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Study and Literature Survey for Safety Applications: Intelligent Transport System (ITS)

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Abstract: Connected vehicle technology aim to solve some of the biggest challenges in the transportation in the areas of safety, mobility and environment. The safety application for Intelligent Transport System (ITS) is one of the main objectives in this Paper we focus on V2V communication, once cars are connected which is able to share data with other cars on the road and which help to reduce Highway accidents. Ultimately, vehicles are connect via multiple complementary technologies of vehicle to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity based on Wi-Fi, Dedicated Short Range Communication (DSRC)/WAVE wireless media to periodically broadcast their position information along with the driving intentions as they approach intersections. We provide a realistic analysis of the VANET topology characteristics over time and space (Collision Detection) for a highway and intersection scenario to integrate real-world road topology and real-time data extracted from the freeway Performance Measurement System (PeMS) database into a microscopic mobility model to generate realistic traffic flows along the highway. Also provides Collision Detection Algorithm, SSM/TEM/TEMA model to improve throughput at crossing points. In this paper we investigate the use of vehicle-to-vehicle (V2V) communications by using above mentioned algorithms and models.

Index Terms: ITS, V2V, DSRC WAVE wireless media, VANET, Collision Detection Algorithm, SSM/TEM/TEMA model, NS2, AVR Microcontroller, Sensor.

I. INTRODUCTION

Regarding to this smart vehicle system, automobile industries all over the world worked hard to introduce smart vehicle communication models. A new vehicle features that make possible the exchange of information with the internet via specific interface will definitely reduce the accidents. So for this purpose Vehicular Ad-Hoc Network also known as VANET. [1] Can be used to improve traffic conditions. These networks are characterized by highly dynamic topologies due to the fast mobility of the vehicles & their restricted motions to geographical pattern of high ways. As a result, VANET experiences communication discontinuity more frequently compared with traditional Ad-Hoc Networks. DSRC that is dedicated short range communication is one of the important factor regarding to the Intelligent Transport System (ITS) [13]. This DSRC is the wi-fi radio whose bandwidth completely dedicated for automobile use. The DSRC gives us wireless links between Road-Side Equipment (RSE) & Onboard Equipment (OBE). Based on the statistics collected from on Federal Highway Administration (FHWA), a significantly high number of vehicle crashes occur at intersections which are currently managed by stop signs and traffic lights [2]. Our goal is to enhance safety while decreasing the delay introduced by stop signs or traffic lights by using our V2V-based intersection management protocols. Vehicle-to- Infra-structure (V2I) communication is an approach that has been used to address the intersection problem in prior work in this domain. As the word infrastructure implies, the system mainly consists of an intelligent and powerful computational and communicational unit which would be installed at each intersection to communicate with all approaching vehicles and manage traffic by reserving a safe time-space passage through the intersection for each vehicle. This approach is not very practical because of the high cost and inertia of installing the intersection manager at each intersection [6]. Another drawback of such a centralized system is that if the intersection manager fails, crossing the intersection could be chaotic and dangerous, similar to signal breakdown at a busy intersection. Our focus in this Paper is to (a) improve our V2V-based intersection management protocol and introduce a new collision detection algorithm for intersections [8] (b) extend an advanced mobility simulator for vehicles and investigate the use controller model test the performance of our protocols under realistic driving conditions [9] and(c) compare the operational efficiency of our improved protocol with our previous work and conventional traffic lights [3]. The main objective of the proposed work is: Design Vehicle communication manag- ement protocols using vehicle-to vehicle communication to address core issues of safety. Analyse performance of Traffic-Light model. Analyse performance of V2V-interaction model.

II. LITERATURE REVIEW

In [8], author uses V2V communication, DSRC Technologies for to connect Vehicles via multiple complementary technologies for smart connectivity.

