SMART TRAFFIC MANAGEMENT SYSTEM USING CLOUD COMPUTING

[1]Thottempudi Harshitha
Department of Computer Science and Engineering
Institute of Aeronautical Engineering
Hyderabad, Telangana

[2]Kuttikala Gyaneshwar
Department of Computer Science and Engineering
Institute of Aeronautical Engineering
Hyderabad, Telangana

[3]K V Vamshi Raja Sekhar
Department of Computer Science and Engineering
Institute of Aeronautical Engineering
Hyderabad, Telangana

[4]Dr.B J D Kalyani
Department of CSE(Associate Professor And Deputy Head)
Institute of Aeronautical Engineering
Hyderabad, Telangana

Abstract---Traffic congestion is a major problem in many cities of India along with other countries. Failure of signals, poor law enforcement and bad traffic management has led to traffic Congestion. One of the major problems with Indian cities is that the existing infrastructure cannot be expanded more, and thus the only option available is better management of the Traffic. Traffic congestion has a negative impact on economy, the environment and the overall Quality of life. Hence it is high time to effectively manage the traffic congestion problem Over the years, there has been a sudden increase in the number of vehicles on the road. Traffic congestion is a growing problem everyone faces in their daily life. Manual control of Traffic by traffic police has not proved to be efficient. Also the predefined set time for the Signal at all circumstances (low and high traffic density) has not solved this problem. Traffic is a major obstacle faced by all metropolitan cities; this is due to the exponential increase in the number of vehicles on the road but the infrastructure for road transportation remains the same. The average travelling time consumption by people is increasing year by year for the same given way points. Most of the cities still rely on conventional traffic signalling which is controlled manually or time based. This conventional system used around the world is not efficient as it lacks useful data from reliable real-time sources to clear the way for emergency vehicles (ambulances, fire trucks and police vehicles) during heavy traffic conditions. Manual interaction involves manual errors, which leads to more fuel consumption and leads to health issues. Due to this Traffic flowing to a junction from all the directions at a given time is unequal. A smart traffic management is a system, where traffic is controlled by the management system, which controls the traffic lights in accordance with the real time situation of traffic moving from all different directions in a junction. This real time data is collected either from Google maps (future work) or from various sensors placed at equal intervals of distance at a junction. This data is collected and brought to a control system which autonomously calculates the optimum time for the release of the green signal.

Keywords—Traffic Management, Cloud Computing

I. INTRODUCTION

Nowadays, one of the most important challenges in transportation systems is traffic congestion. According to recent statistics, transportation has the second place in greenhouse gas emission factors ranking of USA (STATISTICS, 2015). In 2014, traffic congestion costs 6.9 billion hours of citizenry and 3.1 billion gallons of fuel, 160 billion dollars loss to US economy (STATISTICS, 2015). Infrastructure improvement is an expensive solution to traffic congestion challenge. A Traffic Management System (TMS) as one of the most important components of Intelligent Transportation System (ITS) offers capabilities that can potentially be used to reduce road traffic congestion, improve response time to incidents and ensure better travel experience for commuters. Some of the most important services of TMS are vehicle routing to shorten commuter journey, traffic prediction that enables early detection of bottlenecks, parking management that ensure optimal usage of parking spots and interact with routing and prediction services for improved control of traffic flow and finally infotainment services that provide useful information for both drivers and passengers (Djahel et al., 2015). Traffic congestion on road networks is nothing but slower speeds, increased trip time and increased queuing of the vehicles. When the number of vehicles exceeds the capacity of the road, traffic congestion occurs. In the metropolitan cities of India traffic congestion is a major problem. Traffic congestion is caused when the demand exceeds the available road capacity. This is known as saturation.

II. Literature Review

This variation in traffic Density hampers the speed of vehicles at the time of peak hours as well as regular time. The current infrastructure provides limited resources available to control of traffic congestion. To manage traffic flow real time traffic density management using IOT is used. It helps in optimization of traffic switching; controls traffic flow and prevent congestions. These aspects are been made available on website to displays the traffic status, so that people will get early update and can avoid traffic jam and have alternative path. At time of Emergency vehicle can get early access to reach their destination. Author Proposed a Framework for traffic monitoring system based on traffic density.

This can help reducing vehicle emissions in the most polluted road sections, optimizing the pollution levels while maximizing the vehicle flow. For this, we use datasets gathered from a set of air quality monitoring stations, embedded low-cost e participatory pollution sensors, contextual data and the road network available data. These data are used in the air quality indexes calculation and then the generation of a dynamic traffic network. This network is represented by a weighted graph in which the edges weights evolve according to the pollution indexes. In this work, Author proposes to combine the benefits of agent technology with both machine learning and Big Data tools.

