Vehicle to Everything Communications

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ABSTRACT

Vehicle-to-Everything (V2X) communications is a technology that allows vehicles to communicate with each other, as well as with infrastructure such as traffic lights, road signs, and pedestrians. V2X technology has the potential to revolutionize the transportation industry by improving road safety, increasing traffic efficiency, enhancing situational awareness, and providing drivers with advanced services.

The article highlights the existing V2X communication systems and proposes enhancements to the technology to achieve truly intelligent transportation systems. The essayists stress the significance of machine learning (ML) in advanced vehicle systems networking and communication, and they give a blueprint of ongoing advancement in ML in 6G vehicle networks.

Overall, this article highlights the potential of V2X communications in revolutionizing the transportation industry and improving the overall driving experience. The authors call for continued research and development in this field to address the open challenges and realize the vision of advanced V2X communication networks and intelligent transportation systems.

KEYWORDS: Brain-controlled vehicle (BCV);Intelligent reflective surfaces (IRSs);Machine learning (ML);Nonorthogonal multiple access (NOMA);Radio frequency (RF)-visible light communication (VLC) vehicle-to-everything (V2X);Sixth-generation (6G)-V2X;Tactile-V2X

I.INTRODCUTION

Vehicle-to-everything (V2X) transmission is significant for intelligent transportation systems (ITS) and has definitely stood out enough to be noticed in concentrate on throughout recent years. V2X incorporates various kinds of remote advancements, like vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), vulnerable road users (VRUs), and vehicle-to-cloud (V2N). The objective is for V2X correspondence to be a significant piece of future connected self-driving vehicles. This will have many advantages, for example, better wellbeing on the streets, better client encounters, more transportation choices, and further developed highlights.

There have been two principal kinds of V2X transmission frameworks before: dedicated short-range communication (DSRC) and cell based vehicle organizations. The principal innovation for V2X transmission has been DSRC, which is based on IEEE 802.11p and IEEE 1609.1.4 principles. It has a few issues, however, similar to restricted inclusion, slow information rates, and limitless channel access delay, which are particularly terrible in places with a many individuals moving around. The 3rd Generation Partnership Project (3GPP) has been dealing with a phone vehicle transmission standard called C-V2X to attempt to get around these issues. C-V2X utilizes standard cell advances to allow vehicles to converse with one another and different things in the V2X organization.

The primary goal of V2X communication Is to enhance situational awareness by providing vehicles with real-time data about their surroundings. By sharing information about road conditions, traffic congestion, hazardous situations, and other relevant factors, vehicles can make more informed decisions and take proactive measures to ensure safety and efficiency. V2X communication enables vehicles to transmit and receive data, such as location, speed, acceleration, braking, intentions, and warnings, to create a cooperative and interconnected ecosystem on the road.

II.LITERATURE SURVEY

S. Chen et al [1] The review discussed V2X communications as a rule, with an emphasis on the two key frameworks, DSRC and C-V2X. It covers the fundamental concepts, architecture, protocols, and applications of V2X communication. The paper also discusses the advantages and limitations of each technology and compares their performance in various scenarios.

M. Chen et al [2] In there paper (W. Saad, M. Bennis, and M. Chen) propose a learning-based framework for intelligent reflecting surfaces (IRSs) in wireless communication systems. Although it may not directly focus on V2X communication, it presents a relevant approach that can enhance communication performance, including V2X scenarios.

G. Naik et al [3]There paper focuses on the integration of V2X communications into the 5G network architecture. It discusses the key elements of 5G-based V2X systems, including network slicing, multi-connectivity, edge computing, and quality-of-service management. The paper also highlights the implementation challenges and provides insights into the deployment of V2X services in 5G networks.

J. B. Kenney et al [4] There paper, J. B. Kenney provided an overview of public safety wireless communication systems, including those applicable to V2X communication in emergency situations. It talks about the problems, tools, and possible futures of these kinds of systems.

K.-D. Lee et al [5]There paper explores the applications of machine learning (ML) techniques in V2X communications. It discusses how ML algorithms can improve the performance and reliability of V2X systems, including data analytics, resource allocation, interference management, and security. The paper also presents challenges and future directions for ML-based V2X communication research.

] O. Sadio et al [6] The main topic of that study is the problems with privacy and security in V2X communications. It provides an overview of the different attack vectors and threats to V2X systems, as well as the existing security mechanisms and protocols. The paper also discusses privacy-preserving techniques and emerging solutions for secure and privacy-aware V2X communications.

H. Bagheri et al [7] There paper provided an in-depth analysis of V2X communication technologies and their applications in intelligent transportation systems. It covers topics such as communication protocols, network architectures, channel models, security, and privacy. The paper also discusses the challenges and open research issues in V2X communication.

K. Abboud et al[8]Although a slightly older publication, this survey paper offers a comprehensive overview of vehicular communications, including V2X communication. It discusses the different wireless technologies used in V2X communication, such as DSRC and cellular-based solutions. The paper also examines the challenges in vehicular communications, such as mobility management, scalability, and network deployment.

