Real-Time Traffic Management by Traffic Density Monitoring with Deep Learning

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***Abstract* - Intelligent Intersection Traffic Management has become increasingly important because of the need to reduce congestion and improve the overall travel experience of commuters. Given the dynamic nature of everyday city traffic, this project proposes real-time processing of videos from cameras to estimate the traffic density and optimize the signal parameter of the intersection. The system is implemented by performing road area segmentation. From that segmented image, region of interest is obtained. The detection of vehicles is performed by using Single shot Multibox detector (SSD)-MobileNet model. Density is estimated from the detected vehicle count. Based on the density, traffic signals are interchanged.**

***Index Terms* – segmentation, region of interest, Single shot Multibox detector.**

I.INTRODUCTION

The tremendous increase in vehicles on roads is the main reason for congestion of traffic on roads and will result in wasting of valuable time of commuters in reaching their destinations. The problem is being faced by many big cities Traffic jam will lead to affect a country's economy. The reasons behind this problem are poor traffic management, cars changing lane, unplanned stoppage etc. The restricted infrastructure in metropolitan cities, due to lack of space, can be another reason for congestion. Thus there arises the necessity of an Intelligent Traffic Management System, also known as ITS.

II. METHODOLOGY

A. Input Video

A video sequence of vehicles passing by traffic signals is given as input. to the system. This video sequence is split into frames, each second of the video containing 30 frames .This frame rate was chosen to minimize the difference between each pair of frames.

B. Splitting frames into four quadrants

Each frame in the video is split into four quadrants using pixel coordinates ,such that Top Left, Top Right, Bottom Left, Bottom Right quadrants are formed. This was done to detect vehicles in 4 lanes at a time, i.e 2roads and 2 lanes for each road.

C.Detection and Density estimation using CNN for each quadrant

Vehicles are detected using computer vision algorithms and CNN. This is done for each quadrant inside the frame. Densities of vehicles are performed by counting the number of vehicles in each quadrant and comparing it with the number obtained in the rest of the quadrant.

D. Based on density signal color will dynamically change

Based on the density, traffic light signal will be dynamically changed. Green for the quadrant having highest density while rest quadrants having red color.

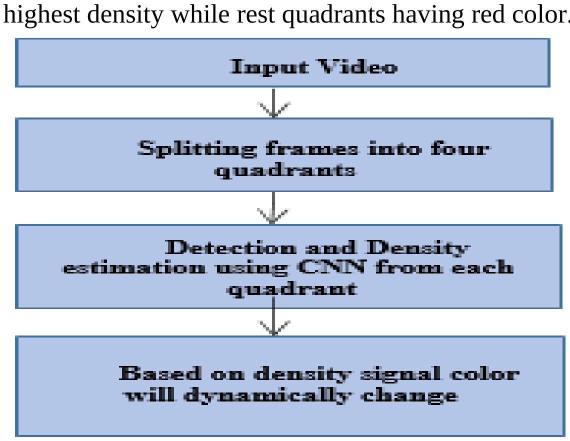

Fig.1 Overall Project Design

III. IMPLEMENTATON

Google provides a Machine Learning Framework for DataStream programming across a range of tasks. In a graph, consisting of nodes which represent mathematical operations and edges in it represent multi-dimensional data arrays (tensors) communicated between them. An augmentation of 2-dimensional tables to information with a higher measurement are Tensors whose highlights makes it suitable for Deep Learning[4].

In order to denote the computation in terms of the dependencies between individual operations, a dataflow graph is adapted by TensorFlow. Thus, first represent the dataflow graph, then construct a TensorFlow session to run parts of the graph across a set of local and remote devices. It is easy to build , train and implement object detection models using TensorFlow API.

Source video is read frame by frame with OpenCV. Each frame is processed by "SSD with Mobilenet" model developed on TensorFlow. This is a loop that continues working till reaching end of the video.

Faster R-CNN adapts region proposal network which constructs bounding boxes and use these to classify objects. The entire procedure keeps running at 7 frames per second which is far beneath what a real-time computation needs. Single Shot Multibox detector(SSD) overcomes this defect by eliminating the region proposal network. SSD increases the real-time processing speed than faster R-CNN. Also, it increases the accuracy than Faste R-CNN. In SSD, features from different convolution blocks collected to form a multibox detector. At each feature map , predictions are made for class label and bounding boxes. Features are scaled from different scales of the feature maps, thus making overall algorithm detect objects at different scales and of different sizes and is more precise then Faster R-CNN.

