Cooperative Collision Avoidance System for VANET

Shruthi .P, KCG College of Technology, IVth year, CSE, shruthiraju111@gmail.com

Sujhitha.V, KCG College of Technology, IVth year, CSE, sujhithavijay95@gmail.com

Sridevi RameshKumar, KCG College of Technology, IVth year CSE, sricool@gmail.com

Mr.S.Cloudin, Associate Professor, KCG College of Technology

Abstract- **This paper focuses on how to overcome the existing limitation in guaranteeing reliable communication and in avoiding the transmission delays caused due to the need to switch over between different RSUs(Road Side Units).In highway systems, despite the potentials of VANETs it is challenging to apply it for intraplatoon control because it is still difficult to assure timely communication in realistic scenarios where latencies and errors may occur due to the mobility of vehicles and the topology changes in the VANETs. The approach to solve this problem is to implement CCA(Cooperative Collision Avoidance)System which removes the need for RSUs and allows the vehicles to communicate critical information directly with one another thereby warding off the risk of likely collisions by implementing a prioritized dissemination of messages .This system is implemented by two algorithms. This system is implemented by using two algorithms. The first one is a prioritized message passing algorithm which is used to establish V2V communication within authorized nodes(nodes inside range) and a greedy logic algorithm to establish V2V communication within unauthorized nodes(nodes outside range).**

***Index terms*-Vehicular Adhoc networks (VANETs) , Cooperative collision avoidance (CCA) , Road side Units (RSU), Intelligent Transport System (ITS)**

I. INTRODUCTION

In the highways, vehicles are put together into groups called platoons in which a particular vehicle is chosen to be the *leader*. A leader in general will be the vehicle which maintains constant velocity. Platooning, is a concept in which number of vehicles run in a group with synchronized driving dynamics through a VANET.

All vehicles running in a platoon can constantly communicate and synchronize with each other. Vehicles are able to take actions such as braking, acceleration and deceleration simultaneously due to the communication in the platoons to avoid and mitigate dangerous situations.Communication both within and between different platoons is possible i.e, both interplatoon and intraplatoon communication is possible. Grouping the vehicles into platoons increases the road capacity, energy efficiency and safety, reduces fuel consumption. Vehicles both inside and outside the platoons update the status of each other .This makes vehicle merging and lane changing a less hazzle free task. Platooning was originally designed for highway automated system (AHS) . But with the evolution and development of wireless networks and vehicle control technology, platoons can be implemented as a part of intelligent transport , in partial automated vehicles as Cooperative Adaptive Cruise Control (CACC) vehicles. Close-following abilities of the CACC vehicles enable the vehicles to be in tight platoons. Although there are many benefits by the platoons, in order to get this right high cooperation between the vehicles is required. This is achieved with the help of a highly organized platoon management protocol.

II. RELATED WORK

We shall discuss here about the platoon formation design based on clustering and elaborate more on the cooperative collision avoidance at intersections.

A. Clustering

Previous studies discuss about the idea of grouping the highway vehicles into clusters to facilitate communication and emphasize on the impact of the design of the clusters, e.g., size and geographical span on communication quality. A comprehensive analysis that integrates the effects of the three important factors on VANETs which are the Media Access Control (MAC) operations at the Data Link layer, the wireless channel conditions at the Physical layer, and the mobility of the vehicles has been presented.An analytical model with an unsaturated VANET cluster with a Markov chain by introducing an idle state is proposed. On validations by extensive simulations, this model is able to accurately characterize VANET performance. The analysis done by the various simulations reveals intrinsic dependencies between cluster size, vehicle speed, traffic demand, and window size, as well as their impacts on the overall throughput and packet loss of the cluster. Performance evaluation results demonstrate the practical value of the proposed model in providing guidelines for VANET design and management. Christo Ananth et al. [3] proposed a secure hash message authentication code. A secure hash message authentication code to avoid certificate revocation list checking is proposed for vehicular ad hoc networks (VANETs). The group signature scheme is widely used in VANETs for secure communication, the existing systems based on group signature scheme provides verification delay in certificate revocation list checking. In order to overcome this delay this paper uses a Hash message authentication code (HMAC). It is used to avoid time consuming CRL checking and it also ensures the integrity of messages. The Hash message authentication code and digital signature algorithm are used to make it more secure . In this scheme the group private keys are distributed by the roadside units (RSUs) and it also manages the vehicles in a localized manner. Finally, cooperative message authentication is used among entities, in which each vehicle only needs to verify a small number of messages, thus greatly alleviating the authentication burden.

