A Comparative Study On Machine Learning Algorithms Using Hog Features For Vehicle Tracking And Detection

[1]C.Ranjeeth Kumar, [2]Abinaya P L, [3]Janani N

[1]Assistant Professor, (Sr.Gr), Department of Information Technology, Sri Ramakrishna Engineering College, Coimbatore, India Email: ranjeeth.chandran@srec.ac.in
[2]Assistant Professor, (OG), Department of Information Technology, Sri Ramakrishna Engineering College, Coimbatore, India Email: abinaya.loganathan@srec.ac.in
[3]Assistant Professor, (OG), Department of Information Technology, Sri Ramakrishna Engineering College, Coimbatore, India Email: Janani.nagaraj@srec.ac.in

Article History: Received: 11 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 16 April 2021

ABSTRACT : Vehicle detection and tracking are important in applications such as highway traffic surveillance, management, and urban traffic planning. For vehicle tracking, to find average speed of each individual vehicle, and vehicle categorising targets, a road-based vehicle detection system is utilized. In intelligent surveillance systems (ITSs), traffic surveillance is now a great concern. Video-based monitoring systems have made great changes in traffic surveillance due to developments in computer vision. The main aim of this project is to use Histogram of oriented gradients (HOG) feature extraction algorithm to identify multiple vehicles in images and then classify them using various classification techniques.

Keywords:

1. INTRODUCTION

To enhance the effectiveness of current traffic infrastructure, the intelligent traffic system was developed. Traffic congestion, incidents, and violations are major problems for traffic management systems in most large and medium-sized cities as a result of rapid urbanisation. Visual surveillance is extensively used in many areas often for safety reasons. Active traffic surveillance, which aims to track and control traffic flow, has recently gained a lot of attention. The established system can capture a vehicle's visual appearance and retrieve knowledge about it through vehicle identification, monitoring, recognition, and behaviour analysis.

Vehicle occlusion, pose variations, all-day monitoring, and behaviour understanding of a vehicle with a single camera network are some of the challenges faced in real traffic scenes in an ITS application. In this work we have detected multiple vehicles in images using HOG extraction algorithm and classified it using different classification techniques namely logistic regression, decision tree and SVM. Vehicles, for example, come in a wide variety of colours. Structured cues, such as shape, on the other hand, offer a more stable representation. The histogram of oriented gradients was used to allow for some shape variability (HOG).

2. RELATED WORK

Bin Tian [1] discussed the current challenges in video-based vehicle surveillance systems, presented a general architecture for video surveillance systems, and offered a detailed survey of state-of-the-art attribute extraction methods, including techniques for vehicle identification, tracking, recognition, and network tracking.

The paper [2] provided the survey on the machine analysis of human motion and they used various views to predict the human movement. The temporal template and segmentation are trained for movement recognition.

Faisal I. Bashir et.al [3] proposed a motion trajectory-based compact indexing and effective retrieval system for video sequences. Two parameters were used in the experiments (accuracy and efficiency). They concluded that the systems show an exceptional amount of improvement in online retrieval time.

Chung-Lin Huang et.al [5] proposed a vision-based vehicle identification system that included object retrieval, object tracking, occlusion detection and segmentation, and vehicle classification. The studies are carried out by collecting image sequences from highway traffic with a digital CCD video camera and obtaining the effects of obstructed vehicle segmentation.

Hossein Tehrani Niknejad et al. [9] proposed a new approach for monitoring and detecting multivehicle using a vehicle-mounted monocular camera, in which vehicle features are learned using a latent support vector machine (LSVM) and histograms of oriented gradients (HOGs). They found that the proposed approach had a vehicle detection rate of 97 percent on average and 86 percent of vehicle-tracking rate in urban scenarios.

Xianbin Cao et.al [11] proposed a boosting Histogram Orientation Gradients (boosting HOG) feature. For moving vehicle detection in airborne images, a linear SVM classifier is trained. They found that the proposed approach had a higher detection rate, a lower false positive rate, and a faster detection rate.

Sri Jamiya S et.al [12] provided a detailed study of the different traffic video surveillance techniques. It uses video surveillance to focus on different techniques for vehicle identification, classification, and monitoring in

order to create an effective traffic management system. The overall analysis provides a deeper understanding of traffic management systems and highlights problems and solutions.
The paper [13] gave a comprehensive overview regarding vehicle classification and detection methods, as well as different techniques for detecting vehicles in inclement weather. They also spoke about the datasets that were used in various experiments to test the proposed strategies.

3. VEHICLE DETECTION

The first stage in video processing is to identify vehicles in a picture. Vehicle detection precision is important for vehicle tracking, vehicle movement expression and behaviour understanding. There are two types of vehicle detection techniques: appearance-based and motion-based. The vehicles are identified or isolated from the background using appearance features such as form, colour, and texture in an appearance-based technique. Whereas in motion- based technique, the vehicle is distinguished from the stationary background image using “moving” characteristics.