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In [9], this paper presents, Importance of Realistic mobility models for VANET Simulation which is considered one of the most important part in ITS. This paper provides The importance of choosing a suitable real world scenario for performances studies of routing protocols in this kind of network so Comparative study between two mobility models, mobility pattern generator for VANET. And provides VANET, Mobility Model, Simulations, Real World, NS-2 etc.
In [1], this paper, author provides the requirements for Realistic analysis of the VANET topology characteristics over time and space for a highway scenario. In [2], this paper presents Emergency message, safety application, vehicular ad-hoc networks, flow theory, car collision to evaluating the performance of emergency messaging via wireless CA systems.
In [3], author presents method VANET Modelling Clustering Design under Practical Traffic, Channel and Mobility Conditions for providing iintegrates the three important factors Eg.size and geographical span, mobility of vehicle into one .model. In [4], the DGPS-Based Vehicle-to-Vehicle Cooperative Collision Warning: Engineering Feasibility Viewpoints, to detect potential collisions provides Vehicle collision warning system (CWS).
In [5], this paper. Headway distance, log-normal distribution, path-loss model, probability distribution, vehicular ad hoc net-works (VANETs), wireless communication, to investigate the probability distribution provides Realistic radio transmission model and a realistic probability distribution model. In [6], this paper, author proposes a method based A map-free intersection collision-warning system for all road patterns for Estimator, intersection collision warning, map free, relay, steady-state driving.

III. METHODOLOGY

Stage1: Design a smart vehicle to vehicle communication model
In this section we describe three models: the Stop-Sign Model (SSM), the Throughput-Enhancement Model (TEM) and Throughput-Enhancement Model with Agreement (TEMA). We will specify their functionality under various scenarios considering vehicle communicate at any intersection point.

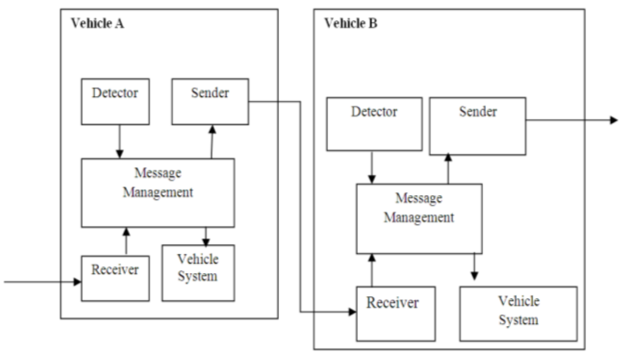

Fig. 1 Design A Smart Vehicle To Vehicle Communication Model

A. Stop-Sign Model (SSM)
In this model, Vehicles use STOP and CLEAR safety messages to inform other vehicles in range about their current situation and movement parameters.

B. Throughput Enhancement Model (TEM)
This model is intended to V2V communication without t utilizing any infrastructure devices. The objective is to improve the throughput at crossing points without bringing on accident. Vehicles again utilize STOP and CLEAR security messages for communication.

C. Throughput Enhancement Model with Agreement (TEMA)
This model is based on TEM and is totally intended to handle lost V2V messages. Additional CONFIRM and DENY messages are utilized to perform clear handshaking between vehicles approaching the same intersection .Every vehicle affirms its choice to cross the crossing point by sending a CONFIRM or DENY message.

Stage 2: Collision Detection
We first identify the conditions required for two or more vehicles to collide at an intersection. Suppose Arrival-Time is the time at which a vehicle arrives at an entrance of the intersection and Exit-Time is the time at which the vehicle exits the intersection area. If a vehicle enters an intersection while another vehicle is in the intersection area, their (Arrival-Time, Exit-Time) intervals must overlap. Two vehicles being inside the same intersection at the same time is a necessary, but not sufficient condition for a collision. In Figure 1(a), two vehicles are within the intersection at the same time but not occupying the same space. Figure 1(b) shows a scenario in which a vehicle is coming from the south and turning right while the other vehicle is coming from the north and also turning to its right. In this case, both vehicles can cross the intersection at the same time without a collision. A collision occurs if the following conditions are all true:
A. Same Intersection: vehicles are at the same intersection.
B. Time Conflict: vehicles have overlapping (Arrival-Time, Exit-Time) intervals.
C. Space Conflict: vehicles occupy the same space while crossing the intersection.

If any of the above three conditions is false, then there will be no collision and vehicles can safely continue along their trajectory. We refer to the part of the road that a vehicle is currently on as its current road segment (CRS), and the part of the road that the vehicle will be moving to after the current road segment as the next road segment (NRS). In the context of an intersection, CRS corresponds to the road segment that a vehicle is on before the intersection, and NRS represents the road segment that the vehicle will be on after crossing the intersection.

Stage 3: Collision Detection Algorithm
Our Collision Detection Algorithm for Intersections (CDAI) will be run on each vehicle that crosses a transaction, with information exchanged among vehicles approaching, crossing and leaving the intersection. The algorithm uses path prediction to determine any space conflicts with other vehicles trying cross the intersection.

