REVIEW ON VEHICLE DETECTION TECHNIQUES

Gopal Manne , Neetesh Raghuwanshi

Abstract— Traffic has increased enormously with the economic development. Due to the increasing urban population and hence the number of cars, need of controlling the traffic in streets, highways and roads is vital. Vehicle detection has been a part of the traffic surveillance system for many years. Still the vehicle detection method is challenging .In this paper, a system that detects the vehicle in real time in highway is done by using image processing. The implementation includes algorithms used for real time vehicle detection. The Vehicle detection is used to identify the vehicles in any video or image file. The process of detection of vehicles includes the object detection by considering the vehicles as the primary object. Now a days vehicle detection techniques are developing and existing techniques are improving to get better accuracy results. This methods mostly used in traffic monitoring, speed management and also in military applications. The objective of this paper is to present a survey of research related to vehicle detection techniques and the application of vehicle detection techniques for traffic management and other applications such as in highway traffic surveillance control, management and urban traffic planning.

Index Terms— vehicle detection, Feature extraction.

1) RELATED WORK

In 2013, R.Sindoori et al. [1] suggested an approach for vehicle detection system from satellite images. Vehicle detection is done by pixel wise classification method. The essential part of the paper is to extract the feature and classify the vehicle color. Extraction of feature involves edge and corner detection. For edge detection, the Canny edge detector technique is applied.The Harris corner detector process is applied for the corner detection.Adaboost is used for extraction of vehicle colour to divide vehicle and non-vehicle colours. An absolutely, morphological operations are applied for the enhancement of the vehicle detection.

In 2013, Youpan Hu et al. [2] proposed the Haar features and Histograms of Oriented Gradients (HOG) as helpful features for the detection of vehicle respectively. They propose a method proposed a method to to detect vehicles in videos and classify them into two types depending on combined the Haar features and HOG features. Due to this method,it can classify and detect the vehicles in multi-orientations with good classification results.

In 2015, Ekta Saxena et al. [3] proposed a algorithm for Object detection from a satellite image or aerial image and developed automated system using morphological recognition algorithm in MATLAB R2013a in which image is captured from camera and converted into gray scale image for pre-processing.The binary conversion is applied on image after completion of image complemented through conversion.After conversion canny edge detection method then it is passed through the dilation process. After filtration and dilation, and the quantiy of vehicles is large enough that area is to be selected and vehicles are identified in the form of bounding box from the image. So,blob analysis is used for the detection of number of vehicles each separately.

In 2014, Prutha Y M et al. [4] proposed a system that detects the vehicle in real time in highway is done by using image processing. Each image is processed separately and the number of cars has been counted by applying a threshold value. If the number of cars increases beyond the value of threshold, then it automatically gives heavy traffic warning.

In 2015, PAWAR B.D et al. [5] introduces a comparison in the study of automatic Vehicle detection from high resolution aerial images. The approach is based on morphological operation that describes the detection using structure based representation. During feature extraction, the study compares the two basic morphological operations like Top-Hat and Bottom-Hat. The experimental result shows promising result using proposed method and gives precise detection of vehicles. This paper identifies a proficient and robust method for automatic vehicle detection from highway aerial images among two significant morphological operations (Top-Hat & Bottom-Hat). We use morphological methods as image pre-processing, Top/Bottom Hat processing, Identification of Vehicle shape, Segmentation of vehicles to identify candidate vehicles. From This ,we can say that the Top-Hat operation is the efficient technique for vehicle detection.

In 2010, Yan Liu et al.[6] proposed, a Quasi-shot Segmentation Vehicle Detection (QSVD) method to improve the accuracy and robustness of traffic flow detection. The QSVD method is based on histogram intersection method to find the biggest difference between successive frames. Adjacent frames are considered in when vehicle is detected in current frame. Relying on the QSVD method, vehicle can be detected by signal peak and valley search and gradual transition shot detection problem can be resolved. The initial video is used to accomplish detection directly without image preprocessing.

In 2014, Bharti Sharma et al. [7] proposed differential morphology closing profile to extract the vehicle automatically from the traffic image. They also made comparison from previous image processing based methods and the results indicate that the proposed method provides better results than traditional image processing based methods.

In 2015, RON MAHABIR et al. [8] proposed a technique for the detection and identification of vehicles from RGB images, by making use of both object spectra and image morphology. The identification performance results increases upto 62% with false positives occurring by using the images with sun glare and vehicles with like spectra values.

In 2012, Zezhong Zheng et al.[9] proposed a novel and robust method for automatic vehicle detection from highway aerial image. In this method, a GIS road vector map is used to limit a detection of vehicle system to the highway management networks. Here, morphological oerationaal method is used to identify candidate vehicles. Experiment is conducted with 0.15 m resolution aerial image. And the result demonstrated that the novel method has an excellent detection performance, thus the method is very promising.