This model represents a new approach for the performance study of VANET. In particular, the system measures that quantify the effects of cluster design criteria on VANET performance have been derived. Such measures can be used to determine the suitable cluster size, typical network span, and adequate data traffic control to achieve the desired system reliability and network throughput. The proposed model and analysis provided guidelines for the design and management of VANETs to maintain acceptable communication performance. The idea of this paper can be extended by using the cluster model to incorporate inter-cluster routing, channel allocation, and interference management.

B. Platoon enabled VANET

This paper aims in developing a DA (Disturbance adaptive) Platoon architecture. Authors putforth the idea of a platoon controller that adapts to the disturbance scenario and shall consider both VANET and platoon dynamics requirements.

- Based on a specific realization of the DA-Platoon architecture, the traffic dynamics inside a platoon is analysed and the desired parameters, including intraplatoon spacing and platoon size, which satisfies VANET constraints under traffic disturbance is discussed.
- It has been discussed that driving vehicles in a platoon architecture alleviates all the driving discomforts caused to the driver.
- To mitigate the adverse effects of traffic disturbance, and to determine the interplatoon spacing a driving strategy for the leading vehicle of a platoon is discussed.
- Finally, extensive simulation experiments, which not only validate the analysis but also demonstrate the effectiveness of the proposed driving strategy is elucidated in this paper.

To implement the platoon ACC (Autonomous cruise control) is used.The ACC system with laser or radar sensors can obtain the distance to the preceding vehicle and regulate the movements of individual vehicles in a platoon.This paper mainly focusses on investigating the dynamics of a VANET enabled platoon under traffic disturbances and the specifications .

Specification Of DA-Platoon Architecture:

- Platoon Parameters: Intraplatoon spacing is the distance between adjacent vehicles in the same platoon, and interplatoon spacing is the gap between the tail of a preceding platoon and the leader of the next platoon.
- Knowledge of Traffic Information: To acquire traffic information, it is assumed that each vehicle is equipped with a Global Positioning System and other sensors that can collect all needed local information from neighbors, including acceleration, velocity, location, direction, etc.
- VANET Communication Model:From a physical-layer perspective, many factors may affect VANETconnectivity, such as transmission range, transmit power, data rate, interference,etc.,In this paper, the authors consider only the transmission range as the major impact on VANET connectivity. Moreover,to reliably deliver data among vehicles, ideas to maintain the topology of the VANET even under disturbances is mentioned.
- Platoon Driving Strategy: Due to strong interaction among adjacent vehicles within the same platoon, a driving model for the cars in the platoon is mentioned in this paper.

  With all the above mentioned features this analysis aims at implementing a DA- platoon architecture that mitigates the shortcomings mentioned and enhances the driving experience thereby, promoting the intelligent transportation system to a higher level of sustainability.

C.Cooperative collision avoidance at intersections

Vehicle-to-vehicle (V2V) communication technology to implement computationally efficient decentralized algorithms for two-vehicle cooperative collision avoidance at intersections have been proposed earlier. This is done by designing controllers on board of each vehicle that use V2V communication in order to negotiate the intersection and apply automatic control only when it is absolutely necessary.The algorithms employ formal control theoretic methods to guarantee a collision free (safe) system, while overrides are applied only when necessary to prevent a crash. Model uncertainty and communication delays are explicitly accounted for by the model and by the state estimation algorithm.The software implementation part of this particular paper includes estimation,communication and control.The algorithm comprises of computing a capture set and a bad set .The comparison of these two sets will result in a set of parameters that will help in the collision determination.The bad set is generated by taking advantage of the order preserving properties of the dynamics with respect to state and input.The major contribution of this paper is an experimental validation of the algorithm proposed above on two instrumented vehicles engaged in an intersection collision avoidance scenario in a test track.This experimental validation was given based on the results noted on an experimental setup that was created. No trajectories generated by the experiments ever entered the bad set, hence all collisions were averted. Also, the trajectories passed fairly close to the bad set, indicating that the control algorithm is non-conservative as expected from theory.

