Image Analysis Driven Intelligent Traffic Light Control for Smart Cities

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Abstract— Traffic signal control system currently works in a static way i.e. timing of each signal point is fixed. Due to this system there is an issue of traffic congestion on road. To avoid this issue, we present this paper which optimizes the congestion on road based on number of vehicles and timing. This is just a conceptual based paper. This paper is based on machine learned supervised learning model.

Keywords-Machine learning supervised learning, optimized image sensor.

I. INTRODUCTION

As the cities are turning into smart cities there is a necessity of having congestion less roads. This problem is rising at a very high rate as the number of personal vehicles has increased due to less utilization of public transport. The biggest problem behind this congestion is Dynamic traffic flow and Static traffic signal. Due to saturation of traffic, driving has become the most hectic task for any driver as they experience annoyance. Congestion occurs due to the current traffic control system that uses static waiting time for controlling the traffic. To make the road congestion less we came up with the concept which would be based on machine learned and supervised learning model. Analysis of number of vehicles will be captured by taking images through wide range optimized sensors.

II. EXISTING SOLUTION

- In an existing system [1], The prediction of congestions operationalizes by using the algorithm of back propagation to train the neural network.
- In an existing system [2], Suggest to change the average waiting time by monitoring the number of vehicles in a lane using min max fairness. Data will be sent to the central system through internet which will decide timing for signal according to the dump program.
- LoRa developed by Cycleo of Grenoble, France and acquired by semtech in 2012 is a long-range communication that achieves its connective at possible 100km+. This technology provides a strong traffic management for smart cities which is also suitable for manageability and effective use of time.

III. PROPOSED SOLUTION AND STUDY

Analysis of this paper is based on machine learning model. Supervised learning-based model will be used initially. Analysis of number of vehicles on each side of signal will be captured by taking images through wide range optimized camera installed at each signal point. As this is supervised learning-based model, the model will be trained using images/ data captured at each signal point. Congestion would be avoided using this model as it will be trained to produce optimized signal duration considering the specific timing of data as well as area/ location of the signal.

IV. METHODOLOGY

A. Object detection techniques

1. Single Shot Detector: SSD takes only one shot to detect multiple object present in an image using multiple high detection accuracy in SSD is achieved by using multiple boxes or filters with different sizes and aspect ratio for object detection. It also applies these filters to multiple feature maps from the later stages of network. This helps perform detection at multiple scales

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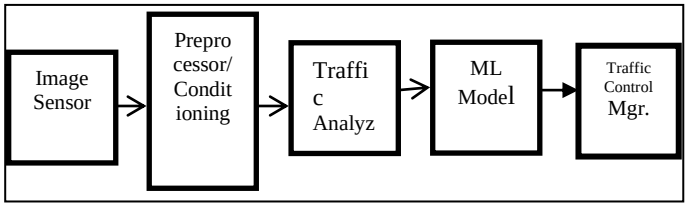
2. You only look once: A fast real time multi object detection algorithm. It utilizes single convolutional network for object detection. Unlike another algorithm which sweep the image bit by bit, this algorithm takes the whole image and reforms the object detection as a single regression problem, straight from image pixel to bounding box coordinates and class probability i.e. take image, split it up on S*S grid, Pass through neural network to create bounding box and class prediction to determine the final detection output

3. Convolutional neural network: it used to find each object in the image (for example person o kite) and identified with certain level of precision. we would use simplest deep learning approach and widely used one for detecting object in image. we pass an image to the network and it is then sent through various convolutions and pooling layer finally we get output in the form of object class. we can use this technique to detect various objects.

4. Scale-invariant feature transform (SIFT) algorithm: It is feature detection algorithm in computer vision to detect and describe local features in image. Key point of objects is first extracted from a set of reference image and stored in database. Then object is recognized from new image and compared with each feature from database. From the set of matches subset that agree on the object is filter out. The

determination of consistent cluster is performed using efficient hash table. Each cluster that agree on an object is then subject to further detailed model verification and outliers re discarded. Then finally the probability that a particular set indicates presence of object is computed. Object matches that pass all these tests is identified correct with high confidence.

V . System Model



1.Image Sensor: Images are generated by the combination of "illumination "source and the reflection and absorption of energy from that source by the element of the "scene" being images. The "scene" elements could be familiar objects such as automobiles like heavy weight/ light weight vehicles, biotic components. A principal sensor arrangement is used to transform illumination energy into digital image.

2.Preprocessing: The aim of image processing is to improve image data that suppresses unwanted distortion or enhances some image features important for further processing. In this phase the quality of the image would be improved by using number of techniques like converting to grey scale, sharpening, scaling etc. as data would be collected by any time of the day.

3. Traffic analyzer: Traffic will be analyze based on location, time of the day week days. Using the above three constraints the model will be fed with its initial dataset/ training set. This would work in the following way:

1) The processed image is fed to the model which then divides the image into number of segments.
2) The biotic components are subtracted in second function.
3) Segmentation is performed in third function.
4) Feature extraction is done using various algorithms.
5) Features are matched to classify the vehicles.
6) Finally, the number of vehicles is counted to give approximate count.

4. ML Model: The processed data by ML model will give the output as no of vehicles on road in specific area during particular time of a day. This is sample data of how the data will be collect for the model. [8]

Time	Northbound			Southbound		
	Vehicle Count		Average Speed (MPH)	Vehicle Count		Average Speed (MPH)
	Current	Historical		Current	Historical	
01:00	51	52	47	55	52	43
02:00	27	32	48	18	27	41
03:00	31	26	47	13	17	43
04:00	15	17	44	13	14	45
05:00	20	26	46	29	27	47
06:00	56	66	47	103	112	46
07:00	176	185	46	334	405	46
08:00	592	590	47	961	1168	47
09:00	747	846	48	1083	1285	47
10:00	616	691	48	694	785	46
11:00	557	633	49	576	703	46
12:00	640	751	49	650	707	45
13:00	770	847	50	714	772	45
14:00	749	824	50	825	811	45
15:00	876	891	49	776	859	46
16:00	929	1151	49	814	885	45
17:00	1264	1416	48	828	920	45
18:00	1376	1826	47	898	1038	45
19:00	743	942	48	597	706	44
20:00	424	526	48	367	437	44
21:00	242	353	49	244	366	44
22:00	189	266	47	263	277	44
23:00	139	164	46	152	207	43
24:00	91	107	45	89	99	42

5. Traffic Control Manager: The output from ML model, count of vehicles will be useful for controlling the saturation of automobiles on roads by traffic control manager. According to the count of vehicle on any side of the lane the timing of the signal would be incremented or decremented by 15% of the actual time (30 Seconds).

CONCLUSION

This paper has given a conceptual idea about handling traffic saturation on road using machine learning and supervised learned model. By capturing the image of automobiles on road through wide range optimized sensor we can get the count of the number of vehicles on each lane during the day. We can analyze the congestion in peek time of a day and decrease the average waiting time by increasing the timing of signals dynamically.

FUTURE ENHANCEMENT

Future scope for the project is to actually implement the proposed system using machine learning. we can also have a good quality image in various weather condition and optimize the congestion of automobiles on road.

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