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A SECURE REAL TIME EMBEDDED VEHICLE TO VEHICLE COMMUNICATION SYSTEM

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Abstract : More people die in car accidents each year than in all the deaths caused by cancer, heart disease, and natural disasters put together. According to studies, if drivers were alerted half a second before an accident, almost 60% of such incidents might have been avoided. Delays in the distribution of emergency notifications are caused by the limited perception of human drivers during road emergencies. The goal of this paper is to decrease traffic accidents by implementing a system that notifies drivers in advance of impending speed-related collisions and by allowing cars to access the speed data of the vehicle ahead of them. This will allow an intelligent speed control system to regulate the car's speed independently of the driver's reaction. The neighboring vehicle's speed is recorded by a specialized electronic control unit using a wireless radio. A comparison is carried out between the two data units that employ the Control Area Network (CAN) protocol to establish connection. One area where CAN protocol finds widespread application is in the automotive sector; it enables several controllers to communicate with one another independent of a host computer. After comparing the two cars' speeds, the one in question will slow down to match the neighbor's pace. When compared to conventional communication modules, the NRF Module makes Vehicle-to-Vehicle (V2V) communication more efficient and reduces latency. A gas detector, an alcohol detector, and proximity sensors are all part of this vehicle-to-vehicle system, which could reduce the number of accidental fatalities.

*Keywords- C*ontrol Area Network, Vehicle-to-vehicle, electronic control unit, Message based communication, Motor Driver.

I. INTRODUCTION

Traffic accidents claim more lives than severe diseases and natural catastrophes. Research indicates that approximately 60% of traffic accidents may be prevented if the driver of the vehicle received notice at least half a second before a collision. The limited perception of human drivers during emergency situations on the road causes significant delays in the dissemination of emergency alerts. As a component of car safety systems, the collision warning system lowers the number of collisions. Such a system should be able to support real-time technologies that can alert prospective drivers to an approaching collision in order to be most successful. By regulating the speed of nearby vehicles, the proposed system aims to reduce the likelihood of traffic accidents. Area network controller. In this discourse, we delve into the convergence of Vehicle to Vehicle (V2V) technology, safety, and environmental consciousness. V2V communication is transforming the way vehicles interact on our roadways, which will lead to more intelligent, responsible, and effective transportation systems. This conversation is a testament to the fusion of cutting-edge technology with a commitment to safety and environmental preservation, a promising journey towards a safer, cleaner, and more connected future on the road. The urgency of addressing environmental issues has never been more pronounced, "V2V Aware" stands as a pivotal topic of discussion. V2V represents a revolutionary advancement in transportation, promising to fundamentally transform the way vehicles interact and navigate our roadways. The potential environmental benefits of vehicle-to-vehicle (V2V) technology are substantial, and not limited to the promising future of safer and smarter driving. Using vehicle-to-vehicle (V2V) awareness technology is a springboard to more eco-friendly and secure transportation options. This innovation transcends the traditional view of vehicles, transforming them into intelligent communicators. Through the seamless exchange of real-time data, vehicles can proactively work towards enhancing safety on our roads and reducing the likelihood of accidents. Furthermore, this technology offers a remarkable opportunity to address our environmental challenges by optimizing traffic flow, reducing energy consumption, and diminishing the carbon footprint of our transportation systems. 2 A comprehensive exploration of V2V Aware, delving into its multifaceted implications for safety, environmental sustainability, and the way we move from one place to another. From the intricacies of the technology itself to the profound implications for our society and planet, this discussion embodies a bridge between innovation, safety, and eco-consciousness, steering us towards a future where our vehicles don't just transport us, they guide us towards a safer and greener world. In this discussion, it embarks on a journey through the intersection of V2V technology, safety, and environmental consciousness, shedding light on how this innovative approach is redefining the way vehicles interact on our roadways. It will uncover the intricate web of benefits that V2V communication offers, such as proactive collision avoidance, real-time traffic management, and eco-friendly driving habits. It is a testament to the fusion of cutting-edge technology with a steadfast commitment to safety and environmental preservation, a compelling narrative of progress towards a future marked by safer, cleaner, and more interconnected mobility. The potential of V2V Aware to not only protect lives but also to safeguard the planet by minimizing the environmental impact of transportation. V2V Aware technology champions the vital intersection of safety and environmental responsibility within the transportation sector. No longer confined to their role as mechanical devices, vehicles are empowered to become intelligent entities. This intelligence, fueled by real-time data exchange, holds the promise of safer roads and a reduced environmental impact. In a rapidly evolving world characterized by the ongoing evolution of technology and a growing global concern for both safety and the environment, the emergence of "V2V Aware" presents an opportunity for transformative change. At the core of our quest for safer and more sustainable transportation lies V2V Aware, a technology that reimagines the very nature of vehicles. Gone are the days of isolated mechanical machines; V2V Aware facilitates the evolution of vehicles into a network of intelligent communicators. This exchange of real-time data opens the door to a future where road safety is heightened, and accidents are dramatically reduced.V2V communication has risen to the forefront of modern transportation innovation, offering not only the promise of enhanced road safety but also the potential to make significant strides in reducing our ecological footprint.

