IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-5, Issue-9 E-ISSN: 2347-2693

Classification of Vehicles using SURF Technique & SVM Classifier

Preeti Saini

Dept. of Computer Science and Engineering, Northern India Engineering College, Delhi, India

*Corresponding Author: *preeti.saini67@yahoo.in*

Available online at: www.ijcseonline.org

Received: 22/Aug/2017, Revised: 08/Sep/2017, Accepted: 19/Sep/2017, Published: 30/Sep/2017

Abstract- There has been an enormous increase in the number and types of vehicles on the roads with the increase in population. Vehicle Classification (VC) has become an important subject of study in the last few years because of its importance in security system, traffic congestion avoidance, traffic management etc. This paper implements vehicle classification on the basis of appearance based technique "Speeded up Robust Features" (SURF) descriptor and Support Vector Machine (SVM) classifier. Keeping this as focal point, SURF Technique is used for the purpose of feature extraction from the images in form of descriptor and then matches these feature points of training images and test images whereas SVM classifier is used to classify images based on the outcome of feature points. Through the experiment and analysis of results, the proposed methodology provides better results in terms of accuracy and matching time.

Keywords-SURF, vehicle classification, Feature extraction, SVM classifier, BOF

I. INTRODUCTION

Computer vision based vehicle classification has become a vital subject of study in recent years. The cause of this is mainly due to its numerous applications such as electronic toll collection management, traffic surveillance, traffic congestion avoidance etc. However, vehicle classification is a very demanding task because there are number of dissimilarities in vehicles like height, number of wheels, body shape and color etc. In addition, occlusion, shadow and illumination make the classification task even more challenging. So, developing a robust vehicle classification to cope with all these issues is main Concern here. In the domain of image processing, Vehicle categorization in images basically deals with grouping of images according to different classes provided to the System. In this approach using training information i.e. input as well as testing data i.e. output. After training, the Classifier is trained to classify an image based on different classes provided. Thereafter classifier, examine the classifier on the testing images to see whether it classifies the images correctly or not. In this paper SVM classifier is used to classify the vehicles on the basis of data set provided to the system.

The Rest of the paper is organized as follows, Section I contains the introduction of Vehicle classification , Section II contain the reviews of previous research on vehicle classification, Section III explain the proposed work methodology with flow chart, Section IV describes results and discussion. Finally, conclusions are summarized in Section V.

II. LITERATURE SURVEY

The problem of vehicle classification was attempted by a number of researchers using different techniques. Each technique uses different procedures and different attributes for vehicle classification. Generally, the classification accuracy of detected vehicles depends crucially on the combination of the extracted features of vehicles and the type of a classifier used for the classification. These techniques can be classified via the sensors used in the classification system, namely laser sensors, magnetic sensors, and vision sensors.

Laser sensors: They have the most noteworthy unwavering quality since it permits the three dimensional profile of the vehicle to be recovered as the data for vehicle characterization undertaking. An operation led by Tropartz et al in 1999 demonstrates that laser sensor has high dependability and precision. The operation includes an overhead laser sensors assessed under troublesome movement condition. Hussain and Moussa, (2005) states that the employments of laser sensors offer the guarantee of sensors that are less delicate to disintegrated ecological conditions, for example, rain and haze [1]. However, laser sensors are extremely costly contrasted with vision-based sensor. It would require to a great degree extensive measure of start cost if such vehicle grouping framework was to be executed.

Inductive sensor or Magnetic sensor: They can be used to separate overwhelming low-intricacy highlights including vehicle tally, speed, length and so forth. An assessment leads in Kaewkamnerd et al in 2009 demonstrates the outcomes when the grouping depends on sizes, restore a precision of (95%) [2]. In any case, when characterization is done on vehicles of comparative sizes (car auto, van, pickup truck), the outcome is as low as 70% - 80%.

Vision-based sensor: Vehicle characterization framework utilizes ease camera to catch picture or picture arrangements of the scene of a vehicle. At that point, the order framework recovers the data from the picture in view of the calculation utilized. In this way, the execution of a dream based vehicle grouping framework depends especially on the calculation rather than the sensor. Vision based sensor can either be picture based or video based.
Most machine-learning order techniques in the writing can be sorted into two primary methodologies in view of the extricated highlights: geometry-based and appearance-based characterization [1].