III. EXISTING SYSTEM AND PROPOSED SYSTEM

A. EXISTING SYSTEM

In the existing system vehicles are grouped together into clusters called platoons and V2I (vehicle to infrastructure communication) takes place. The vehicles try to communicate with the Road Side units(RSU) for obtaining information about the other vehicles as well as network related information .Due to the highly dynamic nature of vehicles in VANET ,there would be a need to switch between multiple RSUs to obtain the required information .This switching over between multiple RUSs cause , a transmission delay or latency which leads to unreliable communication. Most of the existing studies on the system focuses mainly on maintaining the platoon stability they do not focus on mitigating the transmission delay or reducing any other discomforts.

B. PROPOSED SYSTEM:

Using VANET to implement (ITS) in which the 6number of accidents can be reduced. The main aim of the paper is to propose a system that can mitigate the accidents in a highway by avoiding the collision between vehicles. For this purpose , a Cooperative Collison Avoidance System is designed which avoids accidents by sending alert messages to the respective vehicles of the a particular platoon via a leader node called the Platoon leader .This is implemented using two algorithms namely Message Prioritization Algorithm and Greedy Algorithm . This system also reduces the latency caused due to the V2I communication as the V2I communication is replaced by V2V communication where each and every vehicle communicates with one another directly. In this, messages are transferred from source to destination through the optimal paths identified with the help of adversary and clone nodes . The alert messages are prioritized when there are many sources flooding the same destination with multiple messages .

IV. ALGORITHMS USED :

Following algorithms are used to implement the prioritization of messages

- XED, EDD algorithms
- Prioritized Message Passing algorithm
- Greedy Algorithm

A. EXTREMELY EFFICIENT DETECTION (XED)

During message passing, the XED and EDD algoirthms are used. The XED algorithm is used for the following reasons .

- To detect if the nodes are already authorized to communicate or not
- To find if the nodes are within the range or not .To detect if the availability of the channel .

The algorithm works in two modes:

- **Online mode:** In this mode , the nodes are active and keep checking the path for communication i.e. check the shortest path between the source and the destination and also finds if the communication channel between the source and destination node is busy or not .
- **Offline mode:** In this mode, lists about the number of nodes between the source and destination, nodes that have already checked the channel availability are all maintained.

// this algorithm is performed by node N at each time t
//N_d is the node distance

Step 1 : Set D = arbitrary value
Step 2 : If $N_d \leq D$
//The node is authorized
Step 3 : Else
//The node is unauthorized
Step 4 : If channel is busy
Set C=1
Step 5 : Else
Set C=0
Step 6 : Stop

B. EFFICIENT DISTRIBUTED DETECTION (EDD)

The algorithm is used to establish the communication between the various nodes in the VANET. Like XED, EDD also works in both online and offline mode.

// This algorithm is performed by node u at each time t
//$v_1 \ldots v_d$ are the neighbours of u
//L[v] is the list containing visited nodes
Step 1: Broadcast beacon b_u such that b_u contains (V_{id}) the ID of u
Step 2: If node is not sender receive beacons
Step 3: Add V_{id} to the list L[v]
Step 4: Repeat steps 1 to 3 until all the nodes receive the id.
Step 5: Stop

C. PRIORITIZED MESSAGE PASSING ALGORITHM

The algorithm is mainly implemented to prioritize the incoming messages between the source and destination. A single destination node may have many source nodes and at times can be flooded with multiple messages from various nodes. In order to overcome the flooding of messages. They are sent to the destination node based on priority. The algorithm follows the following steps:

Step 1: Checks the nodes for messages
Step 2: If too many messages arrives then tries to send the messages based on priority
Step 3: Compares the message priority
Step 4: if
//message 1 has greater priority than message 2
priority(msg1) > priority(msg 2)
Step5: then
Enqueue message 1 to the first position .
Step 6: Perform Step 4 for all the incoming messages and create a sorted list
Step 7: Send messages to the destination in the order as in the sorted list.

