Rapidly Exploring Random Trees for Improved V2V Communication using Location Information

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ABSTRACT—This paper has proposed a Rapidly Exploring random tree algorithm to reduce the routing burden and to increase the routes' life time in VANET (Vehicular ad-hoc network) environment. Then it has been combined into the LAR (Location-aided routing) protocols to see the performance. After the simulation work done by the Qualnet simulator, the result shows much obvious improvement in data transmission. In VANET environment, the nodes' fast movement leads the increasing of the redundant node number in the route, and also leads the increasing of the route maintenance consumption.

I.INTRODUCTION

Vehicular Ad-hoc Networks (VANETs) present a unique set of challenges that require the integration of advanced technologies in the rapidly changing field of vehicular communication. These networks need effective routing protocols to provide dependable Vehicle-to-Vehicle (V2V) communication because of their highly mobile and dynamic nodes. The routing load brought on by the frequent topology changes in VANETs is a major problem that increases packet loss, latency, and network congestion.

This project suggests a novel method that combines Location-Aided Routing (LAR) protocols with Rapidly Exploring

Random Trees (RRT) to address these issues and improve V2V communication performance.

Our approach aims to reduce the routing burden, extend route lifetimes, and enhance data transmission efficiency in VANET environments by utilizing RRT algorithms, which efficiently explore the network topology, and incorporating location information into routing decisions.

This project is driven by the urgent need to improve the efficiency and dependability of vehicle-to-vehicle (V2V) communication systems, which are essential for enabling a number of applications, including infotainment services, traffic management, and warnings about oncoming hazards. Due to their inability to handle the dynamic nature of VANETs, traditional routing protocols frequently produce subpar performance and deteriorated communication quality.

We envision a solution that improves route selection, becomes more robust overall, and dynamically adjusts to changing network conditions through the integration of RRT algorithms into LAR protocols. Our approach aims to transform the way cars communicate on the road and create safer, more dependable, and efficient vehicular networks by utilizing the power of location-awareness and rapid exploration. This project aims to address the inherent challenges of VANETs and

II. LITERATURE SURVEY

[1] The accuracy of the new algorithm, we chose two famous reference routing protocols which are AODV and LAR. After adapting those two protocols, we compare them with the original protocols at several parameters, such as the CBR server throughput, packet delivery success rate and etc. Most of them have demonstrated that our algorithm have improved the performance of the protocols greatly.[2] The presented method is more reliable as compared to the existing techniques. The cluster formation in the rhombus shaped network using presented method provides less network overhead and delay in different protocols whereas high throughput packet delivery ratio, mean and standard deviation while transmitting the data through the cluster heads in different protocols.[3] the communication model of the VANET to reduce service request and response delay; on the other hand, we will further study the location privacy mechanism to meet the introduce a novel methodology that will further the ongoing efforts to advance vehicular communication technologies., the packet delivery ratio is improved with a reduction in the average transmission delay. Our proposed mechanism performs better at low speed and higher vehicle density due to increased network connection time. With the increase in vehicle speed, the network connection time decreases. Thus, it degrades the performance of the

system.

III.PROBLEM STATEMENT

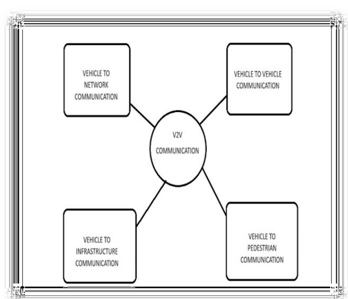
In the context of Vehicular Ad-hoc Networks (VANETs), Efficient data transmission and routing are significantly challenged by the dynamic and highly mobile nature of vehicles. The inability of current routing protocols to adapt to the quick changes in network topology results in higher packet loss, latency, and congestion. Moreover, conventional methods frequently fall short of efficiently utilizing location data, which restricts their capacity to adjust to the particularities of automotive environments The need for a novel routing solution that can reduce routing burden, extend route lifetimes, and boost data transmission efficiency in VANETs is the main issue this project attempts to solve. The project's specific goal is to create a routing algorithm that maximizes the performance of V2V communication by utilizing Rapidly Exploring Random Trees (RRTs) and seamlessly integrating them with Location-Aided Routing (LAR) protocols.