H. Zhou et al [9] That paper gave an expansive gander at vehicle interchanges, which included V2X contact. It discusses the requirements, plans, issues, standards, and ways of fixing them in vehicle communications. The paper explores various aspects of V2X communication, such as networking protocols, mobility models, security, and privacy.

III.METHODOLOGY

A.PROTOCOL DESIGN AND OPTIMIZATION:

Make or change V2X correspondence conventions and guidelines, considering things like message structures, data sharing mechanisms, security components, and controlling congestion.

Optimize the protocols for efficient utilization of network resources, improved reliability, low-latency communication, and support for diverse applications and services.

Consider the coexistence of multiple V2X technologies and the interoperability with other communication systems.

B.NETWORK ARCHITECTURE DESIGN:

Design the network architecture for V2X communication, including the integration of vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications.

Determine the optimal placement of infrastructure units, such as roadside units (RSUs), base stations, and cloud servers, to enable efficient communication and data exchange.

Consider the hierarchical or distributed architecture, network connectivity, and routing protocols to ensure seamless and reliable communication among vehicles and infrastructure.

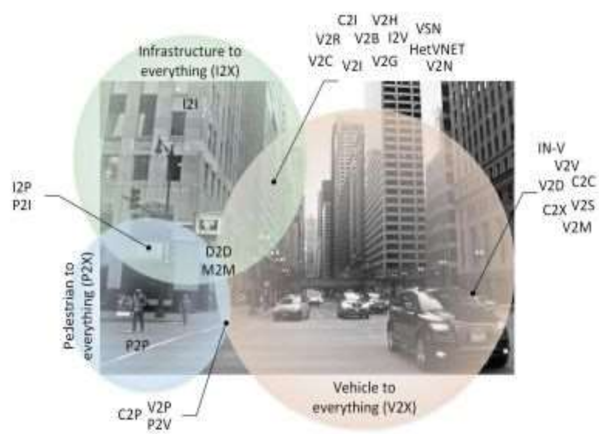

***Figure 1**. Diagram of interactions between vehicle, infrastructure, and pedestrian communications*

Address the security and privacy concerns associated with V2X communication, such as message authentication, encryption, intrusion detection, and privacy preservation.

Implement robust security mechanisms to protect against malicious attacks, unauthorized access, and data breaches.

Ensure compliance with privacy regulations and guidelines to protect the personal information exchanged during V2X communication.

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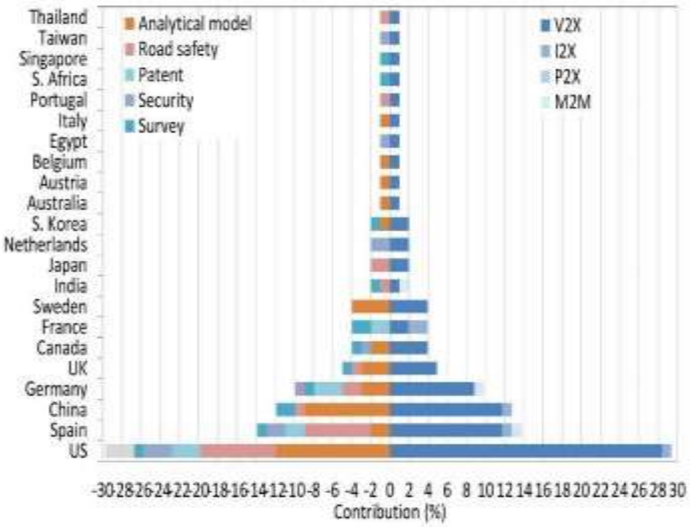

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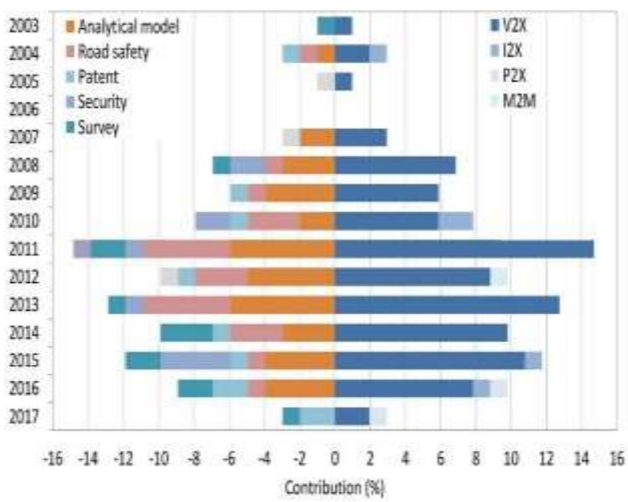
Figure 2. For a representative sample of the 100 most cited publications in the state-of-the-art: (a) Type Of communication and use case versus coun



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IV APPLIED MACHINE LEARNING (ML) METHODS

In this study, two different ML algorithms these algorithms, namely Logistic Regression, Support Vector Machines (SVM) were selected based on their distinct abilities to handle classification tasks effectively. The following description provides an insight into the operational mechanism and mathematical notation of machine learning models.

