Dynamic Signalling System for Vehicular Traffic Control Using Density Based Approach

Nagaraja SR, Nalini N, Mohan BA, Sarojadevi H

Abstract: Objectives: Designing a Dynamic Signaling System algorithm based on vehicular density to control vehicular traffic and En-hancement of effective designing guidelines for congestion control mechanism. Methods/Statistical analysis: Design congestion control technique for VANETs (Vehicular Ad-Hoc Networks) consists of three important steps as follows i. Congestion Detection, ii. Congestion Notification. iii. Rate Adjustment. Implementation of Dynamic Signaling System Algorithm based on density of vehicles by using IR sensors and ARM processor. Findings: Existing signaling system is based on static time slot allotted to traffic lights. The traffic lights cannot be changed as per changing traffic density. Dynamic Signaling System [DSS] will solve this problem by continuously sensing the density of the vehicles and adjusting the timing of traffic lights. Statistical analysis results shows that dynamic signaling system is better compare to existing signaling system. Application/Improvements: Dynamic signaling system helps to avoid the vehicular traffic and to minimize the traveling time, waiting time of traveler. This will help to enhance future research work in VANETs.

Keywords: VANETs, Signaling System, Short Range Communication, Wireless Access.

I. INTRODUCTION

VANET is a mobile ad-hoc networking technology, created by establishing a network of vehicles with road side units and base station unit 1, used for communication purpose on highways or in urban environments as shown in Fig 1.1. VANETs is an important part of Intelligent Transportation System [ITS]1. The On Board Units [OBU] are fixed in vehicles. These vehicles are interacting with RSU. Road side units [RSU] are fixed near the junctions. These units collect the information from OBU and sends to BSU. Base Stations Units [BSU] are centralized units. The computation will take place and result will sends to OBU through RSU.

VANETs are an upcoming high-tech technology, combination of ad-hoc network, wireless LAN, and cellular technology to attain intelligent vehicle Communication system2. Vehicular traffic will occurs when the size of vehicles flow require more space than the existing road capacity. The congestion is one of the important technical challenges in VANETs. In this paper we deal with some effective designing guidelines for congestion control techniques and also to design Dynamic signaling system based on vehicular density in road scenario. So as to prevent the overcrowding of the vehicles at the junction.

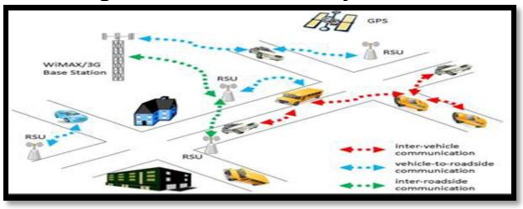

Fig 1.1: VANET architecture

II. VANET PROTOCOLS AND THE STANDARDS

a. DSRC Standard

VANETs use wireless protocol for communication between the nodes to exchange critical data and also follow International standards for VANETs communication. Fig 2.1 represents the DSRC channels.

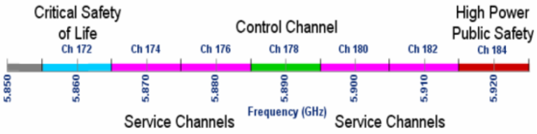

Fig 2.1: DSRC channels

b. IEEE WAVE Standard:

Wireless Access in Vehicular Environment (WAVE) as shown in Fig. 2.3.

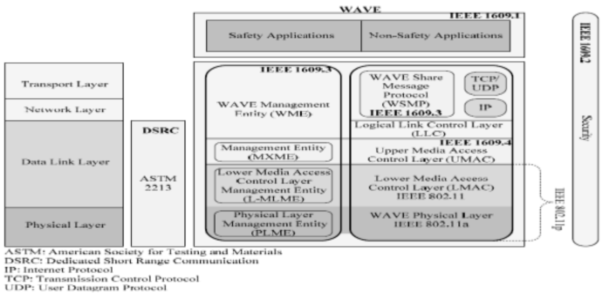

Fig 2.3: WAVE architecture

III. COMPLEX PROBLEMS AND TECHNICAL CHALLENGES

Networks usually instill quite a lot technical issues regarding Data processing and sharing on network involving network management. Along with the above, networks also

Revised Version Manuscript Received on January 25, 2019.

