Intelligent Traffic Management System

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Abstract*: *The importance of traffic signals is increasing owing to the drastic increase in population. Ensuring road safety is of high priority. In this project, we introduce an Intelligent Traffic Management System (ITMS) capable of managing traffic of varying densities, without the need of a traffic warden to physically monitor a particular intersection. This system is designed to retrieve the live traffic feed from a junction and process the same using the TensorFlow Object Detection API over OpenCV to detect the severity of the traffic based on the number of vehicles detected. Upon determining the number of vehicles, the corresponding signal, based on the traffic intensity is given. (More vehicles detected – Green light for longer duration and vice versa.) Thus, this system dynamically adapts to the prevailing traffic conditions and grants the corrosponding traffic light sequence for the required duration to maximize the flow of vehicular traffic. The system is designed to ensure smooth traffic flow by decreasing the wait period of vehicles at intersections and automates the process of controlling traffic signal.

Index Terms:* *Intelligent Traffic Management System, OpenCV, Tensorflow, Object Detection.

I. INTRODUCTION

Vehicular traffic has become a problem of serious concern in populous cities around the world. It is a tedious task for traffic-wardens to constantly monitor the incoming traffic and direct them with either “Stop” or “Go” based on the pre-existing traffic situation and other factors, such as rain, snowfall etc. The task of managing traffic can be automated by implementing an Intelligent Traffic Management System (ITMS), designed to monitor the current traffic situation, and grant the signal best suited for the situation. Unlike the traditional traffic control system, where a traffic signal is given irrespective of the prevailing traffic condition, the ITMS dynamically adapts to the existing traffic condition and ensures maximum and efficient flow of traffic, without human intervention. The system is implemented with a remote computer (Raspberry Pi) which controls the signals at the junction and a PC with a good GPU, which will be used to process the live traffic feed and decides the signal to be granted based on the density of vehicles on-road. The video feed obtained is processed using OpenCV and Google’s TensorFlow Object Detection API and based on the number of vehicles detected, the signal to be granted is determined. Thus, implementing such a system will not only cut down manpower and its related expenses, but will be a potential solution for the ever-growing problem of traffic management through a futuristic approach.

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II. LITERATURE SURVEY

In India, the current system is pre-timed i.e. the time for green signal in each lane is fixed. One of the four lanes in a four-lane road gets the green signal at a time. Therefore, vehicles pass sequentially in all lanes, straight or at 90 degrees. Vehicles must wait for the signal to turn green even if there is less density on roads. Authors in [1] have developed a system which used video-feed of the road at signals and processes them to activate signals based on density of vehicles. In [2] authors have provided a comparison of image processing and machine learning approaches to building traffic lights recognition systems. Authors in [3] have developed an algorithm to control traffic light duration using images as input. In [4], authors have used images from surveillance cameras to estimate the traffic at roads, in [5] authors have used computer vision techniques to determine traffic density and estimate traffic flow rate. In [6], authors have used machine learning techniques to road data to predict traffic parameters and grant the desired signal. In [7], authors have created a system to dynamically control traffic lights using machine learning algorithms on traffic data.

III. PROPOSED SYSTEM

The proposed work is solely based on image-processing and neural networks and aims to provide a smart and cost-effective method of managing traffic signals. The OpenCV module is used to retrieve the camera feed which will be processed by the TensorFlow Object Detection API. The model used to detect objects is the faster_rcnn_inception_v2_coco which has a mAP (Mean Average Precision) of 28. The system will make use of a camera facing a lane of traffic, which provides the live traffic feed of the road on which we wish to control the traffic signals. With the use of OpenCV library, the feed which is obtained is now processed using the TensorFlow object detection API in order to detect the number of cars present in the Region of Interest. As the number of cars detected correspond to the density of the traffic, the amount of time a particular signal-cycle of red-yellow-green lights must be activated is determined. The duration of time up to which the signal must remain active is sent to the Raspberry Pi over LAN by the means of a pipe, and the required signal is

granted. The neural network is trained on 200 images of cars in which 160 images have been used for training the model and 40 images have been used for testing. The training was stopped when the loss was considerably low at 0.041 at around 45,000 steps.

IV. RESULTS

The picture below shows the results of algorithm which identifies cars in a scene. This system is seen to be more efficient when compared to the traditional traffic management system wherein the signals were manually controlled by the traffic warden or the system detects vehicles using haar cascades which was highly unreliable when used under different environment conditions such as smog,rain,fog,etc. However, in this case, the model can be flexibly trained in order to detect cars even in poor environment conditions owing the rain, fog, etc. and ensure that smooth flow of traffic. This approach requires minimal time to process the incoming video feed and return the output.

