EasyChair Preprint

№ 5627

Automatic Vehicle Detection and Tracking System

B Jeyapoornima, P Kiran, R. C. Kesava Amalesh and
L Naveen Kumar

May 27, 2021

VEHICLE DETECTION AND TRACKING SYSTEM

Jeyapoornima[1], Kiran P[2], Kesava Amalesh R C[3],Naveen Kumar L[4]

R.M.K. Engineering College, Department of Electronics and Communication Engineering, Kavaraipettai, Tamil Nadu

Email address:bjp.ece@rmkec.ac.in,kira17221.ec@rmkec.ac.in,kesa17219.ec@rmkec.ac.in, navele181312.ec@rmkec.ac.in

Abstract: Data is the new oil in current technological society. The impact of efficient data has changed benchmarks of performance in terms of speed and accuracy. The enhancement is visualizable because the processing of data is performed by two buzzwords in industry called Computer Vision (CV) and Artificial Intelligence (AI). Two technologies have empowered major tasks such as object detection and tracking for traffic vigilance systems. As the features in image increases demand for efficient algorithm to excavate hidden features increases. Convolution Neural Network (CNN) model is designed for urban vehicle dataset for single object detection and YOLOv3 for multiple object detection on KITTI and COCO dataset. Model performance is analysed, evaluated and tabulated using performance metrics such as True Positive (TP), True Negative (TN), False Positive (FP), False Negative (FN), Accuracy, Precision, confusion matrix and mean Average Precession (map). Objects are tracked across the frames using YOLOv3 and Simple Online Real Time Tracking (SORT) on traffic surveillance video. This paper upholds the uniqueness of the state-of-the-art networks like Darknet. The efficient detection and tracking on urban vehicle dataset are witnessed. The algorithms give real-time, accurate, precise identifications suitable for Realtime traffic applications.

KEYWORDS: YOLO, COCO, tracking.

INTRODUCTION

One of the significant applications of video-based supervision systems is the traffic surveillance. So, for many years the researches have investigated in the Vision-Based Intelligent Transportation System (ITS), transportation planning and traffic engineering applications to extract useful and precise traffic information for traffic

image analysis and traffic flow control like vehicle count, vehicle trajectory, vehicle tracking, vehicle flow, vehicle classification, traffic density, vehicle velocity, traffic lane changes, license plate recognition, etc.In the past, the vehicle detection, segmentation and tracking systems used to determine the charge for various kinds of vehicles for automation toll levy system.Recently, vehicle recognition system is used to detect or classify the type of vehicle class on highway roads like cars, motorbikes, vans, heavy goods vehicles (HGVs), buses and etc.

However, the traditional vehicle systems may be declines and not recognized well due to the vehicles are occluded by other vehicles or by background obstacles such as road signals, trees, weather conditions, and etc., and the performance of these systems depend on a good traffic image analysis approaches to detect, track and classify the vehicles. Signal & Image Processing : An International Journal (SIPIJ) Vol.5, No.1, February 2014

In this review paper, the traffic image analysis comprises of three parts: (1) Motion VehicleDetection and Segmentation Approaches (2) Camera Calibration Approaches and (3) Vehicle

MATERIALS AND METHODS

The detection of moving object's regions of change in the same image sequence which captured at different intervals is one of interested fields in computer vision. An important large number of applications in diverse disciplines are employed the change detection in its work, such as video surveillance, medical diagnosis and treatment, remote sensing, underwater sensing and civil infrastructure. One of the video surveillance branches is the traffic image analysis which included the moving/motion vehicle detection and segmentation approaches. Even though various research papers have been showed for moving vehicle detection but still a tough task to detect and segment the vehicles in the dynamic scenes. It consists of three main approaches to detect and segment the vehicle, as mentioned below:

1. Background Subtraction Methods.

2. Feature Based Methods.

3. Frame Differencing and Motion Based methods.

1. Background Subtraction Methods

The process of extracting moving foreground objects (input image) from stored background image (static image) or generated background frame form image series (video) is called background subtraction, after that, the extracted information (moving objects) is resulted as the= ASthreshold of image differencing. This method is one of widely change detection methods used invehicle regions detection. The non-adaptively is a drawback which is raised due to the changing in the lighting and the climate situations.So, several researchers work to resolve this drawback by proposed methods on this field.

A significant contribution suggested the statistical and parametric based techniques which are used for background subtraction methods; some of these methods used the Gaussian probability distribution model for each pixel in the image.After that, the pixel values updated by the Gaussian probability distribution model these pixel values which are updated from new image in the new image series. Then, each pixel (x,y) in the image is categorized either be a part of the foreground or background according to adequate amount of knowledge accumulated from the model which mention above using the equation (1) below:

$$I(x, y) - Mean(x, y) < (C \times Std(x, y)) \quad (1)$$

Where I(x, y) is pixel intensity, C is a constant, Mean(x, y) is the mean, Std (x, y) is the standard deviation.