II. RELATED WORKS

This investigation delves into the works of renowned experts to provide light on the complex structure of vehicle communication systems, how they will shape intelligent transportation in the future, and the relevance of these systems. To solve the problem of security in vehicle communication systems, Shams et al. [1] suggested a flow-based intrusion detection system for VANETs that makes use of context-aware feature extraction.In their discussion of swarm intelligence and its use in cyberphysical systems, Schranz et al. [2] provide light on possible future developments and difficulties in this field, which may have bearing on how intelligent vehicle systems are designed.For efficient vehicle-to-vehicle (V2V) communication, it is essential to understand the strengths and weaknesses of communication technologies like cellular vehicle-to-everything (C-V2X) and dedicated short-range communication (DSRC), which were tested by Rayamajhi et al. [3].The development of sophisticated driver assistance systems relies on the tools and methodology outlined by Bhat et al. [4]. These authors offer a thorough overview of the current state-of-the-art techniques and technology in the field of autonomous driving systems.To ensure the efficacy of vehicle-to-vehicle (V2V) communication, Arjunan and Kaviarasan [5] presented a prediction-based detection strategy for non-line-of-sight nodes in vehicular area networks (VANETs). This approach addresses the issues related to communication reliability in vehicular contexts.Pressas et al. [6] offered a new way to improve the performance and fairness of vehicle communication systems by using a Q-learning technique to bandwidth-efficient and fair access management in IEEE 802.11p vehicular networks.Reliability and safety of vehicle-to-vehicle (V2V) communication are of the utmost importance. To address security concerns in vehicular networks, Lyamin et al. [7] suggested a data mining-based real-time jammer denial-of-service (DoS) detection strategy for these systems.An important step in creating trustworthy autonomous vehicle technology is building on the theoretical underpinnings of these systems, which Shalevshwartz et al. [8] illuminated with their formal model of safe and scalable self-driving automobiles.An innovative method for effective data distribution in VANETs was suggested by Sun et al. [9] as a V2V routing system based on the autoregressive integrated moving average (ARIMA) model. This method is crucial for enhancing the performance and reliability of communication in vehicular networks. Improving the efficiency and reliability of communication in vehicular environments is essential for supporting emerging applications like intelligent transportation systems and autonomous driving. Mumtaz et al. [10] addressed cognitive vehicular communication for 5G networks, offering potential solutions to this problem.For wireless sensor networks, Yuan et al. [11] suggested a clustering joint annular routing data-gathering scheme based on compressive sensing. This work sheds light on possible methods for efficient data collection in vehicle environments, which is essential for a variety of sensing applications in ITS.It is essential to support growing applications like traffic management and information sharing, and Guo et al. [12] addressed the issues of data distribution in vehicular settings by introducing an effective content dissemination system for cooperative vehicular networks.The Internet of Vehicles (IoV) is crucial for supporting a variety of intelligent transportation applications; Wang et al. [13] addressed the IoV's function in transportation data collecting and dissemination, offering possible ways to improve data collecting and dissemination in vehicular settings.Crucial for the support of vehicle-to-vehicle (V2V) communication applications, Roxin [14] offered insights into IVC technologies by providing a thorough review of communication protocols and techniques that enable communication among cars.In their discussion of vehicle-to-vehicle (V2V) communication's advantages for connected and autonomous cars, Darbha et al. [15] shed light on how these technologies may improve IVS efficiency and traffic safety. Critical to the development of intelligent transportation systems, this literature review examines recent work in vehicular communication systems to give a complete picture of the state of the art in this area. Subjects covered include security, communication protocols, autonomous driving, data dissemination, and vehicle-to-vehicle communication.