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Each lane on the road is considered to be a polygon, which starts from the previous intersection and ends at the next approaching intersection. Then, CDAI predicts the space (or region) which will be occupied by the vehicle during its trajectory. Utilizing the CRS (current road segment), current lane, and NRS (next road segment) information for each vehicle, CDAI predicts the path taken by the vehicle to cross the intersection and generates two polygons: the first polygon is related to the vehicle's CRS and current lane, and the second polygon is related to the vehicle's NRS. Each polygon's height is the length of the road between two consecutive intersections and the polygon's width is the lane width. So, for each vehicle, these two polygons together form the complete spatial region related to its path, which we refer to as its Trajectory Box (TB).

Stage 4: Mobility Model
This stage includes the traffic light model:
Traffic-Light Model: The traffic-light model follows the same basic logic as the stop sign model except that stop signs are now replaced by traffic lights. The Green-Light Time of the traffic light has a default value that can be changed by the user.

Stage 5: V2V communication model
Gigahertz DSRC is a short-to-medium-range communications service that supports both public safety and private operations in v2r and v2v environments. DSRC v2r links must support very high data transfer rates. DSRC is multi-channel wireless protocol used in VANET application which is based on IEEE 802.11a Physical Layer and the IEEE 802.11 MAC Layer. This is designed to help drivers travel more safely and reduce the number of losses due to road accidents. In this experiment we used IEEE 802.11 p medium access control (MAC), which uses carrier sense multiple accesses with collision avoidance. It operates over a 75 MHz licensed spectrum in the 5.9 GHz band allocated by the Federal Communications Commission and supports low latency vehicle-to-vehicle (V2V) and vehicle-to-infrastructure(V2I) communications. It provides wireless link between Road Side Equipment (RSE) and On board Equipment (OBE).

III. PROPOSED FLOWCHART

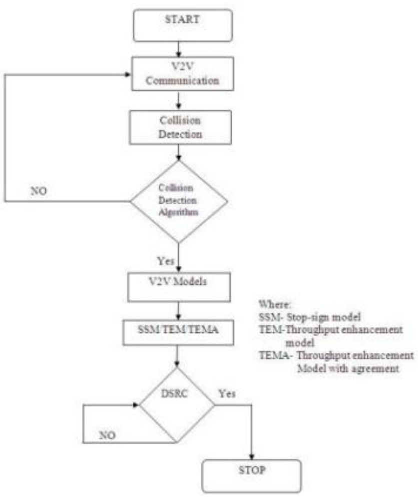

Fig. 2 Proposed Flowchart

IV. SIMULATION

In the V2V protocols we use VANET (Vehicular Ad hoc networks) for this simulation. The main feature of VA NET is communication between two vehicles for message exchange via Vehicle-to-Vehicle (V2V) and vehicle-to-Infrastructure (V2I) communication protocols. VANET is a term used to describe the spontaneous ad hoc network formed over vehicles moving on the roadway. More in detail, VANETs are characterized by high mobility, rapidly changing topology, and transient, one-time interactions. VANETS are considered as one of the most well-known technologies for improving the safety applications as well as vehicle efficiency of intelligent transportation systems. Applications for VANETs are oriented to safety issues of vehicles in order to improve the quality of transportation through time-critical safety and traffic management applications.
VANET simulators, which is an actual digital map for the USA.TIGER files contain detailed geographical information from large highways to small streets. For each road, the TIGER files specify its end points, along with as many intermediary points as needed, depending on the road's shape. For realistic simulation detailed traffic specific information required which is present in TIGER.

V. SIMULATION PERFORMANCE

The roadmap is created in VANET using the MOVE and SUMO tool. In MOVE, the road map will generate that requires the inputs of two types of information, nodes and edges. A "node" is one particular point on the map which can be either a junction or the dead end of the roads. This is simply creating all the map nodes. The edge is the road that connects two points (nodes) on a map. The attributes associated with an edge include speed limit, number of lanes, the road priority and the road length. Next, the movements of the vehicle will generated by using the groups of flows and turning ratio for each junction. The attributes associated with an flows and turn include the number of vehicles in a particular route, vehicle departure time, origin and destination of the vehicle, duration of the trip, vehicle speed, etc. After finished the configuration for movements of all vehicle and visualize that actual movements on vehicle using SUMO simulator.