3.1. HISTOGRAM OF ORIENTED GRADIENTS (HOG)

The histogram of oriented gradients is a function descriptor for object. First order gradients are used to characterise the HOG characteristics. The edge function is similar to first-order gradients. The colour function is associated to zero-order gradients. The bar shape knowledge is associated to second-order gradients. The features have the benefit of describing objects and have been commonly used to extract specific targets by scanning dense and overlapping features with intense image scanning and complex calculations, resulting in low detection performance. Rather than using each individual gradient path of every individual pixel in an image, HOG groups pixels into small cells of n x n pixels. We computed all the gradient directions for every cell and grouped them into a set of orientation bins. The dominant orientation of that cell is depicted by this histogram. We get a representation of the image's structure when we do this for all the cells. The HOG features allow for some shape variance while keeping an object's representation distinct. The following measures are used to determine HOG features:

1) Calculate the image's horizontal GH and vertical GV gradients.
2) Determine the gradient's norm and orientation:
   $N_G(x,y)=\sqrt{}G_H(x,y)^2 + G_Y(x,y)^2$
   $O_G(x,y)=\alpha\tan(G_H(x,y)/G_Y(x,y))$
3) The image window is divided into M × N cells.
4) Create histogram of orientation for each cell. The power of edge orientations in the histogram is visualised by a ‘star' in the cell histogram.
5) To achieve normalisation, group many cells together in a block.

3.2. SUPPORT VECTOR MACHINE

Vapnik was the first to propose the Support Vector Machine (SVM), which has created a greater interest in the machine learning community. Support vector machines (SVMs) are usually capable of providing better classification accuracy than other data classification algorithms, according to several recent studies. A Support Vector Machine, or SVM, is indeed a supervised learning model that is non-parametric. SVM can be used to solve both classification and regression problems. It is, however, mostly used to resolve classification problems. In this algorithm, each data object is plotted as a point in n-dimensional space (n represents number of features), with the value of each attribute being the value of a unique coordinate. They use the kernel trick to map inputs to high-dimensional feature spaces for non-linear classification and regression. SVMs create a hyper-plane or set of hyper-planes in a high-dimensional or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, the hyper-plane with the greatest distance to the nearest training data points of any class (so-called functional margin) achieves a good separation, since the greater the margin, the lower the classifier's generalisation error.

3.3. LOGISTIC REGRESSION

Linear discriminate analysis, least mean square quadratic, kernel, Logistic Regression, and k nearest neighbours are some of statistical algorithms. However, in this paper, logistic regression is used to achieve the desired outcome. Logistic regression is a type of statistical classifier that is used in data analysis. It's a type of linear regression used to evaluate binary or multiclass dependent variables. Logistic regression (LR) is a well-known classification system that has been applied to a broad range of applications, including report classification, computer vision, natural language processing, and bioinformatics. It is represented mathematically as $Pr(G = k \mid X = x)$ is a nonlinear function of x with a range of 0 to 1 and a sum of 1.

3.4. DECISION TREE

Roots, branches, and leaves make up a typical tree. Decision Tree follows the same structure. There are root nodes, branches, and leaf nodes in it. Every internal node tests an attribute, the result of the test is on the branch, and the class label as a result is on the leaf node. A root node is the topmost node in a Tree and serves as the parent of all nodes. A decision tree is a tree in which each node (attribute) represents a feature, each link (branch) represents a decision (rule), and each leaf represents an outcome (categorical or continues value). Since decision trees are built to imitate human thought, grabbing data and making good interpretations is a convenience. The goal is to build a tree like this with all of the data and process a single result at each leaf. Decision trees are supervised types of extremely powerful machine learning techniques that can model nearly any problem; however, overfitting is one of their major drawbacks. Class labels are allocated to leaves and tree branches that correspond to conditions in this form of classification. Changing the criterion for property classification in the given data could reduce computational price and also save decision tree generation time, as this algorithm would obviously affect the efficiency of decision tree generation for large data sets.

4. DATASET

Udacity presented the dataset, which was derived from the GTI vehicle image database and the KITTI vision benchmark suite. It consists of 8,792 vehicle image samples and 8,968 non-image samples. These images are scaled down to 64pixels by 64 pixels and HOG algorithm is used to extract the features of all images in the dataset.

5. RESULTS AND DISCUSSION

The planned work is done in Python 3.6.4 using SKlearn's scikit-learn StandardScaler to build a scaler based on the mean and variance of all the features in the data set. By eliminating the mean and scaling it to unit variance, the StandardScaler normalises choices. Before feeding the scaled feature to our classifier for training or prediction, this scaler is used to convert the raw features from ourFeatureSourcer. HOG, Logistic regression, Support Vector Machine, and Decision Tree are examples of machine learning algorithms that have been implemented. The results show that using a logistic algorithm to detect vehicles is efficient.

Table 1 indicates the accuracy of our experiment.

ALGORITHM	ACCURACY (%)
Logistic Regression	0.99
Decision tree	0.93
SVM	0.98

RECALL AND PRECISION

The percentage of total relevant documents in a database obtained by a search is known as recall. The fraction of true positives inside a set of positively classified results = tp/(tp + fp)

The percentage of relevant documents in relation to the total number of documents obtained is known as precision. The fraction of all positives that were retrieved from a set of positively classified results = tp/(tp + fn).