III. METHODOLOGY

V2V communication revolutionizes the driving experience, transforming roads into a cooperative network where vehicles share vital data. The exchange of information empowers vehicles to 'see' beyond their immediate surroundings, enhancing safety by proactively anticipating hazards and optimizing traffic flow. As a cornerstone of Intelligent Transportation Systems (ITS), V2V communication is instrumental in reducing accidents and facilitating the seamless integration of Advanced Driver Assistance Systems (ADAS). In the future, this technology will allow cars to collaborate in order to make transportation safer, more efficient, and more predictable.

Enhanced Road Safety: V2V communication transcends the traditional "talking car" narrative, fostering a dynamic ecosystem of real-time information exchange between vehicles. This interconnected network allows vehicles to share crucial data, such as speed, location, and direction, painting a comprehensive picture of the surrounding environment. This real-time dialogue empowers individual vehicles to become more aware of their surroundings, proactively react to potential hazards, and even anticipate the movements of nearby vehicles. By facilitating a collaborative exchange of information, V2V communication paves the way for a future of enhanced road safety, improved traffic flow, and a more environmentally conscious transportation system. Emergency Response: V2V communication can provide vital information to emergency services in the event of an accident. This includes data about the location, severity, and number of vehicles involved in a crash, allowing emergency responders to reach the scene more prepared. The proposed vehicle collision avoidance system represents a cutting-edge approach to road safety. Utilizing wireless transceivers and the CAN protocol, it enables vehicles to exchange critical information, particularly the speed of adjacent vehicles, via dedicated Electronic Control Units (ECUs). Positions V2V as a gateway to a better, more integrated transportation system. Directly connects V2V with accident reduction, efficiency, and smoother traffic flow.

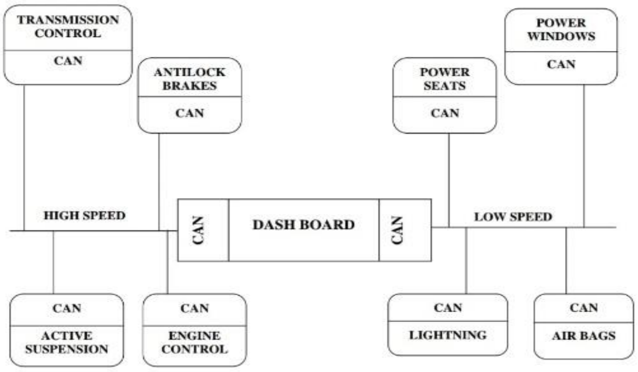

Fig 1. Different devices connected using CAN protocol

Data sharing can include data about the vehicle's speed, position, and heading. By knowing the intentions and actions of nearby vehicles, drivers can make more informed decisions, reducing the risk of accidents. For example, if a vehicle suddenly applies its brakes or encounters an obstacle, it can broadcast this information to surrounding vehicles, allowing them to react more effectively. Accident Reduction: V2V communication holds the potential to notably decrease the occurrence of road accidents. By providing drivers with timely warnings and critical information, V2V technology can help prevent collisions, especially in situations like blind spots, intersections, or sudden lane changes. Traffic Flow Optimization: V2V communication can improve traffic flow and reduce congestion. Vehicles can communicate information about traffic conditions, such as congestion or accidents, to nearby vehicles. There would be less congestion in the roads since drivers can get real-time traffic reports and change their routes appropriately. Rider and Pedestrian Protection: Transmission of data between cars is just one use case for vehicle-to-vehicle communication. It can also include communication with pedestrians and cyclists equipped with V2X (Vehicle-to-Everything) devices. This helps drivers become aware of vulnerable road users, reducing the risk of accidents involving pedestrians and cyclists.