On VOC2007 dataset, SSD worked in 59 Frames Per Second (FPS) with a Mean Average Precision (MAP) of 74.3 % , while Faster R-CNN works only for 7 FPS with MAP of 73. 2 %.is a loop that continues working till reaching end of the video.

MobileNet is a well-known Convolution Neural Network model which is increasingly reasonable for mobile and embedded implanted based vision applications where there is absence of process control. The architecture uses depth wise convolution followed by point-wise convolution. The depth wise which reduces the number of parameters than with the normal CNN with same depth. This results in light weight deep Neural network. MobileNet V1 is a convolutional layer, which computer vision tasks required; however are very costly to compute, can be supplanted by so-called depthwise separable convolutions. The convolution layer divides the implementation into two subtasks: first one is a depthwise convolution layer where the input gets filtered, followed by a 1×1 (or pointwise) convolution layer that produces new features from the filtered values obtained from the depthwise convolution layer

IV. RESULT

Fig. 2 Input Video

The fig. 2 shows the input video. A video titled “new file” is given as the input which was in the AVI format of length 8 seconds.

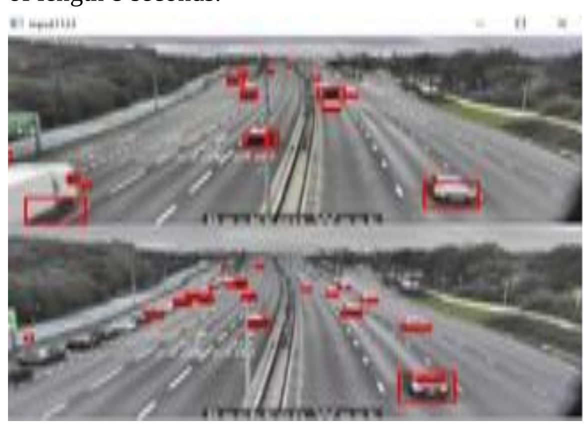

Fig. 3 .Splitting frames into four quadrants

The fig.3 shows the splitting frames into four quadrants .The first quadrant was of coordinates (0:240, 0:320) , second quadrant was (0:240, 320:640), third quadrant was (240:480, 0:320) , fourth quadrant was (240:480, 320:640) .The video was modified to height and width of 640x480.

Fig. 4 .Detection using CNN from each quadrant

The figure 4 shows the detection using CNN from each quadrant. Detection is done using frozen detection graph. In frozen graph, weight and bias are not allowed to change .This is the actual model that is used for the object detection. In TensorFlow, the protbuf" i.e. protocol buffer file contains the graph definition as well as the weights of the model . the required model and the frozen inference graph generated by TensorFlow is used. Thus, a pb file is all needed to be able to run a given trained model. Loading label map. Label maps map indices to category names, so that when the convolution network predicts 5 i.e airplane.

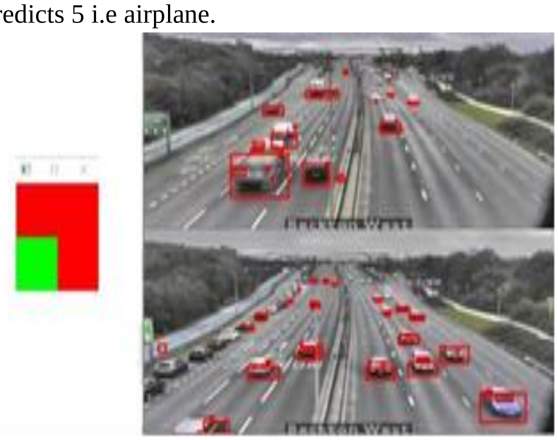

Fig. 5.Dynamic color change based on density

The fig.5 shows the color change based on density. This is done using taking count of vehicles in each frame. If vehicle count of one of the quadrants is compared with other quadrants and also if it is a greater count than the others ,then green signal is indicated.

V. CONCLUSION

The system demonstrated how deep learning could be used for segmentation of roads, vehicle detection and density estimation of vehicles. Vehicle detection and counting implemented using TensorFlow in the proposed system.

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