Geometry-based order: In this, geometric estimations, such as width, length, tallness, territory and so on are utilized as highlights for the characterization. Avery et al. exhibited a length based vehicle order calculation and announced 92% precision for truck characterization under specific conditions. Zhang et al. built up a length-based vehicle identification and grouping framework for the gathering of truck related information [3]. They detailed an exactness of 97% for truck characterization. Their framework confronted a few issues with the longitudinal vehicle impediments, camera developments and head-light reflection.

Appearance-based classification:
In this, vehicle pictures are treated as vectors in some high-dimensional space. Ma and Grimson utilized edge-based highlights and changed scale invariant element change (SIFT) descriptors for vehicle arrangement [4]. They revealed characterization rates of 98% and 96% for auto versus minivan and for auto versus taxi individually. Morris and Trivedi utilized blob highlights took after by straight separate examination (LDA), fluffy C-implies grouping and a weighted k-Nearest Neighbor (KNN) classifiers to characterize vehicles in eight classes [11]. They revealed an arrangement precision of up to 94% with a dismissal of low certainty objects. As of late, Moussa[1] built up a multi-sort vehicle arrangement framework in view of the pack of-words worldview utilizing SIFT highlights and four surely understood classifiers; Linear Discriminant Analysis (LDA), Support Vector Machine (SVM) [5], k-Nearest Neighbor (KNN), and Decision Tree to group vehicles into four unique classifications. The detailed characterization correctness's of the framework utilizing LDA, SVM, KNN, and choice tree are 90.6%, 95.7% 82.9% and 76% separately.

III. METHODOLOGY

There are a number of challenges in vehicle classification system like various sizes of vehicles, obstacles in images of vehicles etc. Features of individual vehicle from different directions are to be considered to address these issues. For this reason, the considered methodology utilized the notion of Bag of Features (BoF) with SURF [6] for feature extraction and SVM classifier for vehicle classification.

The framework of the system is divided into two parts: training scheme and testing scheme.

Training scheme- In this, the system is trained with training images to be intelligent. The output from the training phase offer as the input for the matching phase. The training scheme is implied for disconnected execution, which implies it just happens one time in the framework before any ongoing task.

Testing scheme- In this, the system takes in a query input. Based on the output obtained from the training scheme, the query input is processed to find out the vehicle type. This is done on instant real time basis after the system training.

There are basically two steps for building BoF with SURF features [7]:

1) Obtain the set of bags of features:
a. Select a large set of images.
b. Extract the SURF feature points of all the images in the set and obtain the SURF descriptor for each feature point that is extracted from each image.
c. Cluster the set of feature descriptors for the amount of bags we defined and train the bags with clustered feature descriptors.
d. Obtain the visual vocabulary.
e. Build histogram and train SVM.

2) obtain the BoF descriptor for given image: [12]

a. Extract SURF feature points of the given image.
b. Obtain SURF descriptor for each feature points.
c. Build the histogram.
d. Apply SVM for classification.

The following figure shows the training phases of proposed methodology:

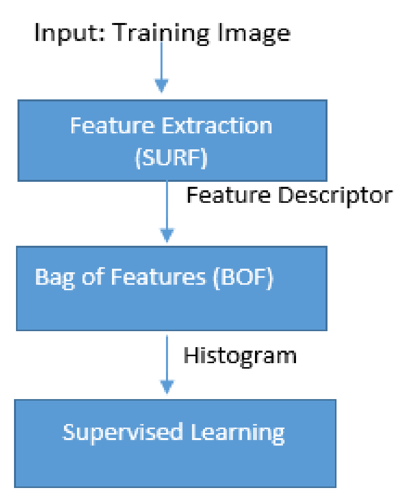

Figure 1: System Training

As shown in figure above, the system is feed with selected training images during the system training. All the training images are processed and the features of the vehicle are extracted into the system. The features extracted can be duplicate; therefore the clustering takes place right after removing the outliers during the feature extraction.

In system testing scheme, the system is feed with a query image in which the vehicle type contained is to be determined. The input undergoes feature extraction and all the features extracted from the image are clusters and histogram is constructed. After this, SVM is applied indicating the likelihood of the vehicle type in the query image.

