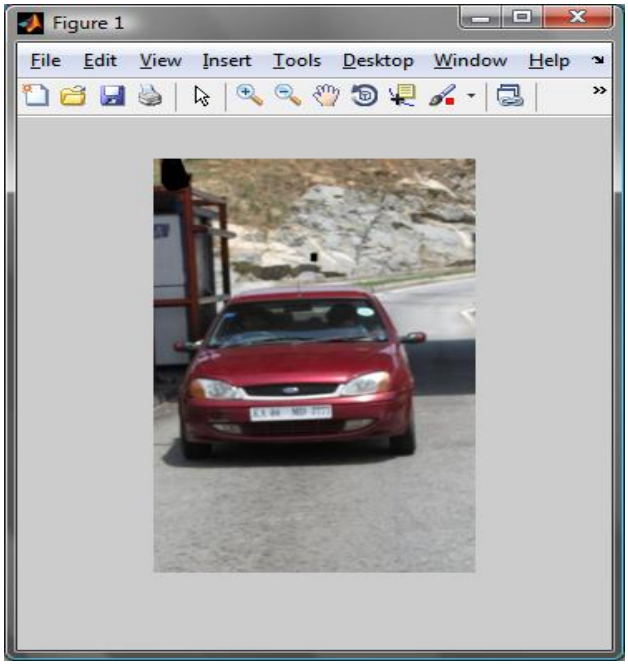


Fig 4: Original Image

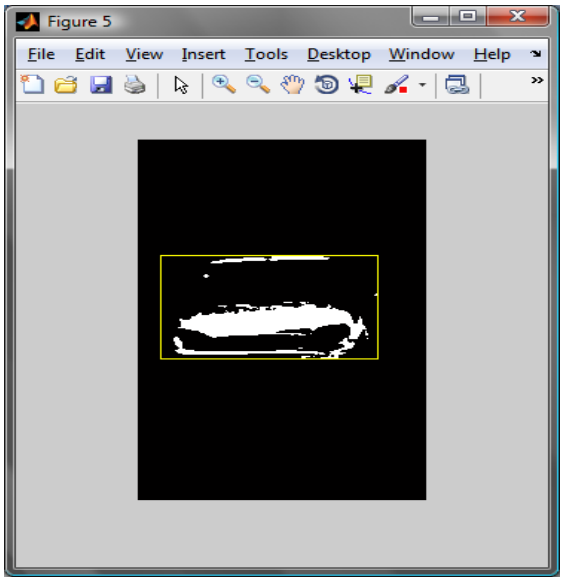


Fig 5:Bounded image

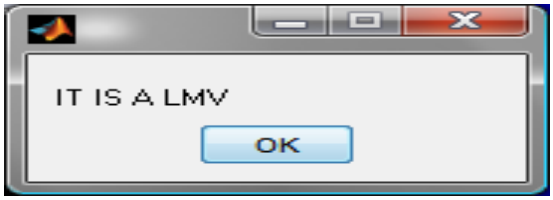


Fig 6: Message Box

Tests were conducted on the algorithm by taking images with vehicles of different colors. When different colors were tried, other than red, yellow and blue, shades of red and brown colored vehicles along with vehicles with different shades of blue gave a fruitful result.

The algorithm was also tried on images that contained more than one vehicle. The vehicles in the image were recognised but the algorithm failed to put a boundingbox around one single vehicle. Instead the boundingbox was drawn around the whole area.

$$\text{Accuracy} = \frac{(\text{True Positive} + \text{True Negative})}{(\text{True Positive} + \text{False Postive} + \text{True Negative} + \text{False Postive})}$$

True positive-correct identification
False positive-wrong identification
True negative-correctly identified as wrong
False negative-wrongly identified as wrong
Accuracy=33+2/(33+2+2+0)=35/37=.9459=94.59%

Number of sample images take are a total of 37. Of those images 35 images were correct and 2 images were wrong. There are a few cases where the algorithm has failed, but still obtaining an accuracy of 94.59%. Hence the algorithm can be called as efficient and accurate.

VI. CONCLUSION

The system identifies the incoming vehicle and segregates them as LMV or HMV depending on their size. The size of LMV and that of a HMV varies very much. The size is determined based on the vehicles' height and width and the algorithm shows an accuracy of 94.59%. This project is run on MATLAB 2010. Furthermore, it is advantageous due to easy installation of cameras near Toll Booths, no damage to roads, involves very less installation and maintenance cost. This system also provides much more information than hardware based detectors, can be adjusted easily to provide wider view and more information about traffic. The present system only identifies one vehicle. This can be extended in future to identify more than one vehicle in one frame. The algorithm can be extended to work on videos by extracting particular frames of the video and working on those frames as images.

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