International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 04 | Apr 2022 www.irjet.net p-ISSN: 2395-0072

Vigilance: Vehicle Detector and Tracker

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Abstract - *Vehicle detection and Tracking plays a prime and effective role within the area of traffic Surveillance systems where efficient traffic management and safety is the main concern. In this paper, we discuss and address the difficulty of detecting vehicle/traffic data from video frames. There are several methods that are checked out in this area but there's always an opportunity for improvement in terms of accuracy and efficiency. For improvement, it's proposed to develop a singular algorithm for vehicle data recognition and tracking using the YOLO and Deep sort algorithm. This paper provides a quick about multiple vehicle detection, recognizing vehicles according to appropriate categories, and tracking them. The experimental results show that the proposed algorithm is often able to detect moving vehicles in complex transportation environments and which also has the potential to be processed in a very cloud computing platform.*

Key Words: **Traffic Management, YOLO, Deep sort, Vehicle detection, tracking**

1. INTRODUCTION

Vehicle detection and statistics in route monitoring video scenes is of great significance to intelligently manage traffic and also the management of the route. With the favored installation of traffic surveillance cameras, colossal info of traffic video footage has been obtained for analysis. The position of cameras must be at a particular height in order that a large area is taken into account. The size of the vehicle changes greatly at this viewing angle, and also the detection accuracy of a tiny low object isolated from the road is low. Within the face of complicated camera scenes, it's essential to effectively solve the above issues and further apply them. During this project, we concentrate on the above issues to propose a viable solution, and we apply the vehicle detection results to multi-object tracking and vehicle counting. With the increasing style of roads and traffic everywhere on the earth, traffic monitoring and control using modern technologies became a compelling requirement. This can be why intelligent transportation systems (ITS) have attracted heaps of attention within the last decades. Among the various tasks of traffic monitoring systems, vehicle detection is the key task. Once a vehicle is detected, different applications are going to be applied plenty more easily.

2. LITERATURE SURVEY

Even though object detection is still relatively in its early stages, many methods and algorithms have already been used to detect and track objects in a frame. We will be going through some of the methods used in previous models used for object and vehicle detection and tracking.

Let's take a look at the model proposed by the author, Sriashika Addala in their paper [1]. They have used a 2-step procedural model – the first one to detect the vehicle and the second step for vehicle recognition. To increase the accuracy, they have used Haar-like features, AdaBoost algorithm and then a classifier to detect the vehicle.

In Computer Vision Based Vehicle Detection and Counting System [2], the authors have implemented the system on a computer vision-based model. The system makes use of background subtraction technique to find the object and later a series of computer vision technologies such as thresholding, morphology operations and hole filling are then applied.

The next proposed model by author Joseph Redmon, in their paper You Only Look Once: Unified, Real-Time Object detection makes use of the YOLO model [3]. It also uses a single neural network to predict the bounding boxes and class probabilities in one go. The YOLO model helps them to get high accuracy and good predictions.

Object detection using SSD had become widely popular in the last few years. The author Jingwei Cao makes use of the improved SSD model to overcome some of the disadvantages found in the regular SSD model [4]. The proposed system also makes use of KITTI dataset which helps their model achieve a better performance in crowded traffic scenarios and dreadful weather conditions.

The author Shih-Chung Hsu makes use of R-CNN i.e. region-based convolutional neural networks for vehicle detection in Vehicle detection using Simplified Fast R-CNN[5]. The model makes use of pre-trained weights from ImageNet. The detector detects the vehicle based on a binary classifier system. The example is positive if the image contains the vehicle whereas it is negative if there is no vehicle.

The R-FCN [11] is a fully convolutional network for object detection which is faster than R-CNN while maintaining

competitive accuracy. This network divides the image into sub-regions and generates score maps for each sub-region. Then calculating the average of all scores there is a probability prediction of an object in that frame.

3. PROPOSED SYSTEM

The proposed system consists of two major deep learning models Yolo (You only look once) and deep sort.

There are two phases of this system

1. Vehicle detection:

The Yolo is the algorithm that has been used for vehicle detection. And the dataset that has been used is the COCO dataset which contains all vehicle categories and YOLO is pre-trained on the COCO dataset.

2. Vehicle tracking and counting

For tracking the vehicles which are already detected using YOLO there is the requirement of Deep sort (Machine learning model). Deep sort assigns unique IDs to vehicles so that they can be tracked. As the vehicle passes the frame counter is incremented to keep the count.

All these will be accessed by a web app so that authorities can monitor the vehicles and take appropriate decisions.
For the above system, there is a need for a camera to be placed at the entry part, and the whole detection and counting process will be automatically done by the system and algorithm.

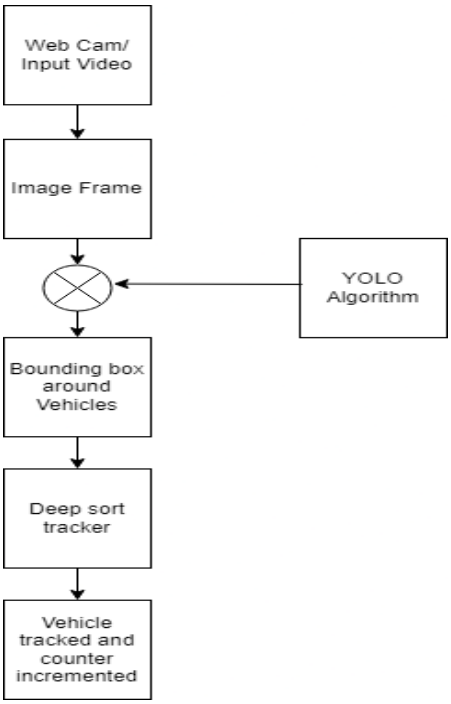


Fig 3.1: Methodology flowchart

4. RESULTS AND DISCUSSION

Dataset:

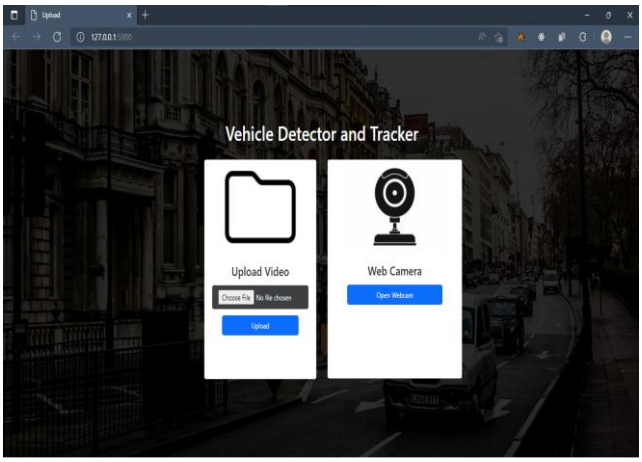
The dataset that has been used is the COCO dataset developed by Microsoft that contains thousands of images of vehicles. It contains JSON structure with labels and metadata of images. This dataset was used for further processing and detection of vehicles.

Vehicle detection using YOLO:

YOLO is one of the object detection models which is trained in the COCO dataset so it can detect the vehicles according to the appropriate category. Detecting vehicles can be done by downloading the weights file which is responsible for drawing bounding boxes around vehicles and also downloading the configuration file.

Vehicle tracking using Deep sort:

The detected vehicle can be tracked using the Deep sort library which is downloaded and used in the project. The advantage of using deep sort is that it can be used to track multiple vehicles in the frame.



Performance of Model:

The performance of model depends on the hardware of the system on which it is run. It mainly depends on how powerful the GPU of the system is. Compared to the YOLOv3 model, YOLOv4 model has a better performance. It provides 10 to 12% fps boost over its predecessor model. The model was run on GTX 1660TI GPU. The fps on the output video ranged from 9-15 frames per second. The fps can also be increased using a better GPU. In the fig you can see the fps achieved in our model using the YOLOv4 algorithm.

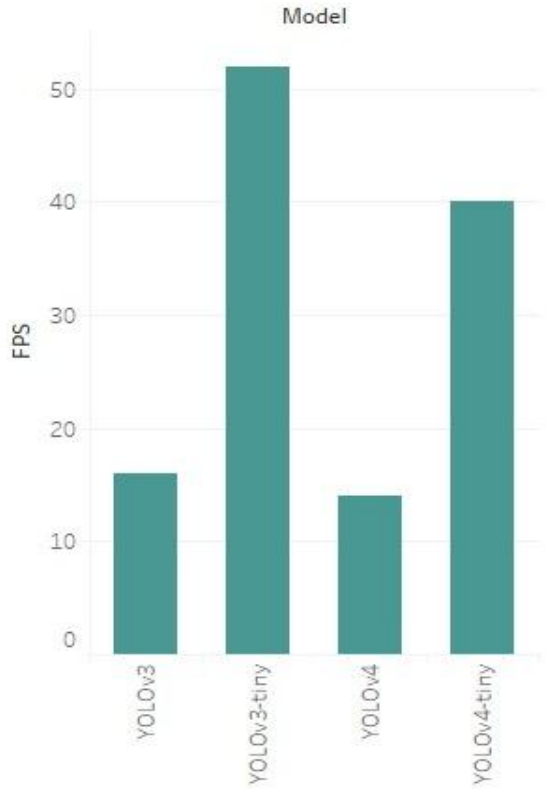


Fig 4.1: Comparison of YOLO version

5. FUTURE SCOPE

It can be used in a Real-time surveillance camera on the highway to determine the number of vehicles passing by according to what time it started to last record. This data then can be used for traffic management by executing an answer if the place proved a lot of congestion or not. The vehicle detection system also classifies vehicles according to different categories e.g. Car, trucks, motorbikes which makes it easier to segregate them into small and large vehicles.
The parking system is one of the applications of the vehicle detection and tracking system where the system keeps track of all vehicles entering and leaving the parking facility which determines the available space in parking and total vehicles.

6. CONCLUSIONS

In this project, visual object tracking is completed on videos by training detectors using COCO datasets which have thousands of pre-trained weights. The moving vehicle detection is finished using a YOLO detector and DEEP SORT for tracking the objects in consecutive frames. Accuracy and precision are often worked upon by training the system for more fine-tuning while training the detector. Performance of DEEP SORT tracker totally depends upon the performance of the detector because it could be a tracker which follows a tracking by detection approach. For Future work, the system is trained for more vehicles so that the accuracy can be increased and it can detect vehicles in extreme conditions. For that, there is a requirement of GPU so that the process will be smooth which not only increases accuracy but also decreases the time.

ACKNOWLEDGEMENT

We would like to express our gratitude and appreciation to all those who gave us the possibility to complete this report. Special thanks are to our supervisor Prof. Shweta Sharma whose help, stimulating suggestions and encouragement helped us in all the time of fabrication process and in writing this paper. We would like to thank our Principal Dr. Shrikant Kallurkar and Prof. Suvarna Pansambal, Head of Computer Engineering Department for instigating within us the need for this research and giving us the opportunities and time to conduct and present research on the topic.

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