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Dynamic Traffic Light Control

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Abstract ***Intelligent Transport System (ITS) is blooming worldwide. The Traditional Traffic management system is a tedious process and it requires huge man power, to overcome this we have proposed an automatic Traffic monitoring system that has effective fleet management. The current transportation system at intersections and junctions has Traffic Lights with Fixed durations which increase the unnecessary staying time which intern harms the environment. An Adaptive traffic light control is implemented using SUMO simulator, that changes the duration of Green and Red light according to the traffic flow. This is an effective and efficient way to reduce the Traffic congestion. The traffic congestion is determined by taking the object count using deep learning approach (Convolutional Neural Network).***

Keywords ***ITS, Traditional traffic management, fleet management, adaptive traffic light control, SUMO simulator, Convolutional Neural Network***

I. INTRODUCTION

Deep learning has been used in many applications such as robotics, medical analysis and so on for recognizing the image. This could be adapted for traffic management system to make it a speedy and efficient one. Our current system has traffic lights with fixed durations but all the times vehicles are not the same on each way. In a scenario, we consider four ways with two ways has less number of vehicles and the remaining has large number of vehicles. Because of the fixed traffic light there will be high duration of green light for the less vehicle to cross and insufficient duration for huge number of vehicles to cross. An adaptive traffic light system will work well for these kinds of situation. The number of vehicles at each road is determined using deep learning approach. With respect to the number of vehicles the duration of traffic light (green and red light) will automatically changes. This is achieved by using SUMO simulator.

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Adaptive traffic control is a speedy process and it helps to reduce the traffic congestion. The unnecessary stay time will waste the precious time of people and that intern harms the environment by producing enormous amount of green house gas (CO_2) emission and causes global warming. This will be useful in future vehicle automation and paves the way for efficient fleet management.

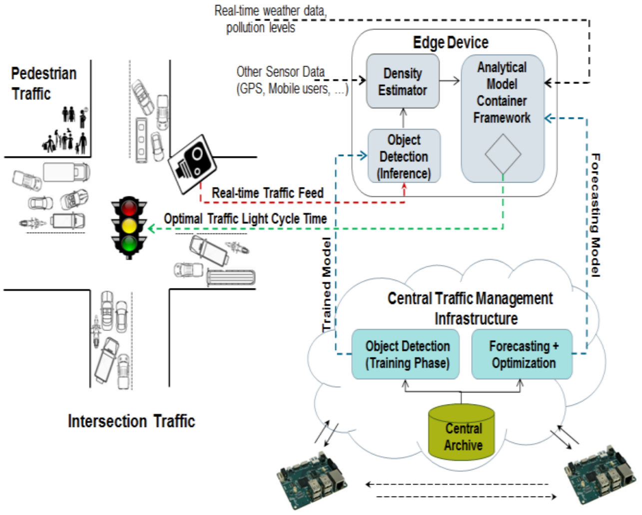

Fig.1. Architectural overview

The idea of our proposed work is timely detection of Traffic congestion state and to adaptively control the traffic light to reduce the stay time and to reduce the congestion. The Fig.1 shows the architectural overview of ITS.

II. LITERATURE SURVEY

The convolution neural network is admired deep learning method and it utilizes well-read texture and key facts for feature extraction. Deep clustering method is used for Short term Traffic Prediction across the board. For Feature extraction a combination of CNN and Triplet loss are used [1]. GPS trajectory dataset are used to improve the offline taxi service by using OT- PHRM and OA-PHRM modules, which works under multitask learning approach [2]. The accuracy of the vehicle prediction is increased by adding extra prediction layers to the Convolutional YoLo [3]. Fully Convolutional network are used for segmentation of Traffic signs and Fast neural network is used for feature extraction [4]. Deep learning approaches are used to estimate the traffic density in an unmanned aerial vehicle. It is used to detect, locate and categories the vehicles [5]. Deep learning approaches such as SSD, Faster R-CNN, YOLO-v3, R-FCN are utilized to detect the object based on the collected dataset [6]. Both deep reinforcement learning algorithms such as deep policy-gradient and value-function based agent are used to control traffic at intersection [7]. Traffic delays are controlled by using Reinforcement learning algorithm accompanied with CNN.

