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Vehicle to vehicle communication and message updation

Dr. Chanda V Reddy[1], Manjunath K[2], Shrikumar B[3], Suhas P Chindi[4], Chandrashekhara Swamy T[5]

Head of Dept CCE, Computer and Communication Engineering, K S Institute of Technology, Bangalore, India[1]

Student, Computer and Communication Engineering, K S Institute of Technology, Bangalore, India[2-5]

Abstract: A key component of Intelligent Transportation Systems (ITS), vehicle-to-vehicle (V2V) communication allows direct wireless communication between automobiles to improve road safety, ease traffic, and facilitate autonomous driving. The development of V2V communication protocols is examined in this literature review, with particular attention paid to updating systems, message distribution, and real-time data dependability. According to studies, efficient traffic management and collision avoidance depend on timely and context-aware message updates. To maximize data delivery in extremely dynamic vehicular environments, a number of models have been proposed, including broadcast-based, cluster-based, and machine learning-enhanced communication frameworks. The main conclusions and approaches are compiled in this review, which also highlights the present difficulties and potential paths forward for reliable V2V communication systems.

Keywords: Intelligent Transportation Systems (ITS), message distribution, Embedded C , ESP32 Microcontroller, broadcast-based

I. INTRODUCTION

Vehicle-to-Vehicle (V2V) communication has become a crucial part of Intelligent Transportation Systems (ITS) due to the quick development of wireless communication and vehicular technology. By facilitating the sharing of real-time data between adjacent vehicles, including position, speed, acceleration, and braking status, V2V communication promotes cooperative awareness and better roadside decision-making. By lowering human error, a major contributor to traffic accidents, V2V communication aims to improve road safety and traffic efficiency. The smooth and prompt transfer of messages between cars is essential for applications like cooperative adaptive cruise control, lane-change assistance, and collision avoidance.Message updation, or the constant and context-aware improvement of broadcasted information, is a crucial component of successful V2V systems.

II. LITERATURE SURVEY

The potential of vehicle-to-vehicle (V2V) communication to transform traffic efficiency and road safety has garnered a lot of research interest. By allowing direct wireless communication between vehicles without the need for fixed infrastructure, it serves as the foundation for cooperative vehicular systems.

Hartenstein and Laberteaux [15] One of the earliest studies on vehicular ad hoc networks (VANETs) who emphasized the function of the IEEE 802.11p standard for Dedicated Short-Range Communications (DSRC). The foundation for V2V communication protocols that are optimized for high mobility and low latency—two critical factors in vehicular environments—was established by their work.

Biswas et al. [19] A decentralized method for spreading emergency messages in VANETs was To guarantee that important messages, like collision alerts, were disseminated, their system used dynamic rebroadcasting based on vehicle density and position.

Tonguz et al. [3] (2010) In order to handle redundant data, the Distributed Vehicular Broadcast (DV-CAST) protocol, which includes a message filtering and priority system. By ensuring that only up-to-date and contextually relevant messages are transmitted, their Dynamic Information Dissemination concept helps to save bandwidth and cut down on communication delays.

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Abdrabou and Zhuang [11] (2011) In order to solve the problem of message delay,suggested probabilistic delay-bounded routing protocols. Their method took into account the safety message expiration time and chose forwarding vehicles in a dynamic topology according to their capacity to fulfill delivery deadlines.

Talebpour and Mahmassani [8] (2016) The application of machine learning to V2V systems to maximize message transmission has been investigated in recent research. Reinforcement learning algorithms were used by to improve message relevance and network stability by enabling cars to modify their broadcasting patterns and message update rates in response to traffic and environmental conditions.

[6] In (2017) This study offered a machine learning-based method for V2V message classification and prioritization. The system reduced channel congestion by making sure that only important messages were broadcast frequently based on traffic and environmental context.

[7] In (2004) In order to ensure efficient alert distribution over wider areas, developed a multi-hop broadcast protocol that included positional awareness to cut down on redundant messages in sparse networks.

