Vehicle Detection and Classification
Team Name: MAVY

Project Name: Vehicle Detection and Classification
School of Engineering and Applied Sciences, Ahmedabad University
Computer Vision- CSE541, Winter 2022

Manan Anjaria
AU1940098
Ahmedabad University
Ahmedabad, India
manan.a@ahduni.edu.in

Anar Bhagat
AU1940145
Ahmedabad University
Ahmedabad, India
anar.b@ahduni.edu.in

Vedanshee Trivedi
AU1940225
Ahmedabad University
Ahmedabad, India
vedanshee.t@ahduni.edu.in

Yuvraj Patel
AU1920082
Ahmedabad University
Ahmedabad, India
yuvraj.p@ahduni.edu.in

Abstract- Highways and roads are getting overcrowded due to a rise in the number of vehicles. Automatic vehicle detection and classification plays a vital role in intelligent transport systems, as it monitors data of traffic flow, which can be utilized for better traffic management. This paper presents a portable computer vision based system for moving vehicle detection and counting. The images will be extracted from the videos and analyzed in order to detect the moving vehicles. The system will be implemented using openCV image kits and for better classification of vehicles we will be using convolutional neural layers. Post detection we will create a database for the types of vehicles and count of the vehicles so the data can be utilized further. This system will be capable of analyzing pre-recorded videos.

Key Words - openCV, convolutional neural layers, deep neural networks, YOLO

I. Introduction

Traffic management has become an important aspect for a city's routine with exponential growth in the number of vehicles on road. The management of the traffic is an essential part for a city to work efficiently. Due to mismanagement of the traffic, the traffic jams take place wasting everyone's time. Hence, there is a desperate need for an intelligent transportation management system.

A vehicle detection and classification system that counts vehicles and classifies them into categories like truck, car, motorcycle, and bus. This helps to manage and divert the traffic. In these types of systems, the on-road object detection is an essential step because the on-road objects differ in size, color, shape, and also there are issues with occulassion, and size changes of the object when detecting. This project aims to provide a solution to this problem with the help of computer vision concepts. We will be using the Indian driving dataset to test our model, which has multiple objects on the road with different sizes, shapes and colors. We will be utilizing the deep neural networks and YOLOv3 architecture to implement the models.

II. Literary Survey

There are few different techniques that can be used in counting and classifying the vehicles. The first approach is the model first classifieds the vehicle and then counting is done according to the vehicle type. The object detection and tracking for the vehicles can be done using 2 methods: the first one being the HOG-SVM[1] based vehicle classification and the second being the MobileNet SSD- based Vehicle classification. The SVM in the first approach is a supervised machine learning algorithm that is used for image classification. The HOG(Histogram of oriented Gradients) is a description feature used in image processing for object detection.

[1] Singh, A. (2019, April 29). *Vehicle detection using a support vector machine(SVM)*. Medium. Retrieved April 24, 2022, from https://towardsdatascience.com/vehicle-detection-using-support-vector-machine-svm-19e073b61d16

This HOG works with the images cells that are divided in sub-images and then histograms are created using the gradients distribution and based on that the model is trained to classify the objects. So combining both of the algorithms creates an efficient and accurate object detection model. The other method is to use MobileNet-SSD based vehicle detection which connects 2 frameworks: MobileNet and SSD. MobileNet is a viable option since it is more efficient than any other network design currently in use. SSD is a cutting-edge object identification framework that predicts multiple bounding boxes for several item categories using a deep neural network. The combination of MobileNet and SSD yields a deep learning-based object detection system that is both quick and efficient.

III. Implementation

We utilized the YOLOv3 architecture which includes the use of convolutional layers and deep neural networks to implement the project. We trained the model on the COCO dataset as it is freely available and has multiple categories of vehicles.

Our approach to solve the problem was to create residual blocks which basically divides an image into NxN grids, then to use Bounding Box regression which sends each grid cell to the model. Furthermore we use intersection over union step which is a metric that evaluates the intersections between predicted bounding box and the ground truth bounding box. To eliminate the bounding box that is very close we used the non-maximal suppression technique so the IOU selects the one with the highest class probability. We are utilizing the YOLOv3 architecture that has a network of 2 fully connected layers to pre and post process the image. We used YOLOv3 because it is much faster than its rival and the accuracy of detection of small objects is better than other architectures. The convolutional layers are pre trained on the image net classification task at half of the resolution. The other layers are added to train the network for object detection and the prediction of object class probabilities and the bounding box probability. We used the OpenCV and deep neural networks directly. We used the OpenCV built-in function to perform the Deep neural network algorithms.

If the confidence threshold is above 20%, only then the object will be classified. We got this confidence threshold after running the program on 10 images and finding the accuracy to be 85% at 20% confidence threshold. We used the image dimension of 1024x768 pixels.