In 2016, Sundaresh Ram et al. [10] proposed an automated method for detecting vehicles of varying sizes in low-resolution aerial imagery. First, they develop a new vehicle enhancement filter involving multiscale Hessian analysis. After thresholding, they refine the candidate vehicle detections based on analysis of bilateral symmetry. They shows that the proposed method provides improved detection accuracy compared with existing vehicle detection algorithms for various low-resolution aerial images.

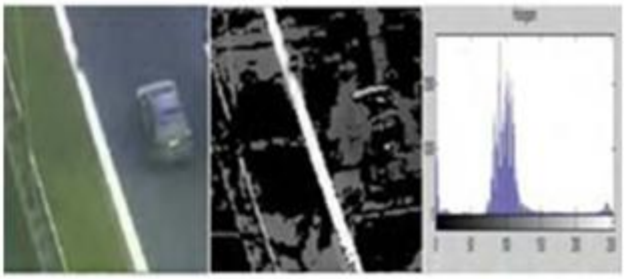
In 2010, Isha Jain et al.[11] developed an algorithmic approach to vehicle detection and classification using fuzzy logic. This not only reduces the complexity of the system but enhances its use in the areas which are too difficult to be detected by normal means. Further, it is proposed that after detection objects can be classified using techniques like neuro-fuzzy etc. so as supervised and unsupervised learning can be used to train the system. This algorithm can be applied on real time projects. They had taken the images of moving and still vehicles and an algorithm is used for vehicle detection.

In 2015, A. Shakin Banu et al. [12] proposed morphological operations and Histogram of Gradient (HOG) feature extraction for detection of vehicle.By finding the common pixels in the detected edge and the ROI regions,we can obtain the gradient.The algorithm (HOG) is an efficient feature extraction for detecting the vehicles whose result is extremely helpful for traffic analysis, management and surveillance. By identifying the vehicle size,the future work can be improved and the size of identified object is belongs to truck or car could be found by comparing indentified size with threshold value. The a success rate of around 83% of accuracy is achieved in vehicle detection using proposed method.

2) Problem formulation

Authors in [1] have been considered experimental results as shown in Fig.1 which shows the snapshots of experimental images. The experimental results show better performance and flexibility.

Fig.1 Snapshot for experimental videos



(a) (b) (c)
Fig. 2(a)Original Image, (b)Background Removal, (c) Histogram

(a) (b) (c)
Fig.3 (a) Original Image,(b) Edge Detection Result (c) Vehicle Detection Result

The frame width and height are 320 x 240. The data rate for video is 2800kbps. Fig.2(a) represents original image and 2(b) shows background removal. The histogram representation of the image is shown in the fig. 2(c). Edge is detected after removing background colour &representation of histogram. Canny edge detector detects the edge of image is shown in the fig. 3(b). The purpose of Harris corner detector to detects the corner.The vehicle detection using adaboost is shoen in fig. 3(c)

Authors in [2] have been considered Moving object detection and classification which is a key task in video monitoring applications. Authors uses real videos to test the result of proposed method and compute the accuracy rate.

Fig.4.Vehicle(up) and random backgrounds(down) samples

They used Haar a feature vector to represent a vehicle, and the results show that Haar features can describe images well and fast. Using AdaBoost, weak classifiers can be combined to create a strong classifier. In this method, HOG features can describe as different types of vehicles, and a strong classifier can distinguish them from each other.In this experiment, author chooses 2530 positive images contain vehicle and

4960 negative images contain random backgrounds(Fig.4), which got from all kinds traffic videos.

Source Image	Total test number	Predict (Vehicle)	Predict (Non-Vehicle)	Accuracy Rate
Vehicle	9000	8750	2500	97.2%
Non-Vehicle	15000	480	14520	96.8%

Table-1: Result of Vehicle Detection

As is shown in Table-1, accuracy rate reaches 97.2%, and most of the vehicle can be detected except the vehicles which size is too small or too large. When this algorithm is applied in vehicle detection, about 95.4% of vehicles can be detected in one frame image. After the step of vehicle detection, they got the images of vehicles, and there is only one vehicle in an image. All of the images are resize into the size of the same 64*64 pixels, which are shown in fig.4 .They built our vehicle image database with 2550 "small vehicles" and 1440 "oversize vehicles" respectively for training. All the images are detected from real world highway monitor video. And the last step, they used some testing images to count the testing accuracy rate. The results of the experiment are listed in the Table-2. The HOG features work well in vehicle type classification, the classification accuracy is quite high with a large amount of test samples. And as all the vehicles are detected from the traffic surveillance video Fig.5 shows oversize vehicle samples and small vehicles samples

Fig.5.Oversize Vehicle samples (up) and small vehicles samples(down)

Vehicle Type	Total Test Vehicles	Classify (Small Vehicles)	Classify (Oversize Vehicles)	Accuracy
Small Vehicle	6000	5600	400	93.3%
Oversize Vehicle	5100	200	4900	98%

Table-2: Result of Vehicle Classification

Authors in [4] have been considered the algorithm is tested under various traffic conditions, using MATLAB & various methods are applied which gives the output and is shown in the figure Fig 6 (a) and Fig 6(b). In fig. 6(a) the left most figure shows the image of the highway when initially there is no traffic and the middle image shows the background subtracted image where no object is present and the rightmost image shows the edge detector applied and the bottom figure shows 0km/h which is the speed of the cars as there is no traffic movement so the arrival rate is also 0 here.