Nagaraja SR, Faculties of Computer Science and Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore, Karnataka, India

Nalini N, Faculties of Computer Science and Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore, Karnataka, India

Mohan BA, Faculties of Computer Science and Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore, Karnataka, India

Pravin S. Game, Faculties of Computer Science and Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore, Karnataka, India

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

throw additional technical challenges in discovering of new networks, congestion control challenges , network control and routing issues, collective information processing, querying. Following are the list of addi-tional challenges involved in VANETs they are

- Vehicular Network Discovery
- Network Control and Routing
- Congestion Control
- Collaborative Signal and Information Processing
- Tasking and Querying
- Security

IV. TECHNIQUES AND METHODS

To control the vehicular traffic, we have to evaluate Con-gestion control techniques in VANETs. Fig 4.1 shows the Congestion Control Framework.

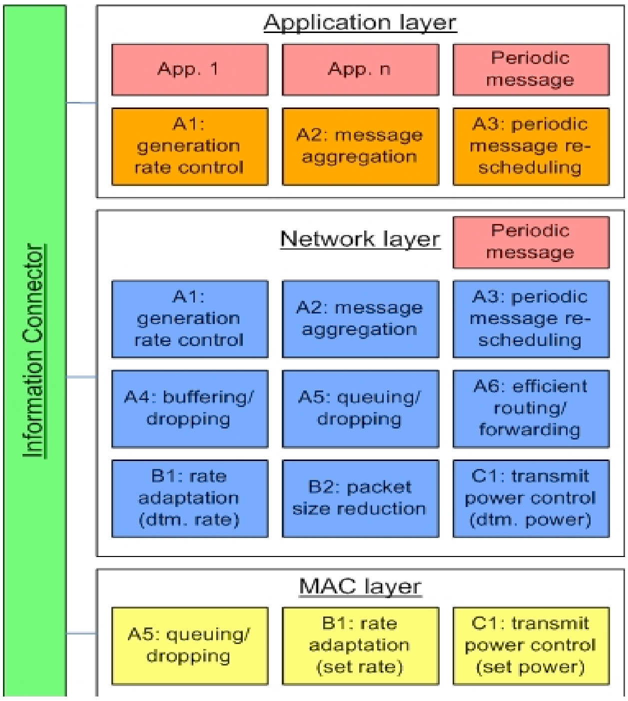

Fig 4.1: Congestion Control Framework

Important steps to be considered for designing any congestion control mechanism are i. Congestion Detection ii. Congestion Notification. iii. Rate Adjustment[1].

Measurement-Based Detection: The congestion can be detected based on packets channel queue in CCH. The CCH channel is congestion if the number of packets in the queue exceeds threshold value.

Event-Driven Detection: In this, event-driven safety message are monitored to start the congestion control algorithm. Once the event-driven safety massage is detected immediately it will launch the queue freezing method for all MAC transmission queues except for the event-driven safety message as show in Fig 4.2 9,10.