Supporting Eco-Friendly Driving: Vehicle-to-Vehicle (V2V) technology may help drivers be more environmentally friendly by giving them input on how to drive more efficiently, such as keeping a constant speed or lowering how often they brake and accelerate. Both fuel usage and emissions may be decreased using this. V2V communication enhances the capabilities of current ADAS technology, which stands as an advanced driver assistance system (ADAS). In order to improve the performance of adaptive cruise control, lane-keeping assistance, and collision avoidance systems, V2V can supply these systems with more precise and up-to-date data. Traffic flow at crossroads can be enhanced by vehicle-to-vehicle communication, which enables cars to coordinate with one another. This leads to smoother intersection management. This has the potential to increase safety at intersections and decrease wait times at traffic signals.

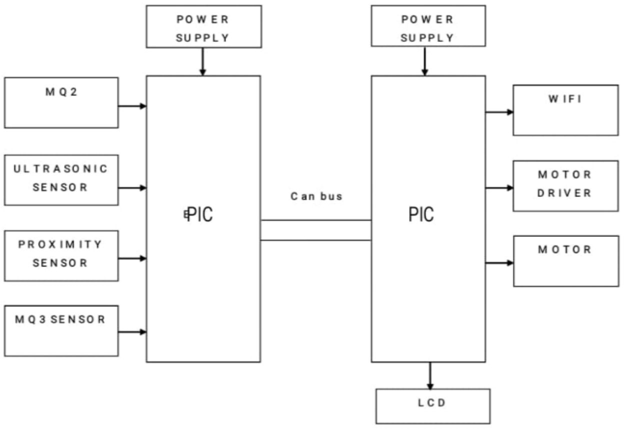

Fig.2 Block diagram of Intelligent Speed Control

The CAN protocol's significance in the automotive industry lies in its ability to facilitate real-time communication among various controllers within a vehicle, eliminating the need for a central host computer. This communication allows the system to continuously compare the speed of the concerned vehicle with that of nearby vehicles. When a significant speed differential is detected, indicating a potential collision risk, the system autonomously intervenes to reduce the speed of the vehicle, enhancing safety on the road. This integrated approach showcases the power of technology and wireless communication in addressing one of the most critical aspects of road safety – preventing collisions. The heart of this system lies in its ability to continually compare the speed of the host vehicle with that of its neighbouring counterparts. When the system detects a significant difference in speed, signifying a heightened safety system, reshaping the way vehicles interact and safeguarding passengers and road users alike. Enhanced Road Safety: V2V communication allows vehicles to share real-time data, such as speed, position, and heading, with nearby vehicles. This enables advanced driver assistance systems (ADAS) to provide warnings and even take autonomous actions to prevent collisions, thus reducing accidents and saving lives. Improved Traffic Flow: V2V technology can optimize traffic flow by coordinating vehicle speeds and reducing traffic congestion. This leads to shorter travel times, lower fuel more efficient and eco-friendly transportation system. Proactive Collision Avoidance: V2V systems can anticipate and respond to potential collision situations faster than human drivers. They can automatically brake or steer to avoid accidents, especially in scenarios where drivers may be unaware of dangers.

IV. RESULTS AND DISCUSSION

The paper aims to shows how the PIC Micro Controller, NRF Module, Ultrasonic Sensor, Motor Driver, Motor, Liquid Crystal Display (LCD), MQ2, MQ3, and Proximity Sensor function together to form the V2V system. It shows that the output from the virtual terminal is a streamlined representation, and that the alert message structure in a genuine V2V system would follow defined communication protocols.