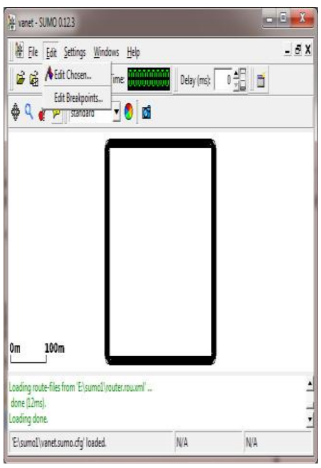

Fig3. Simulation Performance

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VI. NS2 SIMULATON

AODV (Ad hoc On Demand Distance Vector) is a reactive protocol that does route discovery when needed by a node. The route discovery process is initiated only when a source node has data traffic to send to a destination node, that makes AODV a truly On- Demand routing protocol. In our simulations, we chose AODV since it behaves well in several of the performance evaluations of the routing protocols The ns-2 code used in our simulations of AODV was obtained from. Each simulation run lasted for 300 seconds with a uniform block size of 500 x 500 meters; the maximum speed of vehicles is of 40 m/s.

The number of vehicles nodes from 15 to 100. We chose the traffic sources at a constant rate CBR (Constant Bit Rate). Traffic between nodes is generated using a traffic generator which is characterized by the following parameters: Data packets Size is 512 bytes, Interval between packets is 0.25s, maximum of packets transmitted 1000. All nodes use IEEE 802.11 MAC operating at 2Mbps. The propagation model employed in the simulation is Two Ray Ground reflection. With the use of NS2 platform I am using PCL-830 editor and NAM Complier.

Vehicular Ad hoc Network (VANET) are treated as mobile sensor networks and characterized with special characteristics such as high node mobility and rapid topology changes. VANET nodes can sense a variety of data in its surrounding area to offer several services including traffic monitoring, speed controlling, lost vehicle locating and environmental monitoring as it covers permanently a wide geographical region. Nodes are configured with different communication. Vehicles moves within the specified network boundary. Nodes in VANET can communicate in two ways: vehicle-to-vehicle (V2V) communication and Vehicle-to-infrastructure (V2I) communication. In V2I communication model, vehicles communicate to Road-Side-Unit (RSU) through Road-Side-Routers. Data Transmission is established between nodes using UDP agent and CBR traffic. The sample 19.tcl designs a VANET with sensor node configuration, communication model, mobility model, and energy model components.