IV.ALGORITHM

In our project, the algorithm is essential to the coordination of a complex location sharing and vehicle-to-vehicle communication system. The Random Tree (RRT) algorithm, which is strategically used to guide vehicles through dynamic environments while taking communication constraints into account, is at the heart of it. Setting up communication channels and sensor systems, including GPS, IMUs, and proximity sensors, is the first step of the algorithm. It then moves into a main loop, where every vehicle collects sensor data on its own, connects to other nearby vehicles via a communication link, and applies the RRT algorithm to create viable routes. Motion planning and control modules then painstakingly translate these paths into precise control inputs, guaranteeing optimal performance and safety. In the meantime, systems for detecting and avoiding collisions stay alert, constantly scanning the environment for threats and evading them when necessary. Until the termination conditions are satisfied or the navigation goals are met, this iterative process is carried out until the system gracefully ends its operation. Our system enhances traffic management and road safety by enabling vehicles to navigate safely, efficiently, and adaptively in dynamic environments. This is achieved through the seamless integration of the RRT algorithm and complementary modules.

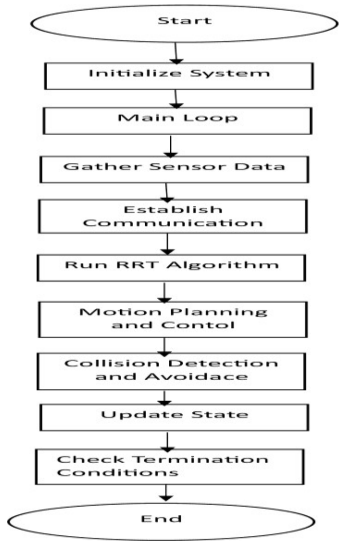
A. Block Diagram

The architecture of our project, which is focused on enabling secure and effective vehicle-to-vehicle communication and navigation, is shown in the block diagram. The Vehicle-to-Vehicle Communication module, at the center of the system, allows cars to easily exchange relevant data and location information. This module communicates with the Environment Perception component, which collects real-time environmental data, including obstacle detection, using a variety of sensors including GPS, IMUs, and proximity sensors. Simultaneously, the RRT (Rapidly-exploring Random Tree) Algorithm module functions to quickly investigate viable routes while taking communication limitations into account, which is essential for dynamic navigation situations. A key component is the Collision Detection and Avoidance
module, which uses sensor fusion techniques to forecast collision risks, produce evasive maneuvers, and guarantee safe navigation



A. Working

Our project's main goal is to use location exchange and vehicle communication to enable safe and effective navigation in dynamic environments. The Rapidly- exploring Random Tree (RRT) algorithm, which is specifically engineered to explore feasible paths while adhering to communication constraints, is the brains behind our system. Every car continuously gathers sensory information through environment perception modules that use sensors like proximity, GPS, and IMU. By exchanging vital location data, this data gathering allows vehicles to establish crucial communication links with nearby counterparts. After that, the RRT algorithm maps out feasible paths by analyzing received location data and local sensor inputs, taking communication constraints and dynamic obstacles into account. The RRT outputs are then used by motion planning and control modules to calculate accurate control inputs, which guarantee both safety and optimal performance during navigation. Together, the systems for collision detection and avoidance stay alert, constantly scanning for possible threats and taking appropriate evasive action when needed. Our system improves traffic management and road safety standards by enabling vehicles to navigate safely, effectively, and adaptively in dynamic environments through this iterative process.



V. CONCLUSION

Our project shows how cutting-edge navigation algorithms and vehicle-to- vehicle communication can be successfully integrated to improve efficiency and safety in dynamic environments. We have made it possible for vehicles to navigate autonomously while taking into account communication constraint and dynamically changing obstacles by implementing the Rapidly-exploring Random Tree (RRT) algorithm. By means of constant data collection from sensors such as proximity, GPS, and IMU, cars create communication channels, share critical position data, and modify their routes accordingly. Motion planning and control modules are employed to guarantee accurate navigation, and collision detection and avoidance mechanisms are employed to augment safety by anticipatorily addressing potential hazards. In the end, our system gives cars the ability to navigate in a safe, effective, and adaptive manner, which helps to raise road safety standards and traffic management. Future developments in autonomous vehicle technology and communication protocols should lead to even more improvements in transportation systems, which will make driving safer and more effective in the future.

VI. FUTURE ENHANCEMENT

We can investigate multiple avenues to further enhance our project's capabilities in the future. While advanced communication protocols could increase the effectiveness of data exchange, integrating machine learning algorithms could improve flexibility and decision-making. Real-time navigation would be optimized through the use of cooperative multi-agent systems and dynamic replanning mechanisms, particularly in crowded areas. Safety and accuracy could be further improved through

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