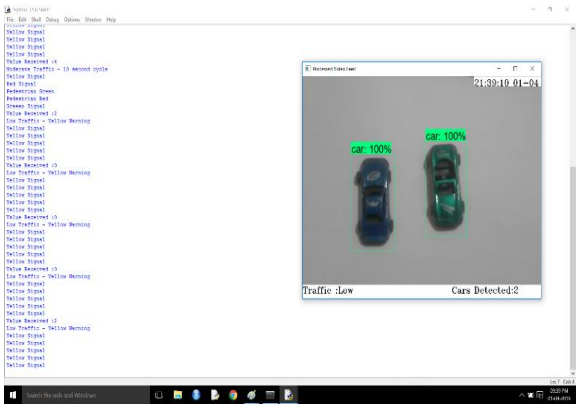

Fig.1 Identification of Cars in low density traffic

Fig. 2 Identification of Cars in medium density traffic

Fig. 3. Identification of Cars in Severe Traffic Situation

The graphs below show the training loss while our neural network trains on the input pre-processed images.

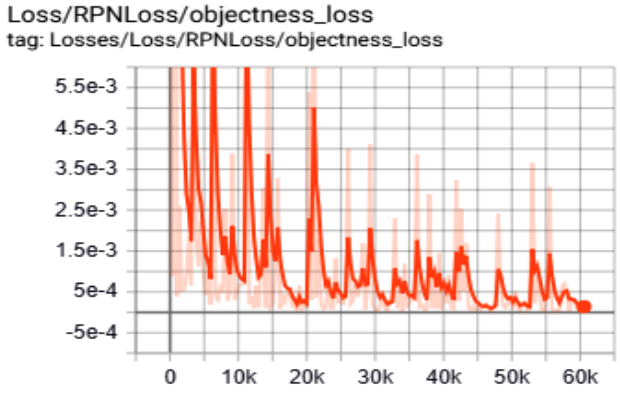

Fig. 4 Loss in case of RPN

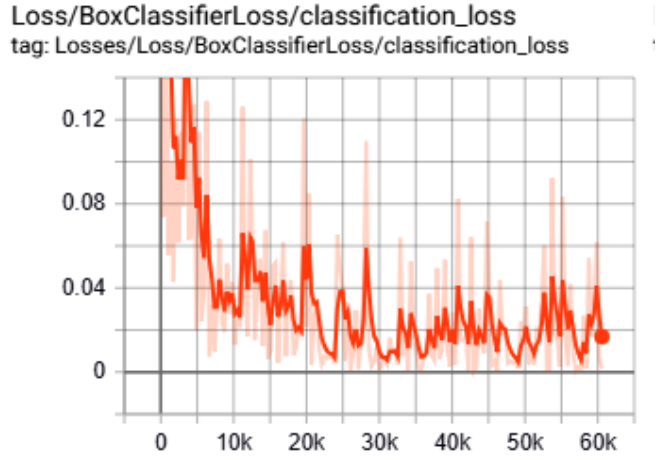

Fig. 5 Loss in case of BoxClassifier

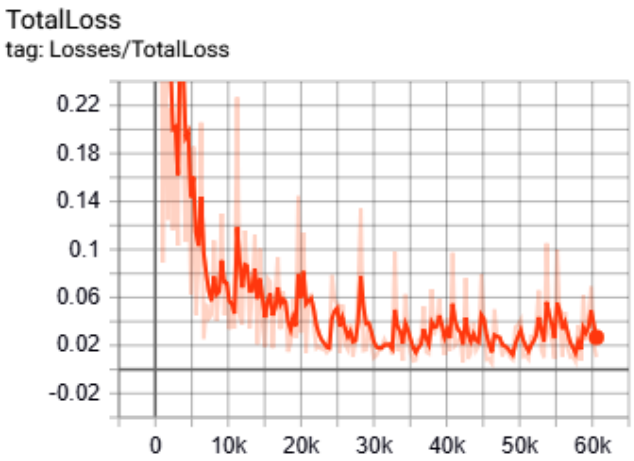

Fig. 4 Total Loss

CONCLUSION

As the traffic situation round the world worsens day-by-day, this system aims at ending the ever-growing problem efficiently by using modern-day technologies which will not only provide a potential solution, but also reduce the human intervention required to manage the system. The system will make use of IoT, along with concepts from Machine Learning and Computer Vision. Further, this system can be designed to monitor traffic violations and automate the process of catching those guilty of committing traffic rule violations.

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