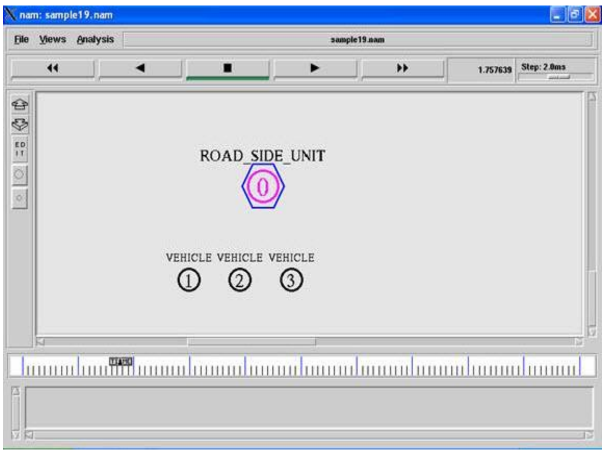

Fig4. Simulation Performance

VII. PROTOTYPE HARDWARE DESIGN DIAGRAM

A. Block Diagram

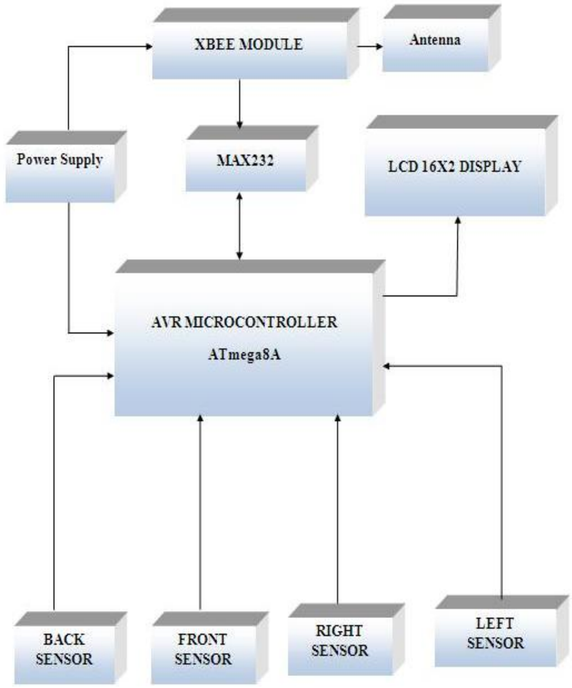

Fig.5. Block Diagram

B. Circuit Diagram

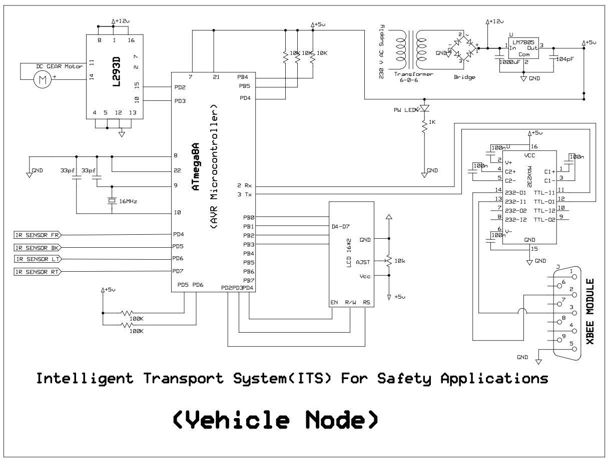

Fig.6 Circuit Diagram

C. Block Description:

AVR Microcontroller:
AVR Microcontroller is used as main control & Decision element. This is an 8-bit Microcontroller with 8K Bytes in-System Programmable Flash

- High-performance, Low-power AVR® 8-bit Microcontroller
- Advanced RISC Architecture
- 130 Powerful Instructions – Most Single-clock Cycle Execution
- 32 x 8 General Purpose Working Registers

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- Fully Static Operation Up to 16 MIPS Throughput at 16 MHz
- On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
- 8K Bytes of In-System Self-programmable Flash program memory
- 512 Bytes EEPROM
- 1K Byte Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)
- Optional Boot Code Section with Independent Lock Bits
- In-System Programming by On-chip Boot Program

True Read-While-Write Operation – Programming Lock for Software Security

GSM Module:
GSM Module (SIM300) is used to send & receive the SMS from/to user.It is an AT command supportable serial communication module with 9600 default band rate. It work over the band of 900MHz to 1800MHz

GPS Module:
GPS module is used to get the current positions in the form of longitude & latitude in band rate of 9600.

MAX232:
It is an logic level convertor & it convert TTL logic to 232 & vice versa. It is used to interface microcontroller with GSM & GPS.

Motor Driver (L293D):
L293D is bidirectional Dual Pair motor Driver. Single IC can drive four motor unidirectional & two bidirectional.Its operate on +5 V & Switch the 12V with maximum 2A current.

Motor (12V DC, 1/2 kg Torque):
12V DC permanent magnet motor with torque of 1/2kg & 30 RPM is used.
- Voltage:12V DC
- Current:250mA
- RPM:30
- Torque:1/2kg

Power Supply:
In the power supply unit following stage are require:
Step Down Transformer (230v AC to 12-0 AC):
Rectifier (Bridge):
Filter (Capacitor):
Regulator (7805):
Here we use +5V & +12V DC supply

IR Sensor:
IR LED is used as IR transmitter which is connected to output of 555 timer which generate 38KHz frequency and TSOP1738 is used as IR receiver which is low when signal is present. (i.e. Acive Low Sensor). So, the output of TSOP1738 is low when reflected signal is present(i.e. Obstacle is Present).Similar circuit of obstacle detector are as follow:

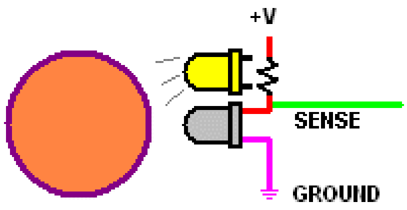

Fig7. Obstacle detector

VIII. CONCLUSION

Proposed to design Vehicle communication management protocols using vehicle-to-vehicle communication to address these core issues of safety. I believe that accidents can be diminished and endured altogether utilizing V2V technology. Since installation of wireless environment at every cross point would be costly. A V2V-based methodology appears to be more reasonable for implementing. I have depicted V2V-based conventions to be specific Stop-Sign, Traffic-Light, Throughput-Enhancement and Throughput-Enhancement with Agreement conventions VANET test system to backing these conventions.Results indicate the potential of these new V2V-based protocols to manage intersections with minimal dependency on infrastructure. Although our protocols are designed for autonomous vehicles that use V2V communication for co-operative driving, they can be adapted to a driver-alert system for manual vehicles at traffic intersections.

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BIOGRAPHIES

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