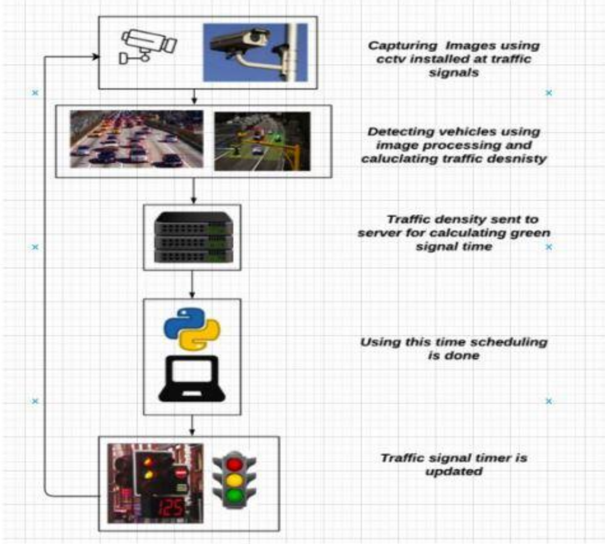
An Artificial Neural Networks (ANN) model and the Dijkstra algorithm are used for air quality prediction and the least polluted path finding in the road network. All data processing tasks are performed over a Hadoop based framework: HBase and MapReduce. This algorithm considers the real-time traffic characteristics of the competing traffic flows at the signalized road intersection. Moreover, they have adopted the ITLC algorithm to design a traffic scheduling algorithm for an arterial street scenario They have thus proposed an arterial traffic light (ATL) controlling algorithm. In the ATL controlling algorithm, the intelligent traffic lights installed at each road intersection coordinate with each other to generate an efficient traffic schedule for the entire road network.

III. EXISTING SYSTEM

1. The exiting traffic system is generally controlled by the traffic police. The main drawback of this system controlled by the traffic police is that the system is not smart enough to deal with the traffic congestion.
2. The traffic police official can either block a road for more amount of time or let the vehicles on another road pass by i.e. the decision making may not be smart enough and it entirely depends on the official's decision.
3. Moreover, even if traffic lights are used the time interval for which the vehicles will be showed green or red signal is fixed.
4. Therefore, it may not be able to solve the problem of traffic congestion. In India, it has been seen that even after the presence of traffic lights.

IV. PROPOSED SYSTEM

Our proposed system takes an image from the CCTV cameras at traffic junctions as input for real-time traffic density calculation using image processing and object detection. This system can be broken down into 3 modules: Vehicle Detection module, Signal Switching Algorithm, and Simulation module. As shown in the figure below, this image is passed on to the vehicle detection algorithm, which uses YOLO. The number of vehicles of each class, such as car, bike, bus, and truck, is detected, which is to calculate the density of traffic. The signal switching algorithm uses this density, among some other factors, to set the green signal timer for each lane. The red signal times are updated accordingly. The green signal time is restricted to a maximum and minimum value in order to avoid starvation of a particular lane. A simulation is also developed to demonstrate the system's effectiveness and compare it with the existing static system



IV.1 Vehicle Detection Module:

● The proposed system uses YOLO (You only look once) for vehicle detection, which provides the desired accuracy and processing time. A custom YOLO model was trained for vehicle detection, which can detect vehicles of different classes like cars, bikes, heavy vehicles (buses and trucks), and rickshaws.

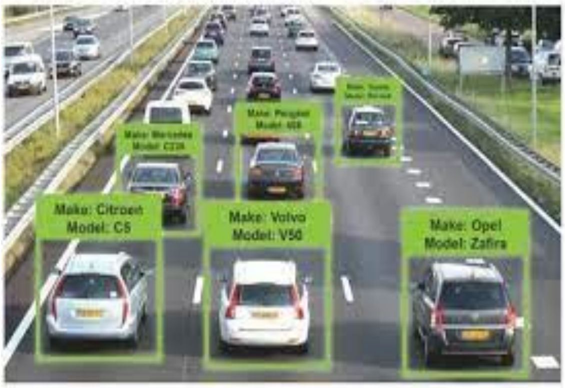
● The dataset for training the model was prepared by scraping images from google and labelling them manually using LabelIMG, a graphical image annotation tool

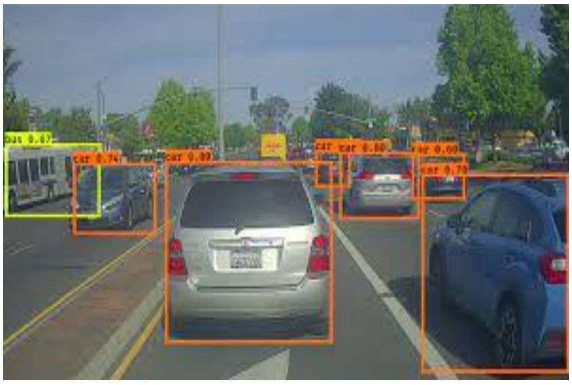
● Then the model was trained using the pre-trained weights downloaded from the YOLO website. The configuration of the .cfg file used for training was changed in accordance with the specifications of our model. The number of output neurons in the last layer was set equal to the number of classes the model is supposed to detect by changing the 'classes' variable. In our system, this was 4 viz. Car, Bike, Bus/Truck, and Rickshaw. The number of filters also needs to be changed by the formula 5*(5+number of classes), i.e., 45 in our case

. ● After making these configuration changes, the model was trained until the loss was significantly less and no longer seemed to reduce. This marked the end of the training, and the weights were now updated according to our requirements.