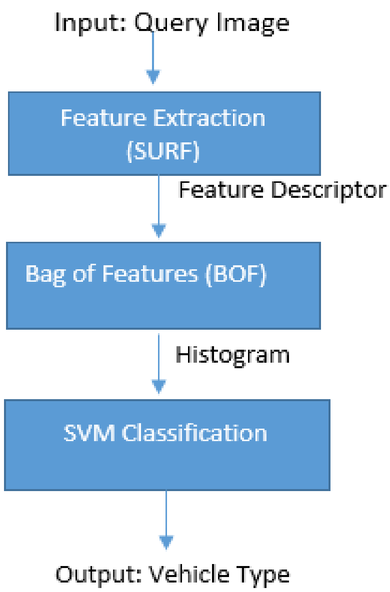

Figure 2: Performance Evaluation Phase

IV. EXPERIMENTAL RESULTS

We have taken two sets of images: one for training and other one for testing. Three types of images have been taken- car, truck and motorbike as experimental datasets. There are a minimum of 250 images are considered from each of these three categories. Randomly, 250 images are selected out of which 30% are included in the training set and rest 70% are used for evaluating results.

Firstly, trained the images that are in the training set. Then images from testing set are taken and results are computed as follows:

If we calculating results for car testing images then these terminologies are evaluated as follows:

1. Ground Truth (GT): It refers to that number of images which are actually cars.
2. Result of Method (RM): It refers to that numbers of images which have been declared as cars after applying the method.
3. True Positive (TP): It refers to the number of images which are actually cars and also have been declared as cars after applying the method.
4. True Negative (TN): It refers to the number of images which are not actually cars and also have not been declared as cars after applying the method.
5. False Positive (FP): It refers to the number of images which are not actually cars but have been declared as cars after applying the method.
6. False Negative (FN): It refers to the number of images which are actually cars but have not been declared as cars after applying the method.

Using these terms, Precision has been calculated as follows:
PRECISION: It is the fraction of retrieved instances that are relevant. It is also termed as positive predictive value. It is calculated as-
Precision= (Intersection of GT and RM) / (RM)
In simple terms, High precision means that an algorithm returned substantially more relevant results than irrelevant.

Table 1

Vehicles	**True Positive (Out of 86)**	**False Positive (Out of 172)**	**True Negative (Out of 172)**	**False Positive (Out of 86)**
Car	84	13	159	2
Motorbike	83	2	170	3
Truck	73	3	169	13

Histogram of a Car Image after Clustering:

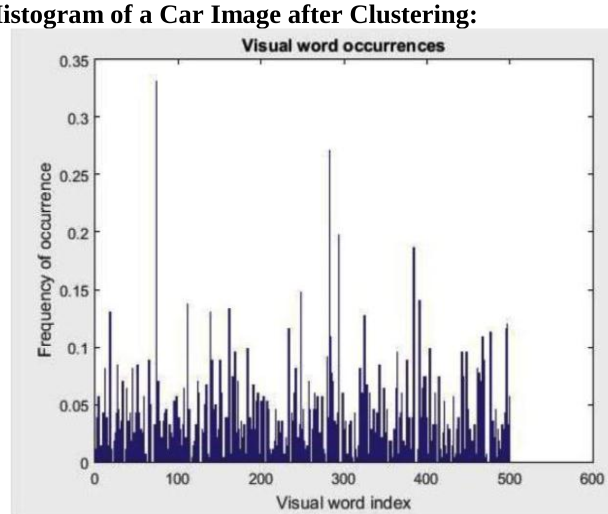

Figure 3. Histogram of Vehicle (car)

Results as Shown by the Output Program:

Table 2

KNOWN	PREDICTED cars	motorbikes	trucks
cars	0.98	0.00	0.02
motorbikes	0.02	0.97	0.01
trucks	0.13	0.02	0.85

* Average Accuracy is 0.93.