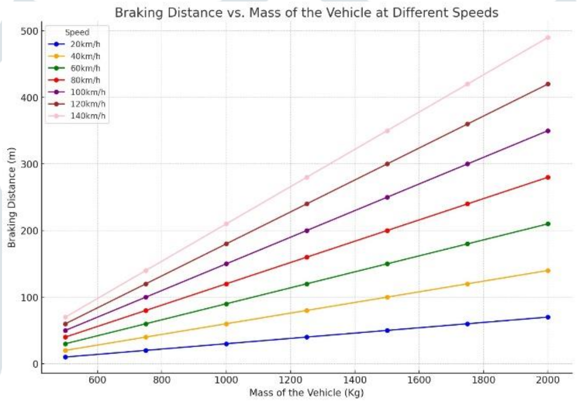

Fig 3. Braking distance given the mass of a vehicle at different speeds.

There is a relationship between the vehicle's mass (in kilograms) and the braking distance (in meters) at different speeds. The distance a vehicle must travel to come to a full stop at a certain speed is proportional to its mass. As an example, a car weighing less than 1000 kg may stop in 50 meters when moving at 140 km/h. On the other hand, at 2000 kg, it would require around 375 meters to come to a halt. The same holds true for vehicles: if they weigh 1500 kg, they may stop within 50 meters when moving at 20 km/h. On the flip side, if its mass is 1250 kg, it just needs 25 meters to come to a complete halt, which is half of the distance mentioned before. Not only would the sensors and capabilities of the cars have an impact on the data provided, but the data format used for vehicle-to-vehicle communication would as well. More data and information exchange between vehicles may be required for V2V communication to ensure safety and situational awareness. A V2V communication system, also called a "V2V AWARE," often requires a complex setup with many different elements, including microcontrollers, CAN transceivers, antennas, a power source, and sensors, in order to build the final circuit design.

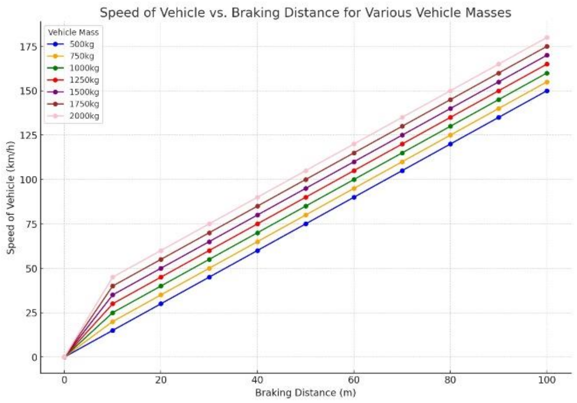

Fig 4. Speed of the vehicle given Braking Distance.

The relationship between speed and braking distance is linear at a constant mass. The stopping distance of a lighter vehicle is less than that of a heavier vehicle traveling at the same speed. For instance, in the case of a 100 m braking distance, a 500 Kg automobile may safely reach speeds of around 140 km/h, whereas a 10,000 Kg car has to maintain speeds of around 100 km/h in order to prevent a collision.

Fig 5. Speed of the vehicle given Stopping Distance.

As shown in Figure 5, cars going at different speeds on dry and wet asphalt require varying amounts of extra stopping distance. When comparing dry and wet asphalt, a vehicle going at 30 km/h will need an additional 1.2 m stopping distance. But the additional stopping distance grows larger as the speed increases. For instance, at 100 km/h, the entire stopping distance on dry asphalt is 71 m, whereas on wet asphalt it is 84 m, resulting in an additional 13 m of stopping distance. At 150 km/h, there is an additional 30 m stopping distance.