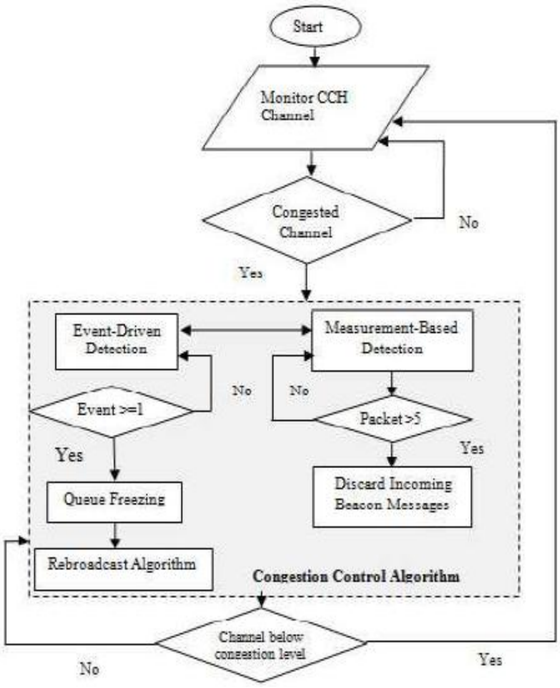

Fig 4.2: Flowchart for Congestion Control

V. RELATED WORK

Vehicular traffic is the main problem in any country. Due to con-gestion lot of problems such as accidents, pollution, excess of fuel consumption, damage to the vehicles occur. The primary motivation to carry out this Research work is to control traffic scenarios in cities, and to improve the signaling system on roads. Dynamic Signaling System [DSS] will solve traffic problems by continu-ously sensing the density of the vehicles and adjusting the timing of traffic lights as show in Fig 5.1. In this research work we are using the hardware components such as Arm-7 microcontroller and for density identification IR sensors are used. The advantages of developing a dynamic signaling system will reduce traffic, traveling time and it helps to build the good infrastructure.

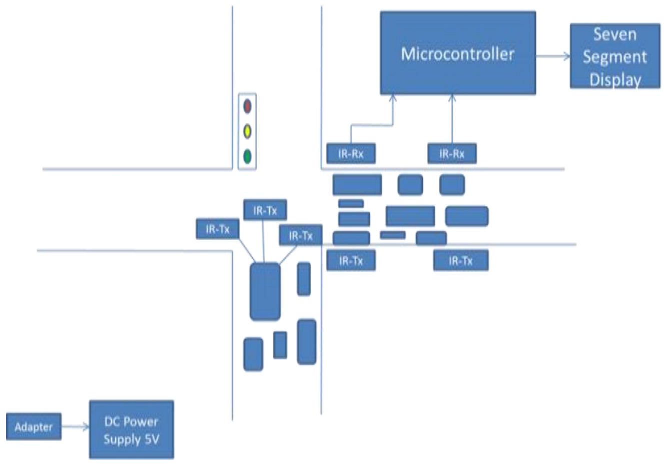

Fig 5.1: Block Diagram Signaling System

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

In existing signaling system is based on static time slot allotted to traffic lights. The traffic lights cannot be changed as per changing traffic density. In this work to develop a dynamic traffic signal system based on density. This system continuously sensing the density of the vehicles and adjusting the timing of traffic lights. In this paper vehicular density can be identified through IR sensors. Three IR sensors are deployed near traffic signaling system. The first L-IR sensor can be deployed at the range of 50 meters from traffic signaling system. The second M-IR sensor can be deployed at the range of 100 meters from traffic signaling system. The third H-IR sensor can be deployed at the range of 150 meters from traffic signaling system. IR Sensors Distance can be re-adjustable according to the traffic congestion. Arm-7 is used as a microcon-troller to do the computation based on the traffic density as show in Fig 5.2.

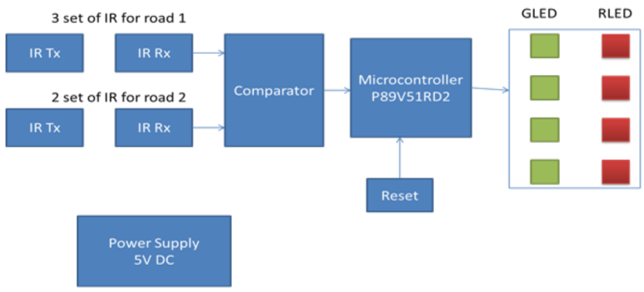

Fig 5.2: Traffic Density Block Diagram

Algorithm: Dynamic signaling system based on density
Step 1: Start
Initialize the variables a=20(assumption), j=0, LIR=0, MIR=0, HIR=0; Step 2:
Repeat
Decrement a;
If LIR is 1Then
Display Low Traffic
If LIR and MIR is 1 then
Display Medium Traffic
If LIR and MIR and HIR is 1 then
Display High Traffic Until (j is greater than a)
Step 3: Again Initialize a=20 and j=0 goto Step 2
Step 4: stop

Description: The three IR Sensors are connected to Arm Micro-controller

Input: Assume the Default Signal timing for green and red is 20 seconds. Based on the vehicle traffic the flag values are generated and this information sent to the Microcontroller.