The labeled data are secured by cycleGAN networks [8]. Convolutional neural network based visual attention are used to categorize the vehicles and they are supported by reinforcement learning [9]. The CNN is used to predict the multiclass problems and congestion state [10].

III. EXISTING METHOD

The existing method utilizes machine learning to predict and classify the traffic congestion state. Random forest algorithm is used for this purpose. The process outline is given below.

1. Original sample set
2. Bootstrap sample set
3. Decision tree
4. Random Forest
5. Vote decision

The procedure of Random forest algorithm is as follows:
Step 1: bootstrapping method is used to select the k dissimilar samples set from original data set. This is the decision tree for all the training data set.
Step 2: K unrouted decision tree is built by using the selected k sample set. Each tree is considered as a complete decision tree and as a result k classification results are generated.
Step 3: finally the category is generated by voting process.
The Fig.2 shows the overall process of the Random forest algorithm. The drawback of this method is it is bit time consuming process and quit complex one to work with.

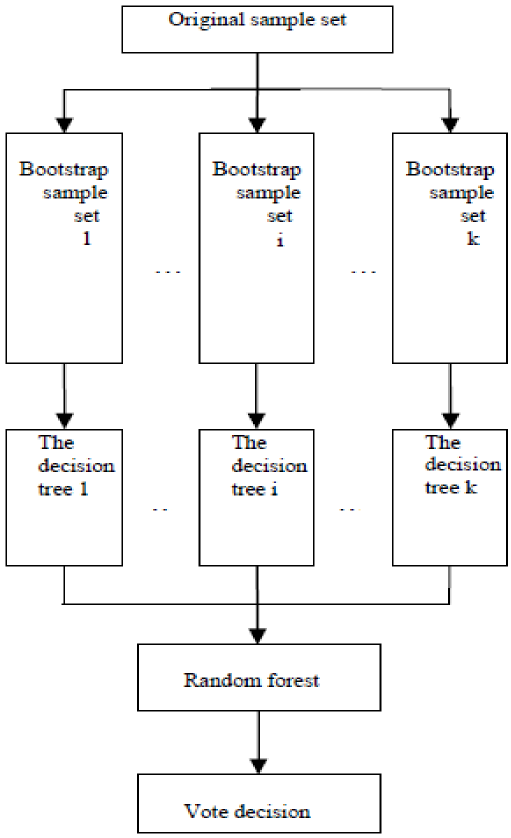

Fig.2. Overview of Random Forest Algorithm

IV. PROPOSED METHOD

In the proposed work Convolutional neural network is used to predict the traffic congestion state. The entire work is segregated into 3 modules:

- Training the neural network
- Estimation of Traffic count
- Simulation module

A. Training the neural network

The Training module works under the following procedure:
Step 1: Dataset Collection
Step 2: Image Pre-Processing
Step 3: Training the network by Convolutional 2D neural network
Step 4: Recognition

B. Estimation of Traffic count

The Fig.3 shows the flow diagram to estimate the traffic count using YOLO object detection model.