An advanced background subtraction technique used to detect and extract features for vehicles in complex road scenes in traffic surveillance. This innovative technique uses a filtering method based on a histogram which collects information from sequences of frames of scatter background.

This proposed background subtraction algorithm depicted a well performance under different conditions including various view-angles, overcrowding and illumination.

Signal & Image Processing : An International Journal (SIPIJ) Vol.5, No.1, February 2014 Another work proposed by which is an example-based algorithm for detecting vehicles in traffic supervision video streams labeled the vehicles from examples for detection process. It involved from, firstly, an adaptive background approximation is used, then, dividing the image into small non overlapped blocks for founding the candidate vehicles parts from these blocks.

Secondly, Principal Component Analysis (PCA) is applied as a low-dimensional statistical method to measure the two histograms of each candidate, and support

vector machine (SVM) is considered for real vehicle parts classification. Eventually, all classified parts shaped and connected as a parallelogram to represent the parts shapes for matching process.

Also, a new method for vehicle detection based on shadows underneath vehicles information has been proposed. This method extracts the size features of vehicles from information that gathered form the distance between ends of front and rear tires for underneath shadow of vehicles to distinguish the existence of vehicles on the lanes. In this paper, the information represented as traffic movement images which obtained from a camera assembled on a low position such as the roadside, sidewalk, and etc. Moreover, this method has accurate vehicle detection because it is used the functions to generate and improve a background image, in addition, approximate and modernize the value of threshold of background subtraction images binarization automatically

Also, a novel well-organized idea based on suggested filters which are used for mobile vehicles detection have presented in this research. The two filters are used to eliminate swinging trees and raindrops from forefront entities respectively, and the swinging trees filter is used to decrease the calculation difficulty of consequent vehicle tracing. In addition, a shade removal method is combined with a versatile background deletion approach to take out the mobile vehicles in background images.

The authors presented a new idea for tracking vehicles by integrating these traits such as volume, location, color dissemination, speed of a group of the forefront entity and Gaussian Mixture based background form. In this approach, each pixel in the image view is demonstrated and categorized as either a noise or forefront entity's background. In addition, the author is employed a projective floor-level transform to reinforce the expectations of speed persistence and entity volume for forefront form.

2. Feature Based Methods

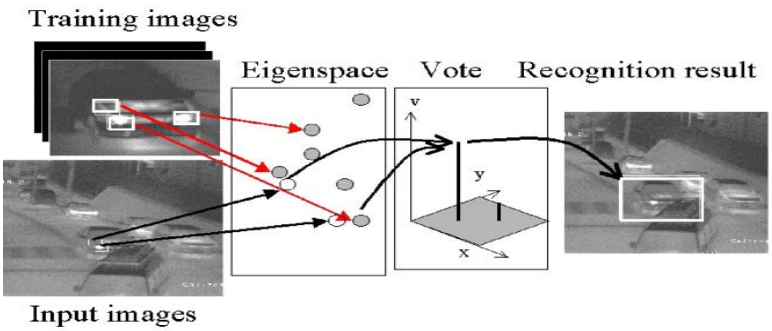
Another trend which the researchers investigate and motivate on sub-features like the edges and corners of vehicles, the moving objects segmented from background image by collecting and analyzing the set of these features from the movement between the subsequent frames. Furthermore, the feature based method supports the occlusion handling between the overlapping vehicles and compared with background subtraction method represents a less level from the computational difficulty view Signal & Image Processing : An International Journal (SIPIJ) Vol.5, No.1, February 2014

Several approaches can discriminate the object from the background by using its

features, a trainable object detection approach has proposed by This approach based on learning which employs a set of labeled training data which used for labeling the extracted objects features. In addition, it uses a Haar wavelets technique as feature extraction method and also uses support vector machine classifier for classification process. Moreover, face, people and cars static images datasets have tested on this approach.

A subregion is a technique used to locate the local features which used for recognition nonoccluded and partially occluded vehicles. Principal components analysis (PCA) weight vector used to pattern the low-frequency components and an independent component analysis (ICA) coefficient vector used to pattern the high-frequency components, these two vectors were generating by subregions. This approach represents a novel statistical method which dependent on local features of three subregions for detecting the vehicles automatically.