● These weights were then imported in code and used for vehicle detection with the help of OpenCV library. A threshold is set as the minimum confidence required for successful detection. After the model is loaded and an image is fed to the model, it gives the result in a JSON format i.e., in the form of key-value pairs, in which labels are keys, and their confidence and coordinates are values. Again, OpenCV can be used to draw the bounding boxes on the images from the labels and coordinates received.

FOLLOWING ARE SOME IMAGES OF VEHICLE DETECTION





4. METHODOLOGY:

Signal Switching Algorithm:

The Signal Switching Algorithm sets the green signal timer according to traffic density returned by the vehicle detection module, and updates the red signal timers of other signals accordingly. It also switches between the signals cyclically according to the timers.

The algorithm takes the information about the vehicles that were detected from the detection module, as explained in the previous section, as input. This is in JSON format, with the label of the object detected as the key and the confidence and coordinates as the values.

This input is then parsed to calculate the total number of vehicles of each class. After this, the green signal time for the signal is calculated and assigned to it, and the red signal times of other signals are adjusted accordingly. The algorithm can be scaled up or down to any number of signals at an intersection.

The following factors were considered while developing the algorithm:

1. The processing time of the algorithm to calculate traffic density and then the green light duration – this decides at what time the image needs to be acquired

2. Number of lanes

3. Total count of vehicles of each class like cars, trucks, motorcycles, etc

. 4. Traffic density calculated using the above factors

5. Time added due to lag each vehicle suffers during start-up and the non-linear increase in lag suffered by the vehicles which are at the back [13]

6. The average speed of each class of vehicle when the green light starts i.e. the average time required to cross the signal by each class of vehicle [14]

7. The minimum and maximum time limit for the green light duration - to prevent starvation

When the algorithm is first run, the default time is set for the first signal of the first cycle and the times for all other signals of the first cycle and all signals of the subsequent cycles are set by the algorithm. A separate thread is started which handles the detection of vehicles for each direction and the main thread handles the timer of the current signal. When the green light timer of the current signal (or the red light timer of the next green signal) reaches 0 seconds, the detection threads take the snapshot of the next direction. The result is then parsed and the timer of the next green signal is set.

All this happens in the background while the main thread is counting down the timer of the current green signal. This allows the assignment of the timer to be seamless and hence prevents any lag. Once the green timer of the current signal becomes zero, the next signal becomes green for the amount of time set by the algorithm

The image is captured when the time of the signal that is to turn green next is 0 seconds. This gives the system a total of 5 seconds (equal to value of yellow signal timer) to process the image, to detect the number of vehicles of each class present in the image, calculate the green signal time, and accordingly set the times of this signal as well as the red signal time of the next signal.

To find the optimum green signal time based on the number of vehicles of each class at a signal, the average speeds of vehicles at startup and their acceleration times were used, from which an estimate of the average time each class of vehicle takes to cross an intersection was found. The green signal time is then calculated using the formula below

$$GST = \frac{\sum_{vehicleClass} (NoOfVehicles_{vehicleClass} * AverageTime_{vehicleClass})}{(NoOfLanes + 1)}$$

Where:

: ● GST is green signal time

● noOfVehiclesOfClass is the number of vehicles of each class of vehicle at the signal as detected by the vehicle detection module,

● averageTimeOfClass is the average time the vehicles of that class take to cross an intersection, and

● noOfLanes is the number of lanes at the intersection

The average time each class of vehicle takes to cross an intersection can be set according to the location, i.e., region-wise, city-wise, locality-wise, or even intersection-wise based on the characteristics of the intersection, to make traffic management more effective. Data from the respective transport authorities can be analysed for this.

The signals switch in a cyclic fashion and not according to the densest direction first. This is in accordance with the current system where the signals turn green one after the other in a fixed pattern and does not need the people to alter their ways or cause any confusion. The order of signals is also the same as the current system, and the yellow signals have been accounted for as well

V. CONCLUSION AND FUTURE SCOPE

The proposed work focuses on Smart Traffic management System using Cloud Computing which will eliminate the drawbacks of the existing system such as high implementation cost, dependency on the environmental conditions, etc. The proposed system aims at effective management of traffic congestion. It is also cost effective than the existing system. Furthermore, the study presents the problems in metropolitan areas all over the world caused by congestions and the related sources. Congestions developed to a problem, which affects economies worldwide. Particularly metropolitan areas are worst hit under these conditions. Congestions have a negative impact on the financial situation of a country, on the environment and hence the overall quality of life.And mainly it allocates the signal timer based upon the traffic density, if we have very a smaller number of vehicles then the signal timer allocation will be around 10-20 seconds only. If the vehicles are heavy rather than usually then it allocates more time based upon that vehicle. This vehicle capturing is done through the open cv which very perfect model for the detection of the vehicles and more over we are providing cloud computing also. So, any one can access it through any device and it can be access from anywhere.

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