Simulation of Accident and Jamming Event Message Generation in VANET

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***Abstract*—Ensuring trust in Vehicular Ad-Hoc Networks (VANETs) is crucial. Since the message relay policy can affect the traffic on the road significantly, we investigate the effect of the message relay policy through simulation in this paper. The simulator is designed for VANETs, effectively modeling accidents and jamming events. Simultaneously, our relay policy strengthens communication reliability. In the trust-centric domain of VANETs, our solutions aim to significantly enhance reliability and security.**

Keywords— VANET, clustering algorithm, event message, blockchain, simulator

I. INTRODUCTION

Vehicular Ad-Hoc Networks (VANETs) stand as sophisticated wireless communication systems, facilitating the real-time exchange of critical event messages between vehicles and roadside units. Leveraging the advanced cellular 5G NR V2X technology [1], these networks are meticulously engineered to meet stringent requirements, including low latency, consistent reliability, and high bandwidth. The fundamental communication modes within VANETs, namely vehicle-to-vehicle, and vehicle-to-infrastructure, are instrumental in enhancing road safety and mitigating accidents.

In this research endeavor, Our primary focus revolves around the implementation of policies governing event message relay within the VANET framework. Specifically, we delve into two distinct approaches: relay-on-event messages and no relay-on-event messages. Our exploration is centered on the nuanced application of the relay policy for event messages. This strategic decision entails a comprehensive examination of the relay mechanism, offering insights into its potential impact on the overall reliability and efficiency of event message management within VANETs.

A. Related Work

An event message clustering algorithm, called VEMCA [2], is used for VANETs, and VEMCA eliminates the need for a predefined K-value, was proposed by Narayan et al., focusing on sequential clustering of event messages based on their event type, making it highly adaptable to the evolving nature of reports generated over time. VEMCA's output comprises a collection of clusters, each associated with a specific event type. By combining this clustering approach with blockchain technology, the trust of vehicles might be managed effectively. A blockchain is made up of a timestamp and transaction information that connects it to the preceding block. As a result, every block links to the next, forming a “chain” of blocks and producing safe and immutable records [3].

II. PROPOSED WORK

In our proposed work, we have implemented a policy for the relay of event messages within our simulator. Our simulator is designed to replicate real-world scenarios, and we have focused on two primary event types: accidents and traffic jams. An accident is defined as an event in which one or more vehicles hit in a way that may lead to loss of life, injury, or vehicle damage, resulting in a traffic blockage on the road [4]. Within the simulator, we've created a dynamic environment. Here's how it works: When a vehicle within the simulator encounters an obstacle, such as a traffic jam or accident, it employs a relay mechanism. This means that the vehicle shares information about the event with surrounding vehicles that fall within a predefined clustering boundary. This relayed information is reported as event messages, allowing for the dissemination of crucial information within the simulator.

A. Relay policy on event message

In the "Relay on event messages" scenario, the simulator employs a relay policy for accidents and traffic jams. When these events happen, the simulator actively transmits messages to relevant recipients in the VANET network, ensuring efficient dissemination of critical information for real-time awareness and response. This active relay policy enhances communication and cooperation in the VANET ecosystem during event-driven situations. In the "No relay on event messages" scenario, the simulator refrains from actively relaying accident and traffic jam messages. Instead, it avoids widespread dissemination to conserve network resources or focus on events directly impacting the simulator's environment, highlighting more localized handling within the VANET simulation. In our paper, we implemented a relay policy for accidents and traffic jams in our simulator.

III. OUTLINE OF SIMULATOR

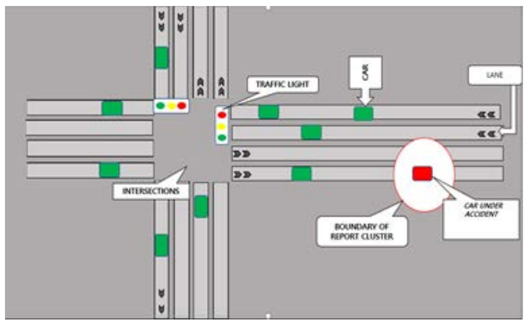


Fig. 1. Outline of simulator

The simulation was created using the Pygame module, which is used to create applications such as video games using Python programming language. Our simulation encompasses essential functions of car movement, report generation, and clustering [2]. It includes five object types: roads, lanes, cars, event reports, and clusters. The VANET simulator allows cars to change lanes, generate reports, and integrate traffic lights for smooth intersection management. The simulation follows a structured sequence, starting with user-defined road and lane object creation, followed by regular events and operations guided by these events.