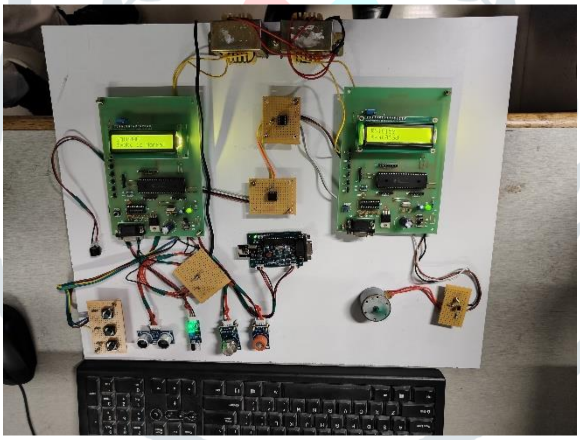

Fig 6. Hardware unit of v2v aware system.

Figure 7 shows a simplified virtual model of a vehicle-to-vehicle (V2V) communication system's architecture. Although the illustration provides a high-level view of the system's parts, it's important to note that in reality, each part would be more thoroughly described, including a plethora of interconnections, functions, and complexities. In actuality, the vehicle-to-vehicle (V2V) system is really an intricate web of software and hardware components that, when combined, allow for smooth communication between cars. In addition, the system would be designed to work with different security measures, protocols, and standards to make sure that essential information like position, speed, and trajectory is transmitted to nearby vehicles in a reliable, efficient, and secure manner. This illustration may lay the groundwork for a more thorough understanding, but it is far from depicting the complex and all-encompassing V2V communication system in its entirety.

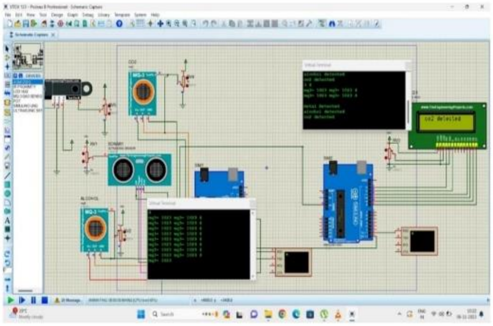

Fig 7. Final Virtual Terminal Output of obstacle detection..

V. CONCLUSION

An innovative and exciting new technology, the CAN protocol in vehicle-to-vehicle communication (V2V) has the ability to revolutionize traffic management and road safety. Reliability and real-time communication are hallmarks of the CAN protocol, which forms the basis of the system. Through vehicle-to-vehicle (V2V) communication, vehicles may share critical data such as location, speed, and status in real-time, which enhances road safety and efficiency. V2V communication is crucial for several reasons beyond accident prevention. It involves making roads safer for pedestrians and bicycles, encouraging more environmentally friendly driving habits, and reducing traffic congestion. Furthermore, vehicle-to-vehicle (V2V) communication is essential for the advancement of autonomous and networked cars, which might radically change transportation in the future. Standardization, legal compliance, and infrastructure deployment are hurdles that need to be surmounted before vehicle-to-vehicle (V2V) communication using the CAN protocol can be implemented, despite the promising potential of the notion.When it comes to managing traffic efficiently and ensuring the safety of drivers, vehicle-to-vehicle communication using the CAN protocol is a beacon of hope. It foretells a future where people engage with automobiles in radically different ways, with fewer accidents and less traffic. Technology like this gadget exemplifies the power of innovation to improve road safety and reduce environmental impact.

VI. FUTURE SCOPE

The future scope of vehicle-to-vehicle (V2V) communication systems encompasses several key areas of exploration. These include enhancing security measures against cyber threats, integrating artificial intelligence for predictive analysis and decision-making, addressing scalability and interoperability challenges, examining V2V communication in autonomous vehicles, focusing on energy efficiency and sustainability, integrating V2V into smart city initiatives, considering user experience and human factors, navigating regulatory and policy implications, exploring emergency services integration, and investigating specialized applications such as vehicle convoys and public transportation systems. Each of these areas presents opportunities for advancing the capabilities and applications of V2V technology, contributing to safer, more efficient, and interconnected transportation networks.