Table 2 represents the performance score of all algorithms

ALGORITM	PRECISION	RECALL	F1 SCORE
Logistic Regression	0-0.97 1-0.99	0-0.99 1-0.99	0-0.98 1-0.99
Decision Tree	0-0.90 1-0.96	0-0.90 1-0.96	0-0.90 1-0.96
SVM	0-0.97 1-0.99	0-0.97 1-0.99	0-0.97 1-0.99

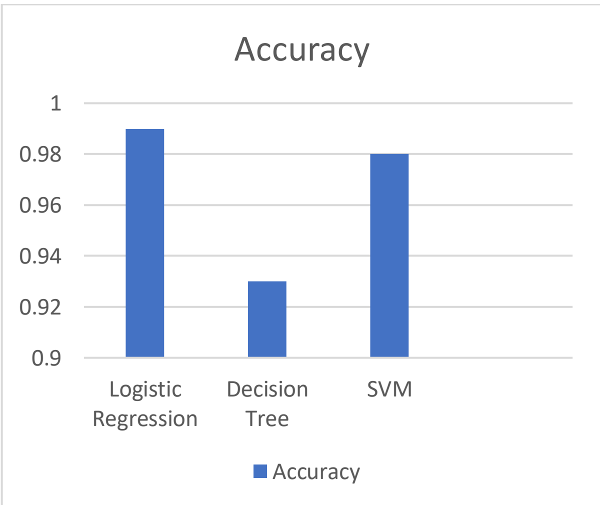

Fig 1:Representation of accuracy

6. CONCLUSION AND FUTUTE WORK

In ITSs, the use of video-based traffic surveillance technology has become popular. These devices are capable of capturing photographs of traffic situations, analyse data from traffic objects, and comprehend their actions and behaviours. In this work HOG feature extraction algorithm is used to detect multiple vehicles in images and it is classified using different classification techniques such as logistic regression, Decision tree and SVM. The experimental result shows that the efficiency is higher while using logistic regression algorithm when compared to decision tree and SVM. The study can be additionally upgraded by using neural networks instead of machine learning algorithms which might provide a better accuracy in detecting the multiple vehicles in images.

REFERENCES

1. Bin Tian, Brendan Tran Morris, et.al, “Hierarchical and Networked Vehicle Surveillance in ITS: A Survey”, in IEEE transactions on intelligent transportation systems, 2014.
2. Aaron F. Bobick, James W. Davis, “The Recognition of Human Movement Using Temporal Templates”, in IEEE transactions on pattern analysis and machine intelligence, 2001.
3. Faisal I. Bashir, et.al, “Real-Time Motion Trajectory-Based Indexing and Retrieval of Video Sequences”, in IEEE transactions on multimedia, 2007.
4. Christopher Richard Wren, Ali Azarbayejani, et.al, “Pfinder: Real-Time Tracking of the Human Body”, in IEEE transactions on pattern analysis and machine intelligence, 1997.
5. Gopalakrishnan, R., Mohan, A., Sankar, L. P., & Vijayan, D. S. (2020). Characterisation On Toughness Property Of Self-Compacting Fibre Reinforced Concrete. In Journal of Environmental Protection and Ecology (Vol. 21, Issue 6, pp. 2153–2163)..
6. Aswathy S Madhu, Shiny C, “A review on vehicle detection techniques in digital image processing”, in International journal of engineering sciences & research technology, 2019.
7. Esther B. Meier, Frank Ade, “Tracking Cars in Range Images Using the Condensation Algorithm”, in IEEE, 1999.
8. Hossein Tehrani Niknejad, Akihiro Takeuchi, et.al, “On-Road Multivehicle Tracking Using Deformable Object Model and Particle Filter With Improved Likelihood Estimation”, in IEEE transactions on intelligent transportation systems, 2012.
9. Tholkapiyan, A.Mohan, Vijayan.D.S, A survey of recent studies on chlorophyll variation in Indian coastal waters, IOP Conf. Series: Materials Science and Engineering 993 (2020) 012041, 1-6.
10. Rajaram, A., & Palaniswami, D. S. (2010). Malicious node detection system for mobile ad hoc networks. International Journal *of Computer Science and Information Technologies*, *1*(2), 77-85.
11. Sri Jamiya S, Esther Rani P, “A Survey On Vehicle Detection And Tracking Algorithms In Real Time Video Surveillance”, in International journal of scientific & technology research, 2019.
12. V. Keerthi Kiran, Priyadarsan Parida, et.al, “Vehicle Detection and Classification: A Review”, in Springer, 2021.
13. Ranjeethkumar Chandran, Dr. Naveen Raman, “A Review on Video-Based Techniques for Vehicle Detection, Tracking and Behavior Understanding”, in International Journal of Advances in Computer and Electronics Engineering, 2017.
14. Rajaram, A., & Gopinath, S. (2010). Efficient Misbehavior Detection System for MANET. *International Journal for Advances in Computer Science*, *1*(1), 12-16.
15. Sokèmi René Emmanuel Datondji, et.al, A Survey of Vision-Based Traffic Monitoring of Road Intersections”, in IEEE transactions on intelligent transportation systems, 2016.