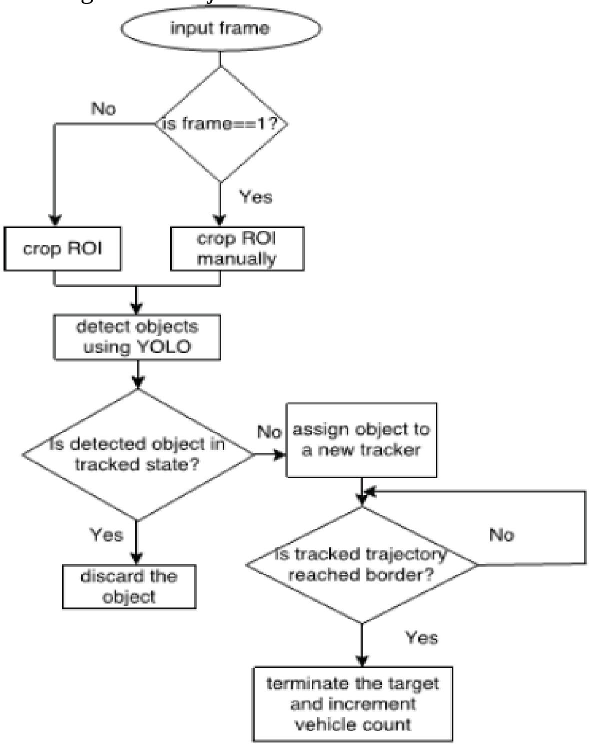

Fig.3. Flow Diagram of YoLo

YoLo model is used as a discovery model. Initially a small portion of the road is cropped manually from the starting frame. Since subtraction algorithm is insufficient to detect the moving vehicle because of the shadow and illumination effects we are moving towards YoLo. It accurately detects and categorizes the moving vehicles. The cropped portion is considered as an entry window where the tracking trajectory is initiated. Border of the frames is taken as an exit line for all the vehicles, where tracking trajectory is terminated by increasing the count.

C. Simulation module

A four-way intersection is taken into account which contains four lanes each. In each and every road, the deepest lane (L0) is for vehicles turning left, the central two lanes (L1 and L2) are for vehicles passing straight and the furthest lane (L3) is for vehicles going straight or turning right. These vehicles are controlled by the traffic signals: green light, yellow light and red light.

Currently all our traffic system has fixed duration of traffic lights which causes lot of issues. To overcome this we have implemented SUMO simulator to dynamically change the duration of the traffic lights(green and red light).

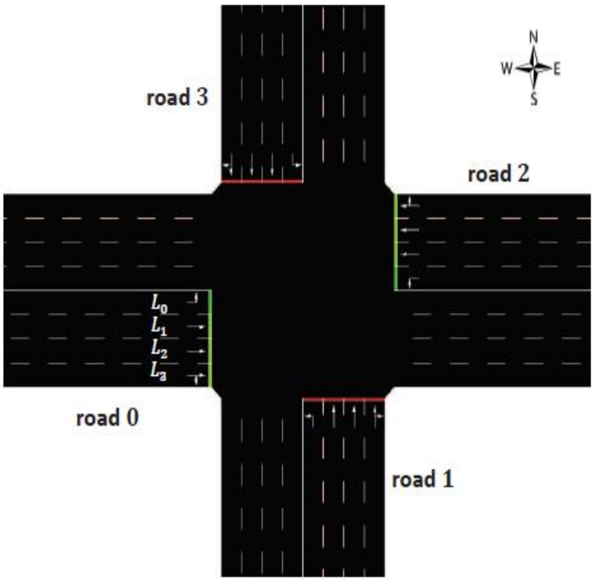

Fig.4. Outline of the SUMO module

The above Fig.4 shows the overview of the SUMO module.

V. RESULTS

The experiment is done by using convolutional neural network, YoLo and SUMO Simulation. Initially the Training phase is carried out against 300 samples. The accuracy is increased by using YoLo and the overall experiment is done and the results are obtained.

