Intelligent Traffic Signal Management System Using Cloud Vision API and Machine Learning

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***Abstract*:- Time and money has equal powers, to save time humans do not give a second thought for money and this goes vice-verse. This is why nearly every house has a vehicle in present situation. The effect of this has lead to the increasing traffic especially during peak hours. Research is still going on this field to have an efficient way of traffic management. This paper is on one such proposal where dealing with the traffic management is different from the existing technology. We are mainly focusing on two aspects which although nearly interrelated. Firstly on cut shot the timing of the less dense traffic (keeping equal priority on each lane) to achieve this we use cloud vision API's which incorporates Machine Learning by using image taken by HD cameras as our input based on the congestion on the next lane the whole system is carried. The former being the traffic signal jump or breaking law enforcement this is done by using IOT device RFID which send the alert to the owner of the vehicle through cloud.**

General Terms:- Vision API's, priorities.

Keywords:- IOT, HD cameras, machine learning, cloud computing, RFID.

1. INTRODUCTION

Vehicle usage is increasing day by day regardless of population of the country. This is one of the reasons for traffic congestion. For a country which is not highly populated, dealing with this problem may be a little easier whereas for the over populated country such as India this is a major issue. The effect of this is polluted air, high fuel consumption and slow economic growth. To slightly overcome these problems traffic congestion has to be reduced by giving equal priority to each lane.Traffic congestion is a major issue in over populated area that even the traffic authorities are providing funds to researchers to adopt latest technologies which can reduce traffic congestion especially during peak hours. Considering the traffic in Bengaluru where there is 24/7 traffic, one should leave from starting point an hour early to reach his/her destination spot. This has resulted in poor time management and also other related issue. Our aim is to reduce the traffic by efficiently managing time and also by controlling traffic signal. ML (Machine Learning) is the latest technology and the emerging one, which is why we make use of this technique in our project. Another reason being the accuracy of the vehicle count and density is more using this technique than with any other. Deep learning is a part of ML which takes the input data iterate it using CNN (Convolution neural network) and produces the required output. With the development of deep learning methods, big data and cloud one can determine traffic related problems, which includes traffic flow prediction [1], traffic accident risk prediction [2] , arrival time estimate[3]. In this paper we make use of the images taken from cameras installed in traffic junction and this image is used as the input to the CNN (Convolution Neural Network).With the help of MATLAB we determine the density and count of vehicles. Once we get the count of vehicle the time take for the vehicle to pass the traffic signal is determined using ML algorithm. And then the required time is reduced from the fixed time of the traffic if the required time is less than the fixed time.Another reason for traffic congestion is that even after the stop light is on the vehicles move breaking the traffic laws. This will lead the consecutive junction a problem of traffic variation. So solve this problem an efficient and cost effective method is to use IOT technology. RFID (Radio Frequency Identification) which consist of reader and tag can be used to identify the vehicles and directly notify the concern and to be followed by the penalty. IOT stands for Internet Of Things this can be explained as if all living and non living thing in the universe were able to communicate or interact then there would be automaticity of every little work and no work would be done manually, which could result in minimum waste and efficient use of time. RFID and Sensors enables this using the help of internet and cloud.

RFID is the product based on IOT which uses electromagnetic fields to uniquely identify the object, provided the object is connected with the RFID tag. The technology behind this is that the tag consists of a unique serial number usually 10 digits which are represented in the form of strips. The tags can be active or passive for active tags a battery is provided .RFID tags consist of three parts integrated circuits, DC power and an antenna. The long suit of these tags is that it can be fixed or programmable.

2. RELEATED WORK

Traffic congestion is the real time issue therefore research is going on in this area. The research includes the existing technology implemented and how the recent trends and technologies will effectively and efficiently overcome the drawbacks of the existing one.

The work in paper [4] shows how by using RFID one can control the public place where event or festival is taking place. A fixed RFID is place in the entrance and the vehicle is detected and provided with a parking slot. This work

includes RFID to detect vehicles and provide a slot, microcontrollers and aurdino to control traffic signals. RFID reader detects the vehicles entering the radio frequency range and this information is compared with already registered authentic users and allots the vehicle a parking slot.

Here RFID uses the concept of handshake and back scattering [8] to transmit information. It follows the concept of master and slave where microcontroller is the master and RF module is the slave. This work is only limited for special or locations or days and not for regular traffic. The main purpose of this paper is to provide a parking space which in turn minimizes traffic.

