DESIGN AND DEVELOPMENT OF A WIRELESS SENSOR MODEL FOR VEHICULAR AREA NETWORKS

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Abstract: Vehicular area network provides vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-person communications. Its aim is to increase the road safety and transport facility efficiency. It also provides a ubiquitous wireless environment for the end users. The vehicle area network is considered as one of the major applications for wireless networks. Here, each vehicle has a unique identifier and eavesdropper to accumulate the locations of vehicles. If the vehicle changes its pseudonym from time to time, then the long-term tracking is to be avoided. The proposed model automatically monitors the flow of vehicles and sends the data to the control room via gateway nodes. It uses number of sensors to reduce the traffic at important junctions while forwarding the vehicle from one place to another.

Keywords: Vehicle adhoc network, sensor, control room, vehicle.

NOMENCLATURES

Val=Number of vehicles at sensor *A*
P= Status of information at sensor *A*
Z=Status of information at sensor *B*
Q=Number of vehicles at sensor *B*
Max=Maximum queue length is 200
Limit=Permissible vehicles between two sensors is 50

1. INTRODUCTION

A Vehicle Adhoc Network(VANET) is a special type of mobile adhoc network[1], where all nodes are vehicles and move regularly at high speed. The VANET has unique requirements with respect to the applications, self organization and communication. It has been envisioned to be useful in many commercial applications[2]. For example, the VANET is also used to alert the drivers to avoid the traffic. It provides efficient routes while forwarding the vehicles from one node to another. It can also be used in propagation of the emergency warning information to the drivers to avoid the collisions[3].

In VANET, it uses sensor devices to monitor the network conditions such as vibration, pressure, motion, pollution, temperature and sound. Each sensor is capable of collecting valuable information and transmits the data to others[5]. These devices are very small, low cost and can be deployed in a large numbers in the network[1]. Failure of a single device does not affect the network performance. It is also possible to replace the broken device. The newly installed device should be detected with neighboring devices for communication.

In mobile adhoc networks, the routing algorithms like proactive and reactive are used but proactive routing algorithms are not suitable for VANETs. Since, each MS keeps up-to-date information and consumes more amount of bandwidth. Generally, each MS has higher mobility and the topology will be changed frequently. The network performance depends on the mobility, density and load. The VANET is used for short-range wireless communication and has emerged as the preferred network design for quick transportation system. Federal Communications Commission has recently allocated 75MHz in 5.9GHz band for short range communication for vehicle-to-vehicle and vehicle-to-infrastructure communications.

This paper presents a design and development of wireless sensor model for VANETs to monitor the flow of vehicles and reduces the traffic over the network. Rest of the paper is arranged as follows. Section 2 presents some of the existing models. Proposed technique is discussed in section 3. Section 4 presents the simulation of proposed model. The results of this model are presented in section 5. Section 6 presents the conclusions and future research work.

2. EXISTING WORK

There are number of models used to monitor the traffic at different nodes. Each model has advantages and disadvantages. The conventional traffic methods are used to route the data packets based on the central administration principles. These models use loop-detectors and cameras to monitor the traffic. These devices are used to transmit the flow of vehicles data to the central room for taking necessary steps. But it is more expensive than non-conventional models. In fact, the performance of these systems is poor[6].

Advanced cruise-assistant-highway system helped to reduce the collisions[7]. It sends the traffic information to the drivers but it is a costly method. FleetNet[8] model uses built-in equipments with the sensors to monitor the vehicles. It is used in sending the emergency messages to the drivers over the networks.

In[9], it measures the end-to-end delay of a packet at local road. Greedy-perimeter-stateless-routing algorithm is a location based protocol, which is presented in[10]. All the data packets are marked by the originator, and then transmitted to the destination location. Previous models are mainly focused on mobility for small distances.

3. PROPOSED METHOD

The proposed model monitors the flow of vehicles and reduces the traffic at various places. It consists of regular nodes and control room. The regular node is equipped with traffic-dot sensor as shown in Fig.1. The proposed system uses IEEE 802.15.4 protocol for communication. It provides low-bit-rate, low-cost, and less-power-consumption. This model controls the flow of vehicles with the help of regular nodes at every entry and exit points of the road using RED and GREEN signals.

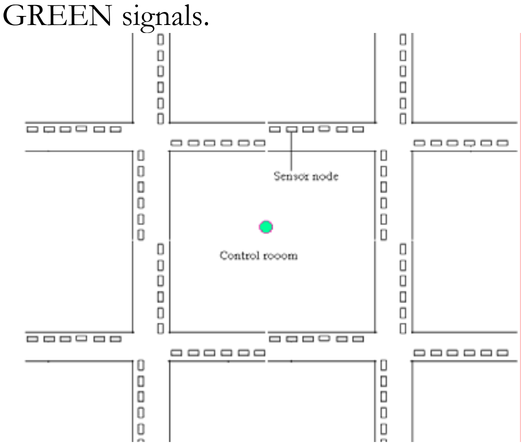

Fig.1. Sample model.

The traffic-dot sensor is equipped with ATmega128L microprocessor, battery and magnetometer as shown in Fig.2. It senses the flow of vehicles and then transmits the data to the control room and neighbor devices. The control room keeps track of all the regular nodes.

Fig.2. Traffic-dot device.

Let us take two nodes 'A' and 'B'. Both nodes exchange the flow of vehicles and same has been transmitted to the control room as shown in Fig.3. The traffic algorithm provides the sensing information from the node 'A' to the central room and 'B'. If the number of vehicles crossed the road is less than *Max*, then the GREEN light is 'ON', This state is maintained till 'A' will receive the stop signal from 'B'.