Output: The vehicular Traffic is measured based on the Flag val-ues as follows:

1. If L-IR Flag bit is one, then the microcontroller will trigger the Traffic density as low and results in low level Traffic and also there will be no change in Traffic signaling time.
2. If both L-IR and M-IR Flag bits are one respectively, then the microcontroller will trigger the Traffic density as Medium and results in Medium level Traffic and also there will be a change in Traffic signaling time. To overcome the above traffic congestion, Green light timings will be automatically geared from 20 to 40 seconds.
3. If all L-IR, M-IR and H-IR Flag bits are one respectively, then the microcontroller will trigger the Traffic density as High and results in High level Traffic and also there will be a change in Traffic signaling time. To overcome the above traffic congestion, Green light timings will be automatically geared from 40 to 60 seconds.

VI. RESULTS

Implemented system will control the traffic based on the heavy flow of vehicles at any particular side. With this system, we shall identify the vehicle density at each side at the junction and give the path to the particular side which has heavy flow of vehicles and keep remaining stop position as shown in fig 6.1 to 6.4.

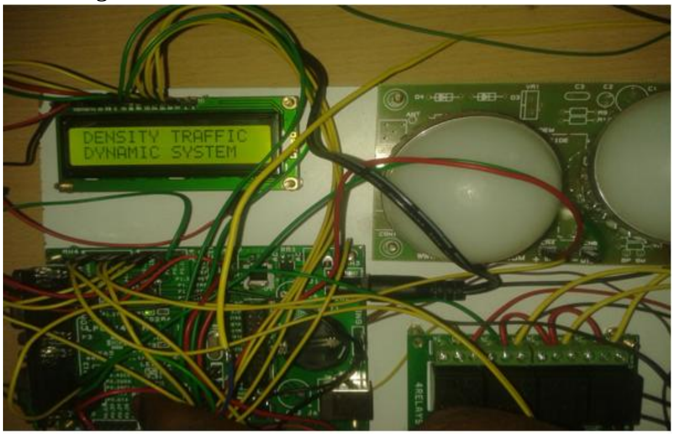

Fig 6.1: Dynamic Signaling System

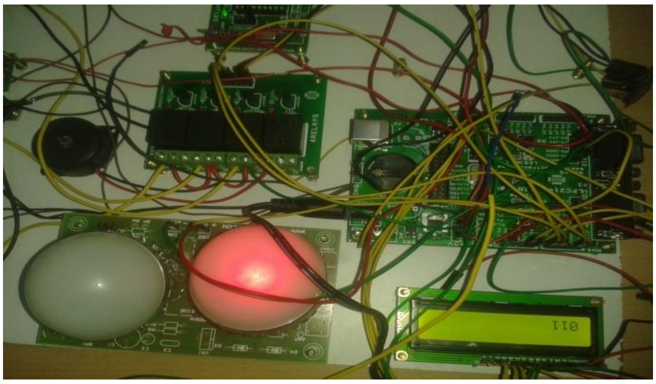

Fig 6.2: Dynamic Signaling System (Red Signal)

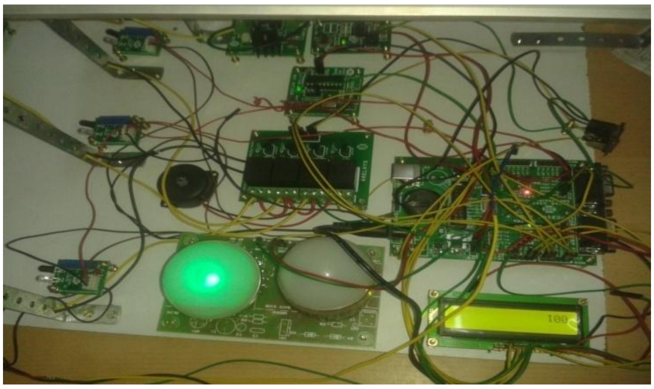

Fig 6.3: Dynamic Signaling System(Green Signal)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Fig 6.4: Dynamic Signaling System view

The fig 6.5 shows the average waiting time of the dynamic signal-ing system is less and increases linearly. Whereas, the average waiting time of pre-timed system increases exponentially.

