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A Review on Smart Traffic Management Using Emerging Technology

Prof. Pramod Gadge, Shaikh Uzzair, Darshana Manohar, Suraj Rangari, Uzma Sheikh, Aditya Sakhare,
Hiba Afzal Naaz

Electrical Engineering, RTMNU/ACET/, Nagpur, Maharashtra, India

ABSTRACT

Vehicular traffic density has increased all over the world and new techniques have been time and again employed to cater to this ongoing problem. Different traffic management strategies have been put forward and most of them focus on managing traffic density on the road. Some authors suggested the utilization of sensors to determine conveyance count while several others suggested the utilization of video cameras to capture moving vehicles and perform preprocessing on the videos to obtain conveyance count. This paper summarizes a review on the methods that were utilized for the development of a keenly intellectual traffic management system. A detailed comparison of all the Methods are provided in this paper along with the pros and cons of every method.

Keywords : Traffic Density, Sensors, Traffic Management.

I. INTRODUCTION

Traffic density has increased all over the world and there are many techniques evolved in managing it which are in terms of changed infrastructure or addition of some more modules to design a traffic management system which can be dynamic enough to change the signal timings according to increased or decreased vehicular flow in any direction at any particular time. CCTV has been installed in many countries to monitor smooth traffic operations as well as punish the traffic violators. Image processing algorithms have been used to identify traffic violators but when it comes to identifying traffic density, not much work has been proven in this regard hence research work is on but it has not been implemented for real time operations. Also if it is used to identify traffic density and control signal timings at each side dynamically, another major concern regarding this process shall be the emergency vehicles that may get

stuck at signals. The system designed should have an availability to dynamically cater to the need of emergency vehicles, normal vehicular traffic and higher traffic density. Traffic violations should be stopped as only punishing the offenders with fines has not proven to be an effective way to stop it. Apart from that there have been many cases of traffic accidents caused due to red light jumping by traffic violators. Rash driving or other negligent violations are the ones which happen all over the roads and highways, this is a problem statement that can also be discussed and solutions to stop it can be found. But this problem is not fully related to traffic signals. Hence the main problem statements that can be focused are traffic density, traffic signal management, emergency vehicle systems and curbing traffic violations at signal. This paper shall discuss the techniques of identifying traffic density, communication technique, controlling parameters, emergency vehicle system modules.

II. LITERATURE REVIEW

This paper is divided into reviewing following techniques

- A. Working of traffic signals
- B. Emergency vehicle systems
- C. Traffic density measurement.

A. Working of traffic signals

The traffic signals generally have four sides and in India adaptive traffic density have not been employed due to infrastructural changes and challenges associated to employing sensor based networks at a large scale. Many countries at present are using the conventional technique of traffic signals i.e. each lane is served for a predetermined time and all the lanes get a chance sequentially. In cases where the traffic density is high, an approach of variation in time is taken into consideration i.e. increasing the signal timings, to allow more vehicular flow. This approach has the following disadvantages.

- i. It has no facility for emergency vehicles.
- ii. If traffic density at all the sides is low, still each side has to wait for the specified duration.



Fig (i): A 4 lane traffic signal

B. Emergency vehicle systems

There are cases where ambulances have not been given way and lead to loss of life of patient although it is a moral duty to give way to ambulance or emergency vehicles but in case an individual fails his/her moral duty it shouldn't lead to loss of lives. Hence there has been much research in finding a way out to eliminate this problem. One main method that has been proposed by many papers is the use of RF module transmitters and receiver sets which shall help the ambulance or emergency vehicle drivers to send request signals to traffic light control section for granting a green signal once they arrive at the signal. But it leads to mis-cordination in timing of transmission and reception apart from that there is no specified distance from which the request should be placed. Image processing algorithm has been used to detect the siren or ambulance sign but it is not a feasible option as the size of ambulance is not fixed and there are high chances that a bigger vehicle in front of it shall block the ambulance and hence it won't be detected. Another approach is to use voice detection of ambulance sound and then grant access but it is not a feasible option as it can also grant access in cases where fake sound is played by any other user, also it shall lead to non detection of emergency vehicles when there is heavy traffic sound and horn sounds [3]. The feasible option can be the use of RFID cards in ambulances which shall detect the card and grant access. Bluetooth module is proposed as an approach for detection of emergency vehicle systems [2].