Furthermore, a multiscale transformation uses the frame elements of image which are indexed by position, measure and orientation criterions, and have time-frequency localization properties of wavelets also it shows a very high degree of directionality and anisotropy, this method called The curvelet transform. The curvelet transform used within a new vehicle recognition algorithm as a feature extraction method has offered . The authors presents that there are three various types of classifiers are used in this paper for vehicle recognition: k nearest-neighbor, Support =vector machine (one versus one) and Support vector machine (one versus all). Finally, the vehiclegm recognition process showed a high performance through the experiments results. A local-feature point's configuration method used for vehicle classification with using computer graphics (CG) model images has introduced.In this work, the eigen-window approach is used due to it has several advantages such as detect the vehicles even if it changed its path due to veering out of the lanes and also if parts of the vehicles are occluded. In addition, the CG model images achieved a high performance results for vehicles recognition process to real images of vehicles. Furthermore, the CG model facilitates the task of collecting real images of all target vehicles because it is a time consuming and difficult task .



Also, a new traffic criterion detection approach based on Epi-polar Plane Image (EPI) has proposed.This method treats the noise sensitivity and existence of the rough edge on edge detection through developed a new sobel operator which overcomes the traditional sobel shortcomings, and the Gabor operator texture edge detection is also used for extracting the features. Experimental tests examined that this approach is accurate and anti-nose edge detection.

In this paper the authors have suggested a low resolution aerial image used as dataset for detection vehicles system, this system uses the edges of the car body, the edges of the front windshield and the shade as the features for the similarity process. The gathered extracted features knowledge is shaped in the structure of the Bayesian network that will use for integration Signal & Image Processing : An International Journal (SIPIJ) Vol.5, of all features. In this research, experiments present good results even if tested images were more complicated.

3. Frame Differencing and Motion Based Methods

The frame differencing is the process of subtracting two subsequent frames in image series to segment the foreground object (moving object) from the background frame image. Also, the motion segmentation process is another fundamental step in detecting vehicle in image series which is done by isolating the moving objects (blobs) through analyzed and assignment sets of pixels to different classes of objects which based on orientations and speed of their movements from the background of the motion scene image sequence [16, 23, 39, 40].

An intraframe, interframe and tracking levels are suggested framework to recognize and manipulate occlusion vehicles. This paper showed by quantitative evaluation that the interframe and interframe could be used to manage and manipulate mostly of partial occlusions images, and tracking level could be used to manage and manipulate full occlusions images effectively.

A multimodal temporal panorama (MTP) method for real time vehicle detection and reconstruction have suggested.This method accurately used a remote multimodal (audio/video) monitoring system to extract and reconstruct vehicles in real-time motion scenes. A multimodal approach in addition to detection and motion estimations has helped during the reconstruction process of vehicles, which removed the occlusion, motion blurring and differences in perspective views.

Visual-based dimensional approximation is an approach that used to extract motion vehicles from traffic image series and adjust them with a simple disfigured vehicle pattern. In this approach, shadow removing technique is used, in addition to, the

experimental tests show an effective performance and sufficient accuracy for general vehicle type classification within the approach mentioned above works on traffic vehicles motion images.

A new method based on versatile movement histogram technique for detection of moving vehicles have introduced.In this method, two procedures involved to segment and detect the vehicles in video sequence. The first step, a novel background changing method will use for bright changing in video scene. The second step, adaptable movement histogram-based vehicles detection is used, supported and modernized corresponding with movement histogram in the dynamic view.

Nighttime traffic supervision is a new trend in the traffic surveillance systems. A suggested realtime several vehicle detection and tracking approach based on motion vehicles in nighttime traffic view used the image segmentation and pattern analysis method to detect and identify the vehicles form its headlights and taillights. A multilevel histogram thresholding technique is applied to extract and bring bright objects of interest from nighttime road scene. Finally, this approach showed an effectively, robustly and feasibly results when experimented in different nighttime situations for traffic supervision vehicles recognition and identification.

RESULT

Results of performance metrics is totally dependent on image data set used. Further objects are detected in video based on region of interest. The performance measures measured such as speed and color of vehicle, type of vehicle, direction of vehicle movement and the number of vehicles in ROI. Multiple object tracking is implemented for traffic surveillance video using YOLOv3 and OpenCV. Multiple objects are detected and tracked on different frames of a video. Further training the models on powerful GPUs and by increasing the number of images evaluate the models on other datasets and modify the design if required to make the model more robust and suitable for real-time applications.

CONCLUSION

Our proposed system is trained to detect and track a vehicle.This system is widely used in defense and navigation units. This involves rendering the datasets to train the module, then processing the datasets to reduce noise and those processed datasets are used to train the deep earning model. finally, the model would be trained and evaluated for the proper outcomes. This system can be used in defense military tanks and fighter jets.

ACKNOWLEDGMENT

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

- Adrian Rosebrock - Deep Learning for Computer Vision with Python 1,Starter Bundle(2017, PyImageSearch).
- Bochkovskiy, Alexey, Chien-Yao Wang, and Hong-Yuan Mark Liao. "YOLOv4: Optimal Speed and Accuracy of Object Detection." arXiv preprint arXiv:2004.10934 (2020).