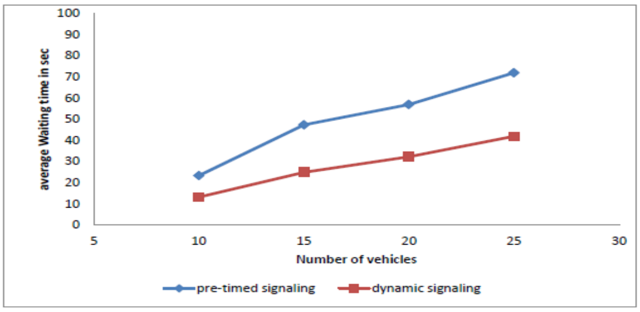

Fig 6.5: The Average waiting time in second's v/s Number of vehicles

VII. CONCLUSION

We present a dynamic signal system for control vehicular traffic based on density. The implementation and experimented Results show that the Dynamic Signaling System model has obtained better results compare to existing system in terms of the average waiting time, traffic level at the junctions. Hence, it will help to improve the traffic conditions, traveling time and reduce the traveler waiting time.

REFERENCES

1. Nagaraja SR, Nalini N. Performance analysis of proactive congestion control techniques for VANETs. IEEE – Wispnet. 2016, pp. 352-356.
2. Nagaraja SR, Nalini N, Rama Krishna K, Satish EG. Alternative Path Selection Through Density Based Approach To Controlling The Vehicular Traffic In VANETS. International Journal of Advanced Research in Computer and Communication Engineering. 2015, 4 (10), pp. 1-5.
3. Nagaraja SR, Nalini, AshwiniG. Alternate Path Selection Algorithm By Virtue Of Proactive Congestion Control Technique for VANETS. International Journal of Computer Science Trends and Technology (IJCST). 2015, 3 (2), pp. 1-5.
4. Jabbarpour R, Noor RM, Ghahremani S. Dynamic Congestion Control Algorithm for Vehicular Ad-hoc Networks. International Journal of Software Engineering and Its Applications. 2013, 7 (3), pp. 95-108.
5. Piran MJ, Murthy GR, Babu GP. Vehicular Ad Hoc And Sensor Networks Principles And Challenges. International Journal of Ad hoc Sensor & Ubiquitous Computing (IJASUC). 2011, 2 (2), pp. 1-12.
6. Darus MY, Bakar KA. Congestion Control Algorithm in Vanets. World Applied Sciences Journal. 2013, 21 (7), pp. 1057-1061.
7. Konur S, Fisher M. Formal Analysis of a VANET Congestion Control Protocol through Probabilistic Verification. In Proc. 73rd IEEE Vehicular Technology Conference (VTC2011-Spring)Budapest, Hungary. 2011, pp. 1-11.
8. Sepulcre M, Gozalvez J, Harri J, Hartenstein H. Application-Based Congestion Control Policy for the Communication Channel in VANETs. IEEE COMMUNICATIONS LETTERS. 2010, 14 (10), pp. 1-3.
9. Darus MYB, Bakar KA. Congestion Control Framework for Disseminating Safety Messages in Vehicular Ad-Hoc Networks (VANETs). International Journal of Digital Content Technology and its Applications. 2011, 5 (2), pp. 173-180.
10. Nagaraja SR, Nalini N, Ashwini G. Congestion Control in VANETs using ReRouting Algorithm. IEEE-Wispnet. 2016, pp. 297-300.