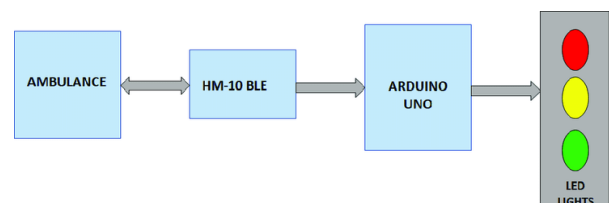


Fig (ii) Bluetooth module based ambulance detection system [2]

C. Traffic density measurement

Traffic density measurement is an important parameter because it shall help to manage the traffic easily and allow smooth flow of traffic. Traffic jams has become a problem for majority of the countries as it wastes time and fuel of the people stuck in these traffic jams. Majority of times this problem can be avoided by dynamically changing the duration of individual signal but the biggest problem associated to it is the detection and measurement of traffic density at each side. Image processing algorithms have been proposed where the already installed CCTV systems are modified to detect traffic density at each lane [2]. It cannot be combined with emergency vehicle systems as it shall make use of extra hardware hence the author has proposed the use of Bluetooth module for emergency vehicle systems. If there are parked vehicles in any lane it cannot identify it as a static object rather it will continue to keep it in count for traffic density measurement. Sensors can be used to detect the traffic density and then accordingly signals can be sent to the controller for changing the traffic signal timings.

An array of IR sensors is employed at each lane and the number of vehicles is counted by checking the number of obstacle IR sensor detects. This is not employed because as a prototype it shall be very easy to implement but at large scale this system shall fail because it is not technologically feasible to use IR arrays in huge numbers as an ideal sensing element [4



Fig (iii) Traffic density measurement using camera system [2]

An intelligent traffic system using VANET was proposed in [2]. The function of these ITL [intelligent traffic light] is to collect the traffic information such as traffic density, traffic statistics etc. Every vehicle will transmit its exact location which is will be used to calculate the traffic density. The system architecture consists of three modules as shown in fig.

1) *Warning Message Module*: This module determines if any traffic accidents have occurred and warns the driver about the same.

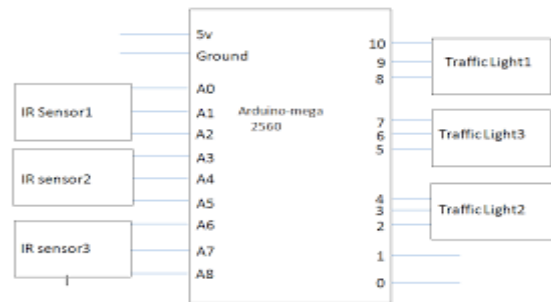


Fig (iv) traffic density measurement using IR sensors [4]

2) *Traffic Density Calculation Module*: This module calculates the traffic density on each road.

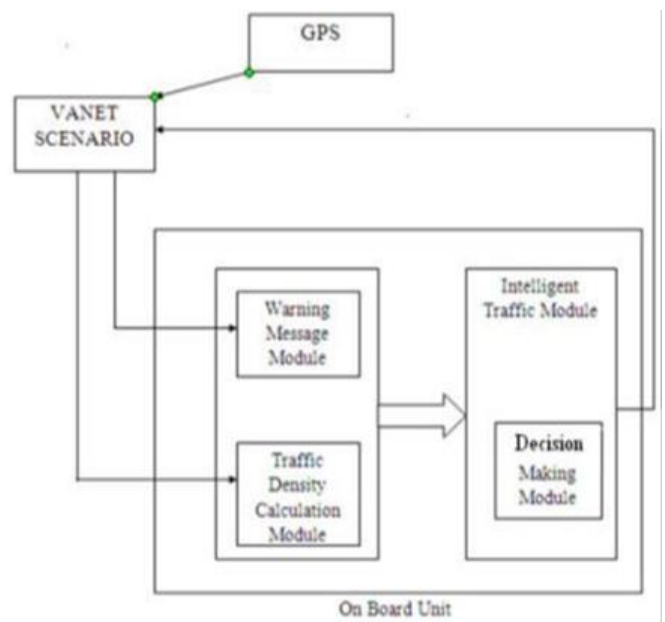


Fig (v) traffic density measurement using GPS module [5]

3) *Decision Making Module*: The above two modules gather their information and send it to the Decision Making Module where appropriate decision is made to provide a congestion free path to vehicles.

The disadvantages associated with the above system are

- i. GPS modules: it is not technologically feasible to control, traffic signal dynamically due to real time constraints of heavy vehicular traffic during rush hours and cost of installing extra hardware module.
- ii. Bluetooth modules: pairing with the receiver fails many a times
- iii. IR sensors: placing these sensors on road is not a feasible option and static or parked vehicles shall fail traffic density calculations.
- iv. CCTV: It can monitor traffic violations but also require manual intervention. Image processing algorithms used for traffic density can fail when there is a major traffic jam apart from this; it also faces problems related to detection of vehicles of varying sizes.

III. CONCLUSION

This paper provides a review on various techniques employed for traffic density measurement and designing of smart traffic light controllers. This review has also mentioned the disadvantages associated to the use of these techniques during real time operations. As the smart traffic light system is still a part of research, it is not implemented in urban cities following the disadvantages associated to the discussed systems.

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