VIII. REFERENCES

[1] E. A. Shams, A. Rizaner, and A. H. Ulusoy, “Flow-based intrusion detection system in vehicular ad hoc network using context-aware feature extraction,” Veh. Commun., vol. 41, Jun. 2023, Art. no. 100585

[2] M. Schranz, G. A. D. Caro, T. Schmickl, W. Elmenreich, F. Arvin, A. Şekercioğlu, and M. Sende, “Swarm intelligence and cyberphysical systems: Concepts, challenges and future trends,” Swarm Evol. Comput., vol. 60, Feb. 2021, Art. no. 100762.

[3] Rayamajhi, A. Yoseph, A. Balse, Z. Huang, E. M. Leslie, and V. Fessmann, “Preliminary performance baseline testing for dedicated short-range communication (DSRC) and cellular vehicle-to-everything (C-V2X),” in Proc. IEEE 92nd Veh. Technol. Conf. (VTC-Fall), Nov. 2020.

[4] Bhat, S. Aoki, and R. R. Rajkumar, “Tools and methodologies for autonomous driving systems,” Proc. IEEE, vol. 106, no. 9, pp. 1700–1716, Sep. 2018.

[5] Arjunan and R. Kaviarasan, “Weighted distance hyperbolic prediction-based detection scheme for non line of sight nodes in VANETs,” J. King Saud Univ. Comput. Inf. Sci., vol. 33, no. 4, pp. 489–496, May 2021

[6] Pressas, Z. Sheng, F. Ali, and D. Tian, “A Q-learning approach with collective contention estimation for bandwidth-efficient and fair access control in IEEE 802.11p vehicular networks,” IEEE Trans. Veh. Technol., vol. 68, no. 9, pp. 9136–9150, Sep. 2019.

[7] N. Lyamin, D. Kleyko, Q. Delooz and A. Vinel, “Real-time jamming DoS detection in safety-critical V2V C-ITS using data mining”. IEEE Communications Letters, pp.1-1, 2019

[8] S. Shalevshwartz, S. Shammah, and A. Shashua, On a formal model of safe and scalable self-driving cars, arXiv preprint arXiv: 1708.06374v5, 2018.

[9] Sun, L. Song, H. Yu, V. Chang, X. Du, and M. Guizani, ''V2V routing in a VANET based on the autoregressive integrated moving average model,'' IEEE Trans. Veh. Technol., vol. 68, no. 1, pp. 908–922, Jan. 2019.

[10] S. Mumtaz, K.M.S. Huq, M.I. Ashraf, J. Rodriguez, V. Monteiro, C. Politis, Cognitive vehicular communication for 5G, IEEE Commun. Mag. 53 (7) (2015) 109–117, doi: 10.1109/MCOM.2015.7158273.

[11] Y. Yuan, W. Liu, T. Wang, Q. Deng, A. Liu, and H. Song, ''Compressive sensing-based clustering joint annular routing data gathering scheme for wireless sensor networks,'' IEEE Access, vol. 7, no. 1, pp. 114639–114658, 2019.

[12] T. Guo, C. Li, W. Dong, Z. Miao, and X. Su, ''Enabling efficient content dissemination for cooperative vehicular networks,'' in Proc. IEEE 28th Annu. Int. Symp. Pers., Indoor, Mobile Radio Commun. (PIMRC), Oct. 2017, pp. 1–5.

[13] J. Wang, C. Jiang, Z. Han, Y. Ren, and L. Hanzo, ''Internet of vehicles: Sensing-aided transportation information collection and diffusion,'' IEEE Trans. Veh. Technol., vol. 67, no. 5, pp. 3813–3825, May 2018.

[14] Ana Roxin "Inter-Vehicle Communication–Research Report" HAL archievesouvertes.fr, October 2014.

[15] S. Darbha, S. Konduri, and P. R. Pagilla, "Benefits of V2V communication for autonomous and connected vehicles," arXiv preprint arXiv: 03.02900, 2018.