[8] Controlling congestion in V2V networks was the focus of In (2010) order to balance bandwidth utilization and communication reliability under fluctuating traffic loads, they implemented adaptive rate and power control mechanisms.

[9] This study focused on named-data dissemination rather than node addresses and presented a content-centric networking model (2012) for V2V communication. Regular metadata updates decreased broadcast storm issues and improved data discovery.

[10] IEEE 802.11p MAC operations were improved in the paper by Torrent-Moreno et al. (2009) to enable dependable and frequent broadcast updates. Priority queuing and adaptive back-off were two strategies used to control high-density message flows.

[11] This extensive implementation assessed V2V communication performance under real-world circumstances as part of the USDOT's Connected Vehicle Safety Pilot.(2013) It offered factual information on latency, message delivery rates, and the significance of timely updates.

[12,13] Road topology's impact on message propagation in urban VANETs was examined by(2007) Their mobility model illustrated how updates' reachability and freshness were affected by physical layout.

In their study, assessed various methods of disseminating information and how well they supported collision avoidance systems. They discovered that keeping the system responsive required managing the refresh rate and message lifetime.

[14] A probabilistic broadcast scheme (2007) that modified rebroadcast intervals according to vehicle speed and direction was In urban settings, it greatly increased the effectiveness of message propagation.

[15] A hybrid V2V-cloud architecture that synchronized real-time vehicle messages with cloud databases. This made it easier to access historical data (2018) and perform predictive analytics for applications related to safety and traffic.

III. PROBLEM IDENTIFICATION

Vehicle-to-Vehicle (V2V) communication systems have advanced significantly, but a number of significant obstacles still stand in the way of their widespread adoption and operational efficacy. The literature identifies important issues that still affect V2V communication's scalability, efficiency, and dependability, particularly when it comes to real-time message updating.

1. **Broadcast Storms and Message Redundancy:** Repetitive broadcasting of identical messages causes broadcast storms, bandwidth waste, and message redundancy in high-traffic environments. Current protocols frequently have trouble efficiently filtering or suppressing duplicate and out-of-date messages.
2. **Safety-Critical Update Latency:** It is critical that safety messages are delivered on time. However, messages frequently experience delays as a result of fluctuating vehicle speeds, changes in network topology, and channel contention, which lowers the efficacy of collision warning systems.
3. **Inadequate Message Update Strategies:** A lot of current protocols are unable to effectively update messages according to traffic context, vehicle mobility, and direction. Vehicles may therefore make unsafe decisions based on outdated or irrelevant information.

IV. APPLICATION

- **Systems for Avoiding Collisions:-**Vehicles can exchange position, speed, and direction data in real time thanks to V2V communication.
- **Warning of Traffic Signal Violation:-**Message broadcasts can be used to alert cars approaching a signalized intersection to a red-light violation.
- **Notification of Emergency Vehicles:-**Nearby vehicles can receive priority messages from emergency vehicles, telling them to move aside.
- **Lane Change Assistance:-**Cars alert other cars to planned lane changes and their current location.
- **Reduction of Traffic Congestion:-**Better route planning and congestion avoidance are made possible by real-time data sharing.
- **Accident Notification and Rerouting:-**When there is an accident or a road closure, vehicles can immediately alert other nearby residents.

V. CONCLUSION AND FUTURE SCOPE

Direct, low-latency data exchange between vehicles is made possible by vehicle-to-vehicle (V2V) communication, which has the potential to revolutionize contemporary transportation. Numerous protocols and models have been put forth to address the issues of real-time communication, message relevancy, latency, and network scalability, as this literature review makes clear.

To improve system responsiveness and safety, important strategies like context-aware message prioritization, delay-aware routing, and dynamic information dissemination have been investigated. Notwithstanding these developments, V2V networks continue to encounter significant challenges in guaranteeing reliable message updating, particularly in situations involving dynamic and dense traffic.

Even though V2V communication systems are promising right now, safe, effective, and intelligent vehicular networks will require ongoing innovation in message updating techniques.

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