Then we will be saving the data of the count and classified vehicle into a CSV file to generate the output that could be further used to improve the Intelligent Transport management system.

IV. Result

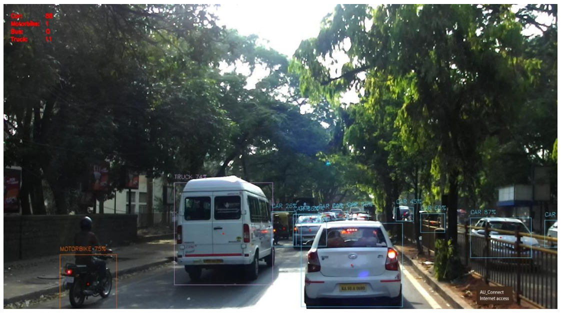
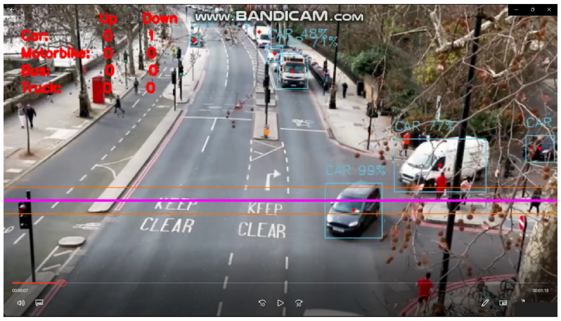


Figure.1 This is our initial implementation of the project using indian driving dataset.

The results were generated based on the Indian Driving DataSet. We successfully generated the result and we were able to count and classify the vehicles but the only issue we were facing is that the detection from the rearview of the rickshaw and truck was misdetected so we utilized the frontal and side left view. We were able to achieve 85%

[1] Singh, A. (2019, April 29). *Vehicle detection using a support vector machine(SVM)*. Medium. Retrieved April 24, 2022, from https://towardsdatascience.com/vehicle-detection-using-support-vector-machine-svm-19e073b61d16

accuracy for vehicle classification when there was a 20% confidence threshold.



	Up	Down
Car:	0	1
Motorbike:	0	0
Bus:	0	0
Truck:	0	0

Figure.2 This is our final implementation of the project using an online dataset for testing our system.

The final results were able to process the video files and were efficiently able to process the object files and were able to process the data giving final results of the CSV file. This was tested on different datasets to test the maximum potential of the program we created and the results clearly shows that the maximum detection is taking place and now this is ready to be implemented.

V. *Conclusion*

Hence, we were able to implement the vehicle classification and counting model and achieve 85% accuracy at 20% confidence threshold . Now we will try and improve our model to work at its maximum accuracy. The model works at its optimum level and is now able to process videos and furthermore, count and classify them and save it in the CSV file. After changing the confidence threshold the accuracy of the detection has increased and works efficiently.

VI. *References*

- *Vehicle counting, classification & detection using opencv & python*. TechVidvan. (2021, July 11). Retrieved March 27, 2022, from https://techvidvan.com/tutorials/opencv-vehicle-detection-classification-counting/
- Poltavsky, A. (2019, September 8). *Real-time object detection using yolo upon google colab in 5 minutes*. Medium. Retrieved March 27, 2022, from https://medium.com/@artinte7/real-time-object-detection-using-yolo-upon-google-colab-in-5-minutes-fd65a4903df5
- *Vehicle detection and counting system using opencv*. Analytics Vidhya. (2021, December 31). Retrieved March 27, 2022, from https://www.analyticsvidhya.com/blog/2021/12/vehicle-detection-and-counting-system-using-opencv/
- Weng, L. (2018, December 27). *Object detection part 4: Fast detection models*. Lil'Log (Alt + H). Retrieved March 27, 2022, from https://lilianweng.github.io/posts/2018-12-27-object-recognition-part-4/
- N., K., & D.N., C. (2021, February 24). *Optimized yolov2 based vehicle classification and tracking for Intelligent Transportation System*. Results in Control and Optimization. Retrieved March 27, 2022, from https://www.sciencedirect.com/science/article/pii/S2666720721000023

[1] Singh, A. (2019, April 29). *Vehicle detection using a support vector machine(SVM)*. Medium. Retrieved April 24, 2022, from https://towardsdatascience.com/vehicle-detection-using-support-vector-machine-svm-19e073b61d16

- Rad, R., & Jamzad, M. (2005, April 7). *Real Time Classification and tracking of multiple vehicles in Highways*. Pattern Recognition Letters. Retrieved March 27, 2022, from https://www.sciencedirect.com/science/article/abs/pii/S0167865505000164

[1] Singh, A. (2019, April 29). *Vehicle detection using a support vector machine(SVM)*. Medium. Retrieved April 24, 2022, from https://towardsdatascience.com/vehicle-detection-using-support-vector-machine-svm-19e073b61d16