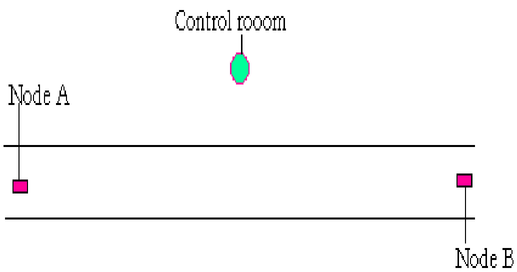

Fig.3. Proposed model.

Traffic algorithm

```
While(sensor_A_on)
{
   Val=Read_sensor_A();
   If(Y!=MAX) then
   Light_A(GREE);
    else
     {
        Send_B(complete);
        Z=Read_B();
        while(Y==MAX&&Z!=complete)
        {
          Light_A(RED);
          Z=Read_B();
         }
         Reset_sensor_A();
     }
}
```

4. SIMULATION

The proposed model considers an area of 100KmX300Km with a set of regular nodes deployed randomly over the network. The vehicle transmission range is 50m. The simulation consists of 10,000 nodes moving around a circular and square road of 6283m length with four lines. Here, it uses UMPS simulator to evaluate the network performance of two routing algorithms.

Table I. Simulation parameters.

Simulation time	2000s
Topology size	7KmX7Km
No. of nodes	1000
No.of clusters	10
No.of cluster heads	10
No. of malicious nodes	7
Transmission range	50m
Routing protocol	ZRP
Frequency	2.4Ghz
Channel capacity	2Mbps
Traffic type	CBR
CBR packet size	512 bytes
Simulator	UMPS
Total packets	30000

5. SIMULATION RESULTS

This simulation considers three performance metrics namely packet delivery ratio, average packet delay and throughput. From the results, it is noticed that the throughput of two models is increased if the number of vehicles is 6vehicles/km per line. The proposed model clearly outperforms for 25vehicles/km per line as compared to Fleet model. The connectivity in network is significantly better than that of small density traffic as shown in Fig.5.

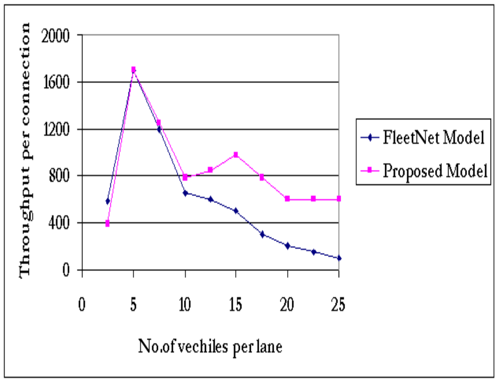

Fig.5. Number of vehicles versus throughput.

Fig.6 summarizes the packet delivery ratio. Based on the results, it concludes that up to traffic density of 5vehicles/km, the packet delivery ratios of two models are 93.56% and 98.35% respectively. At traffic density of 16vehicles/km per line, the packet delivery ratio of proposed model has decreased as compared to FleetNet model. If the traffic density is 25vehicles/km per line, then the proposed model delivers 95.86% of the data packets due to reactive algorithm principles.

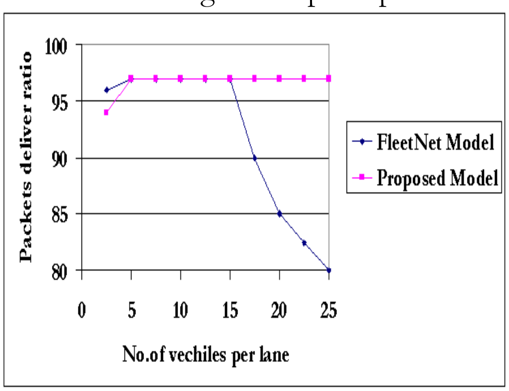

Fig.6. Number of vehicles against packet delivery ratio.

The average delay of a data packet is shown in Fig.7. The average delay of two models varies from 113 ms to 1.10 s. The FleetNet model has experienced more delay for all traffic densities. The route-discovery process will take long time in FleetNet as compared to proposed model. If the traffic density is 25vehicles/km per line, then the proposed model takes only 0.19 s.

6. CONCLUSIONS AND FUTURE WORK

In urban areas, the VANET play an important role to provide transport facility efficiently. The performance evaluation is an important factor in VANET. It is also noticed that the proposed model has shown the better results in terms of packet delivery ratio, average delay and throughput. In this work, transmission range and parameters are fixed. However, it also observed that low transmission range will not guarantee the connectivity among all nodes to ensure effective communication.

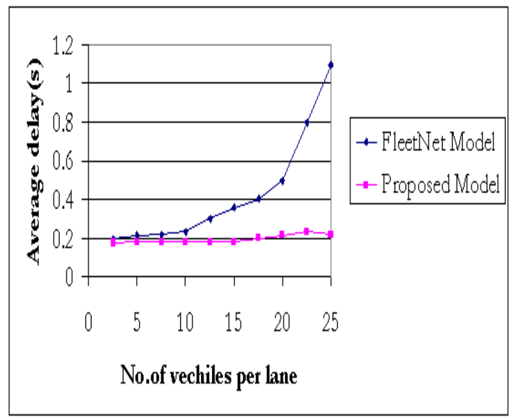

Fig.7. Number of vehicles against delay.

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