V. CONCLUSION

In this paper appearance based robust techniques are used for the purpose of classification of vehicles. In the considered approach, system is feed with selected training images and features are extracted from these images into the system and then extracted features are collected as descriptor. After this, SVM is applied indicating the likelihood of the vehicle type. This method can be useful in a variety of applications mainly in traffic management. The classification system proposed in this paper is based on object recognition techniques SURF descriptor that is utilized for feature extraction along with SVM classifier. Experimental results shown is evaluated on basis of Precision and found that proposed this methodology for vehicle classification system provides more relevant and accurate results.

REFERENCES

[1] G. 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] Creusen I.M., Wijnhoven R.G.J., and With P.H.N. de (2009). "*Applying Feature Selection Techniques for Visual Dictionary Creation in Object Classification*", In Proceedings of the 2009 International Conference on Image Processing, Computer Vision and Pattern Recognition, Las Vegas, Nevada, vol. 2, pp. 722-727, July 2009.

[3] G. Zhang, R.P. Avery, Y. Wang, "*A Video-Based Vehicle Detection and Classification System for Real-Time Traffic Data Collection Using Uncalibrated Video Cameras*," Transportation Research Record: Journal of the Transportation Research Board, pp. 138-147, 2007.

[4] X. Ma, W. Eric, and L. Grimson, "*Edge-Based Rich Representation for Vehicle Classification*", In the Proceedings of 2005 of International Conference of Computer Vision, vol. 2, pp. 1185-1192, 2005.

[5] Corinna Cortes, Vladimir Vapnik," *Support-Vector Networks*", Machine Learning, vol. 20, pp. 273- 297, 1995.

[6] H. Bay, T. Tuytelaars, and L. Van Gool. "*SURF: Speeded up Robust Features*", In the Proceedings of 2006 of International Conference of ECCV, pp. 404-417, 2006.

[7] Parul Prashar, Harish Kundra, "*Hybrid Approach for Image Classification using SVM Classifier and SURF Descriptor*", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (1), pp. 249-251, 2015.

[8] S. Rahati and R. Moravejian, "*Vehicle recognition using contourlet transform and svm*, In the Proceedings of International Conference of IEEE on Information Technology: New Generations, 2008.

[9] R.S Vaddi, L.N.P Boggavarapu," *Computer Vision based Vehicle Recognition on Indian Roads*" International Journal of Computer Vision and Signal Processing, vol. 5(1), pp. 8-13, 2015.

[10] E. Dallalzadeh, D.S. Guru, S. Manjunath and M. G.Suraj, "*Classification of Moving Vehicles in Traffic Videos, Advances in Computer Science and Information Technology*," Computer Science and Engineering, Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering Vol. 85, Issue. 2012, pp. 211-221, 2012.

[11] Kafai, M. and Bhanu, B., " *Dynamic Bayesian Networks for Vehicle Classification in Video*", In the Proceedings of 2012 of IEEE conference on Transactions On Industrial Informatics, vol. 8, no. 1, February 2012 .

[12] Csurka, G. Dance, C. R. Fan, L. Willamowski, J. and Bray C., "*Visual Categorization with Bags of Key points*", In the Proceedings of 2004 European Conference on Computer Vision (ECCV), May 2004.

[13] Sivic, J. Russell, B. C Efros, A. A. Zisserman, A. and Freeman, W. T. "*Discovering Objects and Their Location in Images*", In the Proceedings of the 2005 IEEE International Conference on Computer Vision (ICCV), vol. 1, pp. 370–377, October 2005.

[14] Z. Chen and T. Ellis, "*Multi-shape Descriptor Vehicle Classification for Urban Traffic*", In the Proceedings of International Conference on Digital Image Computing Techniques and Applications, pp.456–461, Dec. 2011.

[15] L. Zhang, S.Z. Li, X. Yuan, S. Xiang, "*Real-Time Object Classification in Video Surveillance Based On Appearance Learning*", In the Proceedings of 2007 IEEE Conference on Computer Vision and Pattern Recognition, India, pp. 1-8, 2007.

Author Profile

Ms. Preeti Saini pursed Bachelor of Technology from Maharshi Dayanand University, Rohtak, Haryana in year 2011 and Master of Technology from Banasthali Vidyapith, Rajasthan in year 2015. She is currently working as Assistant Professor in Department of Computer Science & Engineering, Northern India Engineering College, GGSIPU, Delhi since 2017. Her main research work focuses on Image Processing and NLP.