D.GREEDY ALGORITHM

All the above mentioned algorithms hold good only when the nodes are authorized to communicate. When certain nodes are out of the communication range and they want to communicate with others they cannot communicate directly. This can happen only through a leader node. This algorithm is used to establish communication with the unauthorized nodes. The algorithm is as follows

Step 1: Identify the unauthorized node
Step 2: Identify the node closest to the unauthorized node.
Step 3: Send information about the unauthorized node to the nearest platoon leader through the node closest to it.
Step 4: Determine whether the source node is closer to the node identified in Step 2 or to the leader of the same
Step 5: If the source node is closer to the destination node then the communication is done directly using multi hop technique.
Step 6: Otherwise the source node communicates to the platoon leader of the node identified in step 2 and performs a multihop communication through the platoon leader.

V. OVERALL WORKING

After implementing the algorithm, the flow of the system goes as depicted in the Figure .a

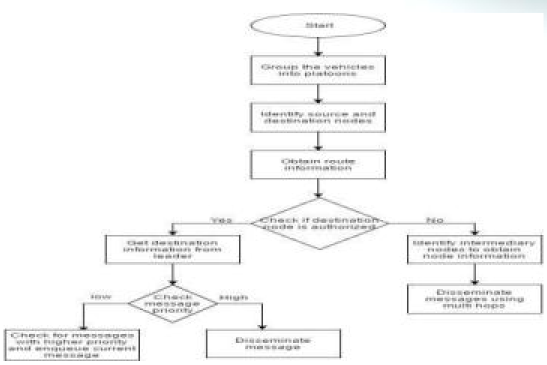

Figure.a

VI. PERFORMANCE MEASURES

The proposed system is evaluated for performance based on the following metrics.

- Throughput: It is the average of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second or data packets per time slot. In table 6.1 the throughput calculation is shown.

throughput= [illegible]

Table 6.1 Throughput Calculation

Performance Measures	Received Data (packets)	Data Transmission Period (ms)
Existing System	35	8
CCA	45	8
Throughput	35	45

Increase in throughput = (45-35)/45*100=22.22%

- Packet loss: It is the number of packets lost when they are intended to be delivered between a source and destination or between different communicating nodes. The more the number of packets lost the lesser the reliablity of the system becomes .

Packet loss = Generated Packets - Received Packets

Table 6.2 Packet Loss Calculation

Performance Measures	Existing System	CCA system
Generated Packets	29	84
Receieved Packets	26	83
Packet Loss	3	1

Percentage decrease in packet loss : (3-1)/3*100=66.66%

- End to end delay : This is the delay involved between the sending and receiving time .When there is more delay, high latency becomes involved which reduces the performance of the system .

Table 5.3 End To End Delay Graph

Performance Measures	Existing System	CCA system
Sending Time	36	18
Receiving Time	12	10
End to End Delay	24	8

Percentage Decrease in end to end delay

=(24-8)/24*100=66.66%

Thus from the above metrics and calculations it is proven that the proposed system is efficient than the existing system .

VII. CONCLUSION AND FUTURE ENHANCEMENT

Thus by using the proposed system the need to switch over between different RSUs is eliminated by facilitating direct V2V communication. It also makes sure that the safety messages that have higher priority are transmitted prior to other messages that hold a lower priority. This way we reduce the negative impacts caused due to the loss of important messages. The communication with the unauthorized nodes that do not come under the range of neither of the platoons has also been established. The future work may focus on load balancing of messages and on a more reliable packet delivery.

REFERENCES

[1] Dongyao Jia, Kejie Lu and Jianping Wang (2014) 'A Disturbance-Adaptive Design for VANET-Enabled Vehicle Platoon'- IEEE transactions on vehicular technology, Vol.63, No.2.

[2] Huxian Wang, Ren Pin Liu, Wei Ni (2015) 'VANET Modeling and Clustering Design Under Practical Traffic Channel and Mobility Conditions'.

[3] Christo Ananth, M.Danya Priyadharshini, "A Secure Hash Message Authentication Code to avoid Certificate Revocation list Checking in Vehicular Adhoc networks", International Journal of Applied Engineering Research (IJAER), Volume 10, Special Issue 2, 2015,(1250-1254)

[4] Tanwee Kausar, Priyanka Gupta, Deepesh Arora, Rishabh Kumar (2013) 'A VANET based Cooperative Collision Avoidance System for a 4-Lane Highway' Published in 16th IEEE Annual Conference on Intelligent Transportation Systems (ITSC 2013), The Hague, The Netherlands.
.