A paper [5] on detecting traffic congestion and controlling traffic details about how an efficient algorithm is used to predict the time required for the vehicles to pass a signal and based on which the signal controlling is done. The author aims at achieving three main goals: i) detecting traffic ii) smart traffic light management iii) law enforcement by RFID.

This system makes use of cameras(usually 4) installed in the traffic the video streaming are taken based on signal intervals and this video is processed by CPU open CV to get the count and density of vehicles based on which the microcontrollers will control traffic signal by this first aim is resolved. Secondly the result of count of vehicles is the input for the algorithm which will compute the required time for the vehicle to pass and thus the required time is given to the traffic. This work will lead to waiting time for less dense traffic and not fair.

The IEEE potential [6] gives a different idea of computing the density of traffic using only RFID's. The basic idea here is to have the RFID in both side of the road. This will help in getting the direction of the vehicles and help to track them and also to find the stolen vehicles. The traffic signal lights are changed based on the density of the traffic detected by the RFID place on the either side.

Priorities are provided to different vehicles during its peak time. For example college buses are given priorities during morning and evening and ambulance 24/7 etc. But this deepens congestion as the vehicle in front of the high priority vehicle is allowed which is not a fair method. Turning points of vehicles are not detected in this system. Waiting time is more for the vehicles in the lane having less traffic.

The paper [7] will give the basic and good knowledge of how and what are the hardware and software components that can be used to control traffic and detect object. It also briefs the technology behind each and their detailed comparison. And also description of machine learning technique to process the images and video. It also details about the mathematical theorems that can be implemented on the real time issues to get the better result.

Figure 1. Traffic congestion from top view

3. PROPOSED METHODOLOGY

In this project proposal the main aim is to reduce traffic as much as possible there by valuing time and contributing to economic growth. To do this we make use of the camera which is already installed in the traffic signal. When we consider the term traffic signal we are dealing with four or more lane. The images of the next traffic junction is taken and updated to cloud and by the help of cloud vision API density and type of vehicles are detected which in turn returns status to the previous signal. The previous signal which is now the present signal will check for the status of the next signal based on the status it does the further operations. If the status is set then the timing is cut to half of the fixed time. The camera will take the image of the vehicles in its lane every 5 seconds before its turn to go. This image is then processed to get the distance between the last vehicles detected in the detection zone. Based on the distance of the vehicle from signal pole time for it to cross the signal is calculated and the resulting timing is fixed on its turn to go. Once this time is elapsed red light is switched on. This trigger the RFID place next to signal to be enabled and detects the vehicles crossing it resulting which a penalty is to be paid to traffic control.

3.1 Find Total Count (tc)

To count the number and density of vehicles in the next junction we make use of cloud vision API's. Image of the traffic is captured and sent to cloud and by the help of Google cloud vision API the count and types of vehicles is classified. Since we are dealing with the image from the top view figure 1 we can get the count of vehicles by considering edge detection and thus find the count of the vehicles. This count is compared with **maximum threshold count** (***mc)*** the lane can with stand. If the count exceeds then a signal is passed to the previous junction by setting the status indicating cut the fixed timing to half no of matter the distance.

3.2 Computing Distance

To find the distance between vehicle and signal pole we make use of MATLAB where the image captured is pre processed using image processing toolbox, neural network toolbox. The image can be classified by edge detection [9][10]. Since we are dealing with the image from the top view figure 1 we can get the perfect edge of every vehicles.

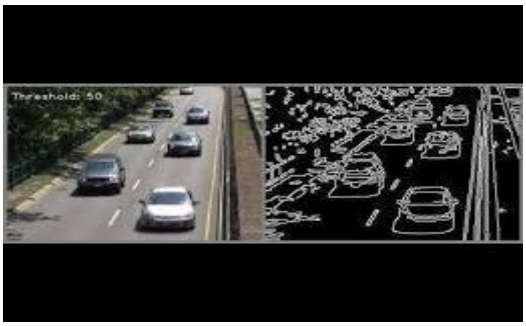

Figure 2. Edge detection

Based on the edge detection we calculate the distance between the last vehicle in the detection zone and the signal. This distance is further processed to get the required time for the vehicle to pass the signal.