1. In logistic regression, the linear regression equation is transformed using the logistic function to obtain the predicted probability (p) of belonging to a specific class. The linear regression equation can be represented as:

$z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p$

Where:

Its worth, z, is the linear combination of the characteristics ($x_1, x_2, \ldots, x_p$) that were taken care of in and their loads ($\beta_1, \beta_2, \ldots, \beta_p$).

β_0 is the intercept term.

$\beta_1, \beta_2, \ldots, \beta_p$ are the coefficients corresponding to each input feature.

p is the predicted probability of the binary outcome.

By applying the logistic function to the linear combination, the logistic regression formula becomes:

$p = \sigma(z) = 1 / (1 + e^{(-z)})$

2. The Support Vector Machine (SVM) calculation is a method for learning with assistance that is utilized for occupations like relapse and grouping. SVM, then again, attempts to find a hyperplane that divides classes by making the space between them as large as could really be expected. The manner in which a SVM calculation pursues decisions can be composed as:

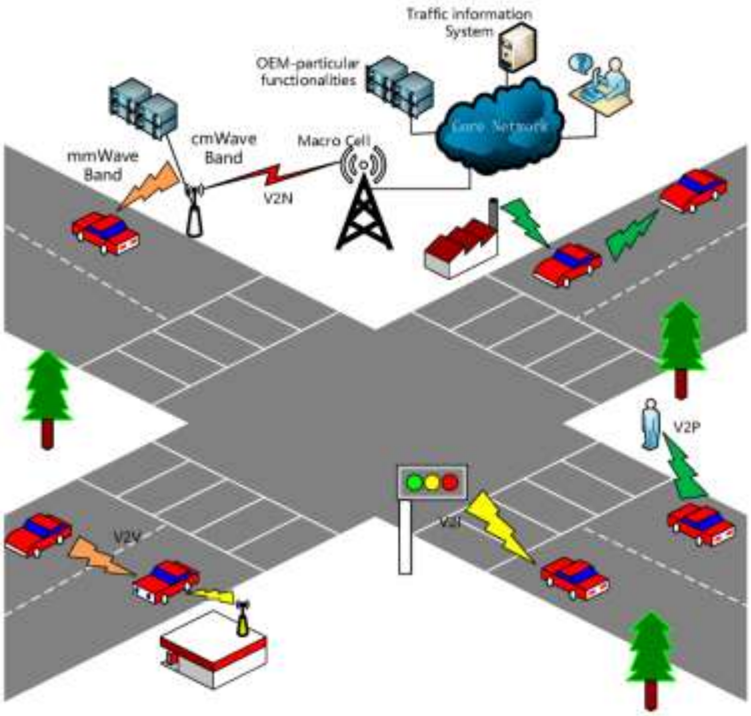
$F(x) = \text{sign}(\theta T * x + b)$ (1)

It has four parts: f(x) is the projected class label, θ is the normal vector to the hyperplane, x is the feature vector, and b is the bias term.

Linear Kernel: $K(x, y) = xT * y$
Polynomial Kernel: $K(x, y) = (\gamma * xT * y + r)^d$
Gaussian (RBF) Kernel: $K(x, y) = \exp(-\gamma * \|x - y\|^2)$
Sigmoid Kernel: $K(x, y) = \tanh(\gamma * xT * y + r)$

V. EXPERIMENTAL RESULTS

Result analysis in V2X communications involves comparing the obtained results with predefined objectives or benchmarks, identifying areas for improvement, and making informed decisions to optimize the communication system's performance. It helps in understanding the strengths and weaknesses of the implemented solution and guides future enhancements and research efforts in V2X communication technologies.

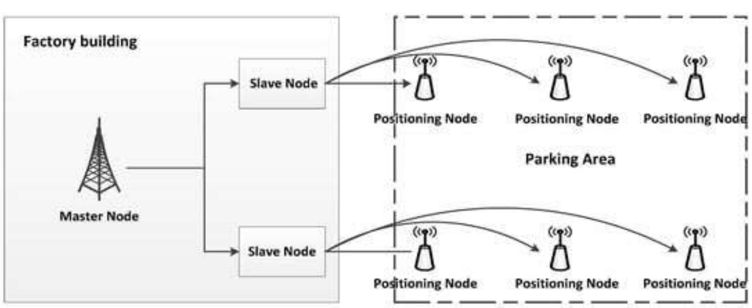


The scenario of Vehicle-to-Everything

Parking management based on high accuracy positioning.

(a)

Photo of the test site



(b)

Deployment of high accuracy positioning.

IV.CONCLUSION

The essayists of the article being referred to have found and discussed the main advancements and inventive pieces of the following flood of 6G-V2X networks. These technologies are expected to surpass the capabilities of the current 5G networks and play a vital role in advancing intelligent transportation systems (ITSs).

Moreover, the piece gives a diagram of the latest headway made in utilizing machine learning (ML) in 6G vehicle networks. ML is viewed as a significant piece of making ITSs fill in too as they can. The authors highlight the significance of ML in enhancing vehicular communication and networking and discuss its role in enabling intelligent transportation systems.

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