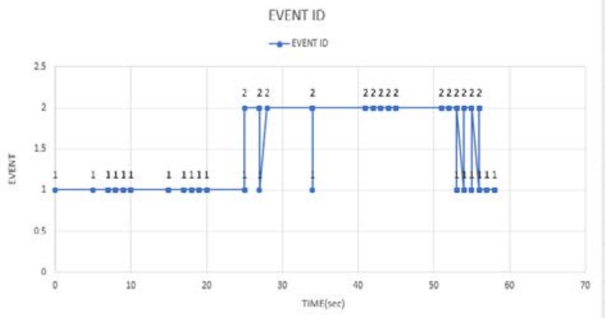
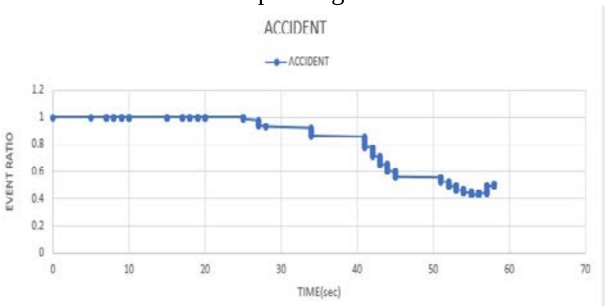


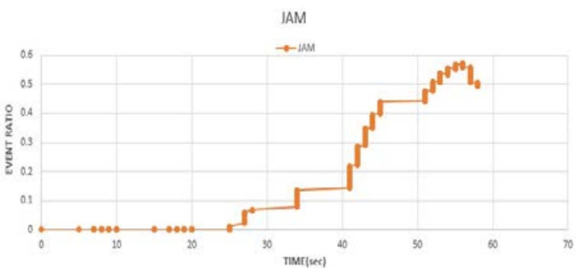
Fig. 2. Data on accident and jam events collected over time

IV. EXPERIMENTAL RESULTS

We did this experiment with the relay policy method by using our simulator, which reports the event messages, and we have set the time for moving and adding cars in milliseconds. These will be updated in batches to report event messages in the simulator. The graph distinguishes between two key event types: Event 1 (accidents) and Event 2 (traffic jams) as shown in Fig.2. Accidents often lead to traffic jams, which are more frequent in this scenario. A car's position and time duration influence its ability to move without obstructions. If an accident occurs, the car halts and reports Event 1 (accidents). If it remains stationary, an accident report is sent. Otherwise, it's marked as Event 2 (traffic jams). We have run the stimulator with a limit and collected some data, as shown in Fig. 4. It also measures the duration of a car's halt, and if it exceeds 5 seconds, it's reported as Event 2 (traffic jams). This approach provides insight into how accidents and jams affect traffic flow and the corresponding actions taken.



A. Accident message ratio over time



B. Jamming message ratio over time

Fig. 3. A comparative analysis of the accident and jamming event ratios

As we analyze a graphical representation that quantifies the relationship between accidents and traffic jams, it becomes apparent that this event ratio has a notable impact on traffic flow within our simulator, as shown in Fig. 3. The data reveals that when the frequency of accidents rises, there is a corresponding increase in the occurrence of traffic jams. This interconnection highlights the importance of addressing accidents to effectively manage and mitigate traffic congestion in our simulation.

DATASETS

X	Y	TIME	EVENT ID
691	144	1698033721	1
691	144	1698033723	1
691	144	1698033727	1
.	.	.	.
526	184	1698033780	2
309	164	1698033781	2
741	144	1698033783	2

Fig. 4. Dataset for simulator

V. CONCLUSION

Our paper presents a novel approach to relay event messages, highlighting the impacts of accident and jam messages in our simulator. The simulator serves as a valuable tool for understanding event dynamics. Future research will explore a no-relay policy to enhance the reliability and efficiency of event message management in VANETs.

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