3.3 Find Required Time

To find the required time for the vehicles to cross the signal firstly, we have to check for the signal from the next signal this signal is sent by setting the status ***s***=1 if so then the required time is set to half of fixed time we have distance of the last vehicle from the signal light as our input. Say our zone detection range is within 5(fixed distance) meters then, the vehicles covering 5 meters we will take more or less of 60 seconds. By taking this into consideration we design our algorithm in such a way that the input will be the distance between the signal pole to the last vehicle multiplied by 60(fixed time) seconds to which we divide 5 meters.

Algorithm

1. **Input** : distance ***d***, fixed distance ***fd***, fixed time ***ft*** and status ***s*** from next junction
2. if ***s***==1
3. ***rt=ft/2***
4. else if ***d*** >= ***fd*** then
5. ***rt=ft***
6. else
7. ***rt***= ┌***(d*ft)/fd***┐
8. end if
9. Return ***rt***
10. end

Where ***rt*** is the required time to cross signal.

This ***rt*** is the time required for the vehicle to cross the signal and the signal timing is set to ***rt*** and the green signal is turned on.

3.4 Triggering RFID

The green light is on till ***rt*** seconds after which the red light is on which triggers the RFID to read the vehicle which passes the signal even if the red light is on. To avoid a sudden rush we must place the RFID reader with a distance of half or less meter so that the driver may not be affected with the sudden change.

This RFID reader reads the Electronic Product Code (EPC) which is unique to each vehicle from the tag attached to the vehicle. This Electronic Product Code consists of Vehicular Identification Number (VIN) which can be used to get the details of the vehicles and thus imposing a penalty. When the reader reads the EPC which in turn detects the VIN and send it to the authentic server where the details of the vehicle retrieved thus providing penalty to the vehicle. We could possibly have a separate lane dedicated to priority vehicles or one side of the road so that the ambulance would get an emergency exit than be an unfair to other vehicles.

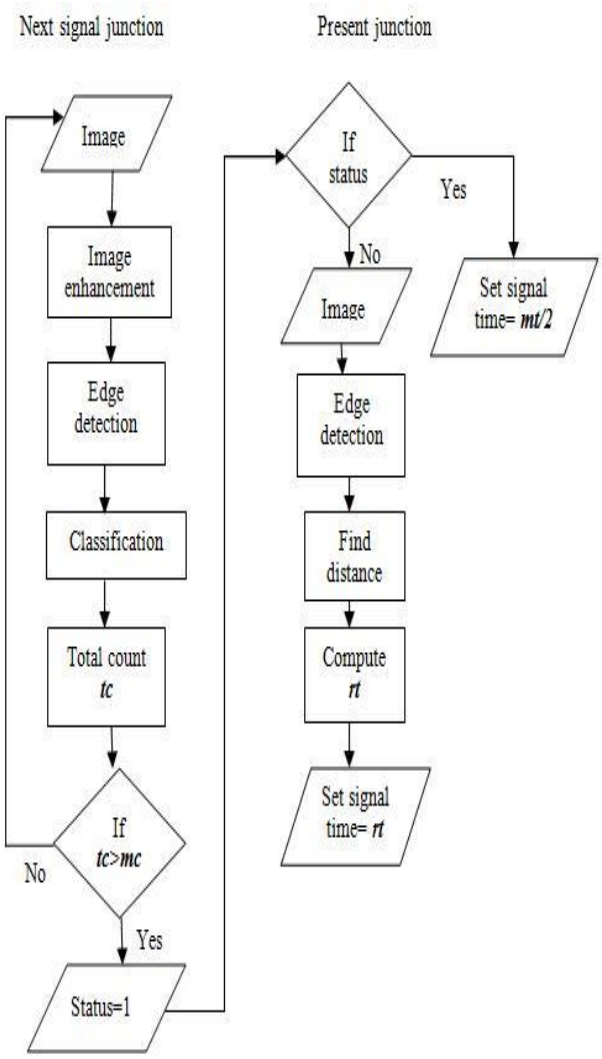

Figure 3. Flowchart for setting signal time.

4. CONCLUSION

In this paper idea proposed is to reduce the traffic congestion considering the adjacent traffic as the main point along with the distance of vehicle from the signal. Matlab with neural network toolbox is used to detect, detect classify and compute the distance of vehicles and microcontrollers is used to set the time and change the signal light. Integrating ML along IOT for better enhancement is the main aim of the work. However on certain conditions system may be normal way like if the traffic on all 4 side of the lane is equally congested than our proposal is just ignored following the normal process. This drawback can be overcome by having ITS (Intelligent Traffic System) by having different lane for different types of vehicles.

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