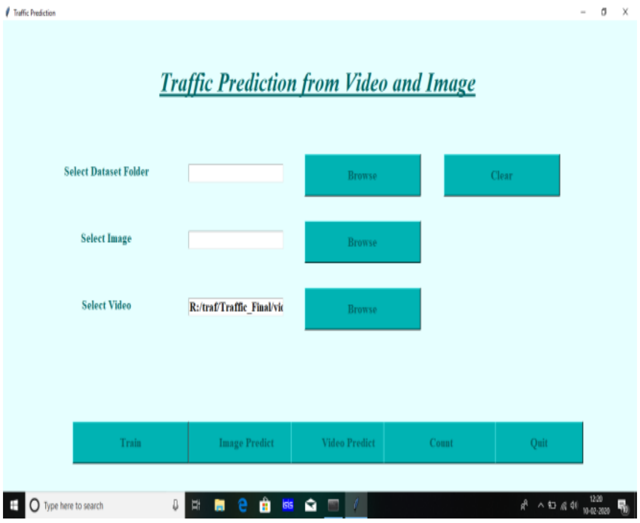

Fig.5. Traffic Prediction

The above Fig.5 shows the Traffic prediction screen, that contains comment buttons.

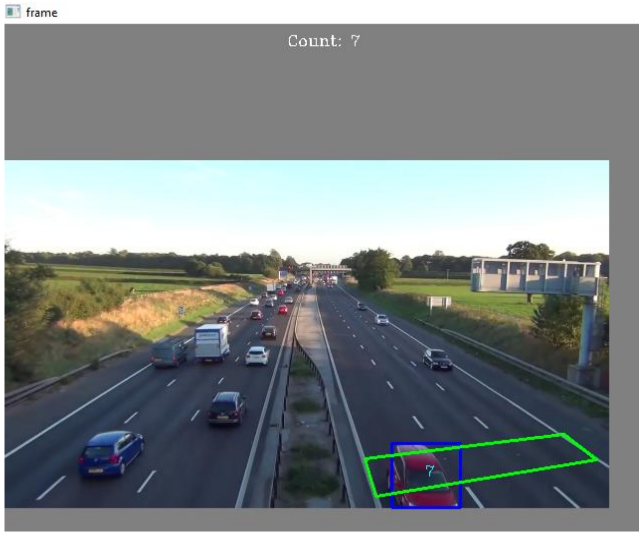

Fig.6. Traffic count

The above Fig.6 shows the Traffic count window. The green box indicates the trajectory and the blue box detects the vehicles and shows the count of the vehicle.

The Fig.7 shows the output of heavy traffic image that is labeled on the image. This deals with multiclass problems such as dense, sparse traffic, accident and fire accident. Convolutional neural network is used to categorize the given input samples.

Fig.7. Heavy Traffic Output

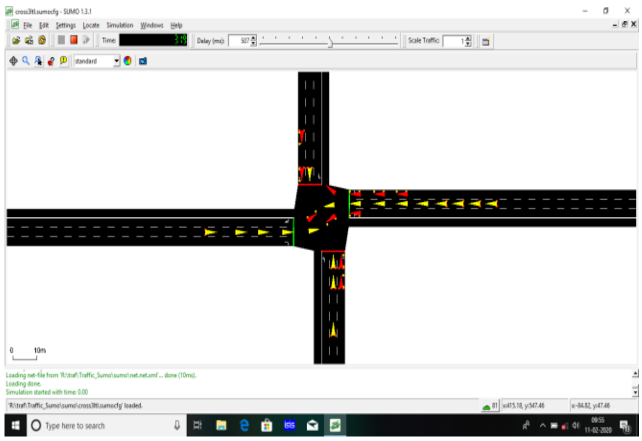

Fig.8. adaptive traffic light control

The above Fig.8 shows the output screen of Adaptive traffic light control, where the traffic lights (green and red) changes automatically as the density of the vehicle increases or decreases.

VI. CONCLUSION

Thus the Traffic Management is effectively improved by dynamically changing the Traffic signals at Intersection. This paves the best Fleet Management platform that reduces the unnecessary staying time in long queue.

Future Enhancement

As a future enhancement, the emergency vehicles can be identified and the traffic light automatically changes accordingly to free the way for the emergency vehicles to cross. This improves the Intelligent Transportation System.

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