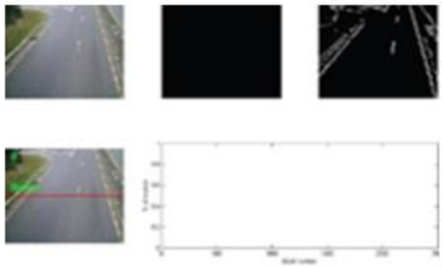


Fig.6 (a) output shown when there is no traffic in highway

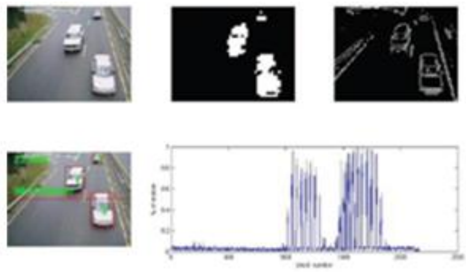


Fig. 6 (b) output shown when there is traffic in highway

the figure Fig 6 (b) the leftmost figure shows the image of the highway when there is traffic and cars travelling on the road and the middle image shows the background subtracted image where objects are detected hence it is in white patch and the background is made black and the rightmost image is the edge detector applied which has different edge detection techniques applied to it and optimal detector is selected and the figure in the bottom shows the objects being tracked and masked with rectangular boxes and numbered as the object arrives which is considered as frames. The speed and the arrival rates of the cars are estimated by setting a threshold value. As the speed n arrival rate changes the values are shown on the screen. The bottom figure shows the performance graph of the traffic flow where the x-axis is the number of blocks and the y-axis the percentage of motion of the vehicles, it varies as the traffic movement changes.

Authors in [5] have been considered total 9 numbers are cars present shown in following fig. In the vehicle detection, total vehicle detected are 9 using Top-Hat processing and Bottom-Hat processing. All the testing result is applied on 5 highways. Fig 7(A) to 7(G) shows result of Top-Hat processing as which are as follows,

Fig.7(A) Original Image

Fig.7(B) Top Hat Image

Fig.7(C) Bottom Hat Image

Fig.7(D) Making of Top Hat Image

Fig.7(E) Making of Bottom Hat Image

Fig. 7(F)Vehicle detection using Top-Hat Operation

Fig.7(G) Vehicle detection using Bottom-Hat Operation

Authors in [7] have been considered The automated vehicle detection using morphological differential profile is tested on image . The detection algorithm is tested on the traffic image as shown in fig 8. Total vehicles visible in the input image are 26. The algorithms [15] [16] is tested on the same traffic image and the statistics measures of proposed and other algorithms [15] [16] are summarized in Table 1, which present the false positive rate, true positive rate, false negative rate .The statistics measures of Table-3 indicate that the proposed vehicle detection method has better detection rate than other methods. Figures fig 8 & fig.9 show original image, the result of method [14] [15] and proposed algorithm respectively. Method [14] result shows that some detected vehicles are very blurred and merged with background .So it is difficult to recognize them as true vehicles. The true positive rate of the method [14] is 84%, method [15] is 38% and proposed algorithm shows 96% true vehicle detection rate.

Statistics Measure	Method [15]	Method [16]	Proposed Algorithm
Vehicles detected	84%	38%	96%
Non-Vehicles Detected	0%	0%	0%
Vehicles missed	16%	62%	4%

Table-3: The performance statistics of different detection algorithm

Fig.8.Input Image

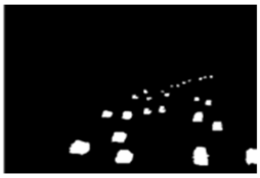


Fig. 9 Result of Proposed method

Authors in [9] have been stated that the bot-hat and top-hat images can be partitioned with Ostu method (see fig 10), and fig11). And the vehicles can be detected respectively. The detected vehicles with two different methods could be overlapped (see fig 12). As the methods described, from fig.12, total 17 cars was detected, only one car was omitted and one false car objection was detected. Therefore, the precision is very high.

Fig.10.Top Hat highway partitioning aerial image

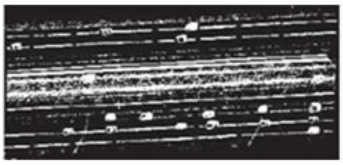


Fig.11. Bottom Hat highway partitioning aerial image

A

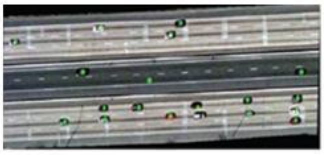


Fig.12.Vehicle detection result of highway aerial image

3) CONCLUSION

This paper provides a summarizing study on the proposed techniques which have used in traffic video. It focuses in on vehicle detection This review shows the how these vehicle detection methods plays an important role in the traffic surveillance systems gives better understanding and highlights the issues and its solutions for traffic surveillance systems.

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