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Automated Traffic Signals: A Review

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Abstract: One of the major problems faced by the people living in well-populated areas is the issue of "Traffic Congestion". Traffic lights and manual traffic police force have been helpful in managing the traffic. Performing scientific analysis further facilitates to reduce the traffic related issues. This paper discusses about different approaches proposed for traffic analysis and management.

Keywords: Traffic, Road, Lane, Image sensors, Traffic light control.

I. INTRODUCTION

In the year 1897, the first automobile ran on the Indian road. Mechanized automobiles were limited only to rich people in India. But, due to Industrial revolution, automobile industries were set up in India as well, reducing the overall cost of the cars and the bikes. From the onset of the 21st century, the number of automobiles bought by the Indian families increased by 65%. In order to attract more number of buyers, positioning systems [1], head up displays, rear collision avoidance [2] and automated cars [3] are also introduced.

With people buying more cars and bikes for their convenience, the density of the traffic has also increased. In India, the average time wasted by a person at a traffic signal is more. In most of the places traffic signals are either monitored manually or with the help of timers. Manual monitoring requires the traffic policemen, which is equivalent to inadequate application of man power. On the other hand, the timers are allotted based on the average traffic and is not automated- for example if 30 seconds for the green signal is assigned for a road, it stays 30 seconds in both heavy traffic as well as no traffic situations. This wastes a lot of time of the commuters. Due to lack of patience, people skip traffic signals which results in accidents.

This paper has been into four sections. Section 2 discusses about different approaches proposed in order to rectify the issue related to traffic signals. Section 3 deals with what we infer from the existing methodologies. Section 4 concludes the paper.

II. METHODOLOGIES

The paper [4], describes the two methods to monitor traffic where computer vision is applied to intelligent vehicle highway systems. Here traffic parameters such as flow rates, speeds and link travel times are estimated quickly to avoid accidents. The second method used here is the sensor technology which tracks the vehicle and measures the distance between other vehicles. Hence it alerts the vehicle and reduces the risk of meeting accidents. A prototype vision-based traffic surveillance system is described in this paper. Here the video cameras are mounted in such a way to record the traffic scene from above. The video captured is converted to digital form and processed and accordingly traffic information is given to traffic management centres.

In [5], the road lane line and front vehicle detection is done using new smart image sensors and here lane line detection is done using edge detection algorithm. The smart image sensors used here have 2 poly and 3 metal CMOS process. According to the speed of the car the frame rate of the sensor can be controlled and accordingly the lane information is given as output.

[6] discusses about multiple traffic light control and monitoring, which in turn reduces the traffic jam to a certain extent. Here MCS51 family based 89V51RD2 microcontroller is used. This system makes use of IR transmitter and receiver which are placed on either side of the road. The activation of IR system is done whenever the vehicles pass between the IR transmitter and receiver.IR system is in turn controlled by the microcontroller which gives the count of the vehicles passed on the road. The memory of the microcontroller is used to store the count of the vehicles. Thus based on the vehicle count the traffic light timers are updated.

The paper [7] presents a method to estimate the traffic density classification using video monitoring systems. To calculate the real time density of the traffic live videos are captured from the cameras placed at the traffic junctions. This paper emphasizes on the algorithm based on the vehicle density on the road. To generate the algorithmic results C++ compiler and MATLAB are used.

According to [8], a single microphone which is installed at the roadside is used to acquire the information cues present in cumulative acoustic signal. Several noise signals such as: tyre noise, engine noise, engine-idling noise, occasional honks and air turbulence noise of vehicles are present in cumulative acoustic noise. The cumulative acoustic signal's short-term spectral envelope features are extracted. Their conditional probability distributions are then modelled based on any one of the three density states of traffics i.e., JAM flow where the

speed of the vehicles ranges from 0-10km/h, MEDIUM flow where the speed of the vehicle ranges from 10-40km/h and FREE flow ranges from 40km/h and above.

Dong et.al [9] propose a method to control the real time traffic using Field Programmable Gate Array (FPGA). It uses VHDL language. The code is downloaded to FPGA and then it is verified by simulation. The traffic system is divided into small equivalent models. The VHDL code for each model is written and then it is integrated together.

In the paper [10], Dynamic circulation lane allocation is performed where a separate lane is dynamically allocated for different vehicles like emergency vehicle (ambulance), private transportation and for public transport vehicles like buses. When there are no buses all lanes are allocated for two wheelers i.e., for private transportation. If the bus arrives then on bus drivers request, then the right-handed lane is provided.

Three novel strategies are proposed in [11] that address the heterogeneous traffic signal existing in India. The first strategy that is used is to keep the intersection signal cycle time shorter. The second strategy is ramp metering which corresponds to bottlenecks in our cities due to less number of lanes. Ramp metering leads to freeway which uses signals and this is termed as bottleneck metering. The third strategy presents a micro-simulation model. In the third strategy near the intersections a separate storage area (2W) for two wheelers and exclusive lanes are provided.

III. DISCUSSION

In [4], the vehicles on the road are detected by measuring the distance. Video information is used for traffic surveillance; hence it can be monitored effectively. The dynamic stereo system which is used for vehicle navigation and detection is more complex and more expensive.

In [5], smart image sensors are used for lane line detection and for forward vehicle detection. Lane line detection is done by using edge information accumulated by 10frames. Here various noises like road signs, road curvatures will not give an appropriate result for lane line detection and the removal of these noises are difficult. This method gives less accuracy.

In [6], IR Sensors are used to take the count of the vehicles passing on the road and accordingly traffic light delays are controlled. In case of wider roads when the IR sensors are placed on either side of the road the vehicles passing in middle of the road may not counted. The weather conditions as well as road intensities will not change the output.

In [7], video monitoring is used. The real traffic density estimation, vehicle classification like jam, free flow and heavy flow can be calculated. For compilation C++ compiler is used which is difficult.

In [8], high accuracy is attained by performing this method and the cost is less. The cost of installation is less compared to other methods, since a simple Omni directional microphone is used, which is independent on the surrounding lighting conditions. The traffic is divided into 3 conditions; the speed and volume of traffic are measured. The slow moving vehicle can move faster at the next instant and the speed of the vehicle cannot be averaged and put in the traffic condition.

In [9], real time traffic control is done by using FPGA. VHDL language is used for coding. For flexible coding state machines are used, which is reliable and easy to code.

In [10], to reduce the amount of traffic on road, the authors have implemented a system of allocating different lanes for different vehicles based on sensors. To communicate with the sensors globally, IOT is used. Since IOT is not popularized and used fully it is quite complex process and even it needs internet connection for the control.

The method shown in [11] can be applied only at isolated intersection of roads. Based on the field observation, the use of strategy is quantified by using the simulation model. The long cycle length will reduce the efficiency when first strategy is considered.

IV. CONCLUSION

Traffic load is minimized with the help of algorithm and video processing. The primary function is to calculate the number of vehicles at a particular instant of time by taking camera footage as an input and display the number of vehicles and accordingly traffic lights are controlled. This system can be used in real time traffic control in metropolitan cities and at the places where traffic is more concern. Since we require the live feed of traffic, it is easily accessible from the surveillance cameras that are present at the traffic junction. Installing a camera will reduce most of the hardware cost.

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