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A review: The Self-Driving Car's Requirements and The Challenges it Faces

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ABSTRACT

The rise of autonomous vehicles (AVs) is a big step forward in the history of the auto industry. It was made possible by advances in technology and a shared desire to make vehicles safer and more efficient. The point of this study is to look at and combine all the current methods that focus on safety in the creation and use of self-driving cars (AVs), paying special attention to the requirements for software and systems. A comprehensive examination of prior research has been conducted, spanning essential technologies like computer vision, sensor fusion, localization and mapping, and vehicular communication systems. Our investigation uncovers a noteworthy advancement in the direction of reducing traffic accidents and addressing concerns related to traffic congestion and detrimental emissions. Nevertheless, there has been a significant rise in cybersecurity threats specifically aimed at AV systems, highlighting the need for strong preventative measures. The goal of this thorough evaluation is to give an in-depth look at the progress, problems, and possible solutions for making autonomous driving technologies and strategies safer and more reliable.

Keywords: Autonomous vehicle, Self-driving car, Communication of Strategies , Autonomous technology, Security.

1. Introduction

A multitude of research and industrial endeavors have been done with the aim of improving vehicle safety, mitigating accidents, and forecasting the outcomes of road and vehicle mishaps. One notable strategy is the utilization of autonomous cars, which can proactively mitigate human errors and rapidly address mishaps in real-time. The concept of self-driving cars has experienced significant advancements. The initial efforts were centered around the development of systems that utilized preprocessed data. On the other hand, in recent years there has been a development of methods and solutions that make use of data sensors to collect information in real time from the environment. These systems possess the ability to foresee events, forecast mishaps, and assess environmental conditions. [1]. hence enabling automated decision-making at different levels of autonomous driving. The implementation of autonomous driving necessitates a thorough examination of several design aspects. When conducting a comparative analysis between autonomous cars and regular autos, it is imperative to integrate system and software methodologies, in addition to taking into account mechanical design aspects. Extensive scholarly literature and thorough research in this particular domain have significantly focused on the software component of vehicle design, with a primary objective of enhancing road safety. Using different methods, rules, and new technologies in automotive safety management is very important for keeping cars in good shape and making sure people inside are safe and sound. The field of automotive safety management involves a multitude of aspects. Numerous innovative methodologies have been proposed to address the software design aspects of automated vehicle systems, with the primary objective of augmenting safety within the distinct domain of these vehicles as well as the broader road ecosystem. The main objective of this article is to categorize the various methodologies that have been suggested within this particular domain. The objective of this study is to provide insights into strategies for enhancing the design of systems and software components. This will be achieved through an examination of the challenges, implementation, and simulation aspects, assessment techniques, and key parameters involved in this process. As delineated in the research conducted by [2]. For self-driving cars to work well in traffic that changes quickly and unexpectedly, data collection and analysis must be coordinated in a planned way using a series of software-based layers. This method involves three main layers: data collecting and processing through sensors; the perception stage, which involves recognizing and interpreting the current environmental conditions; and the execution of control plans. Significantly, the three primary levels can be identified as separate software strata that are exclusive to autonomous vehicles, a characteristic notably lacking in conventional automobiles. The complex series of operations [3]. The graphic representation in Figure 1 provides a clear illustration of the sequential and organized nature of the individual processes.

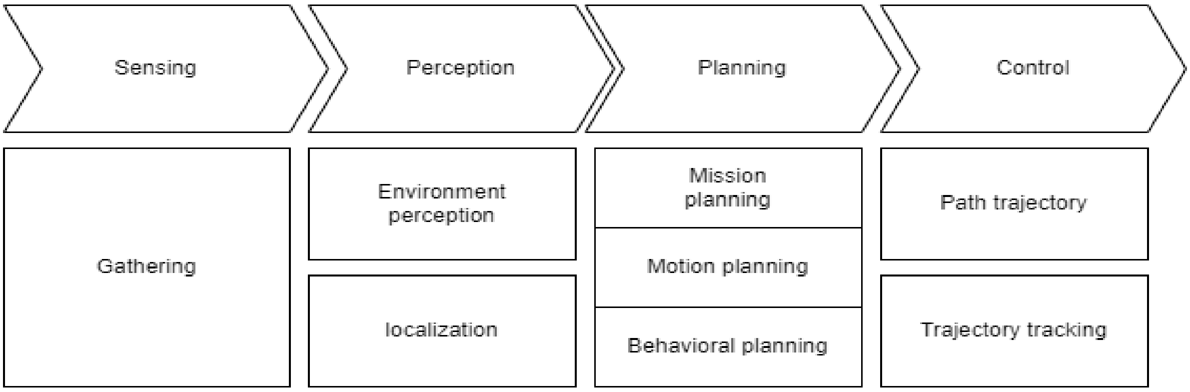

Figure1: Tasks in autonomous vehicles.

The software architecture of self-driving cars necessitates the intricate evaluation of several components. The accurate collection of data is contingent upon the essential role that sensors play, particularly in light of the diverse array of environmental, technical, and meteorological fluctuations that may be encountered in various circumstances.

Anticipating the necessary prerequisites and developing proactive measures are vital in upholding vehicular safety. The implementation of these comprehensive systems plays a crucial role in augmenting the overall level of road safety. With the increasing prevalence of autonomous cars, their dependence on human drivers and subjective decision-making diminishes, hence mitigating their susceptibility to human mistakes [4]. In the field of autonomous vehicle systems, various safety models are applied, which can be classified into specific categories. The first category relates to the detailed level of nodes, tools, and components within the system. The solutions presented in this context are not reliant on communication and instead utilize complex datasets. The second category explores security aspects pertaining to both system and communication levels. The analysis carefully examines key elements and develops solutions within the complexities of networks and systems supported by existing road safety statistics[5]. The safety spectrum is closely interconnected with other essential requirements, including security. Occurrences of system breaches or unauthorized manipulation of data obtained from cars might lead to the dissemination of inaccurate safety alerts at a heightened magnitude, which may ultimately result in accidents. Moreover, errors at the node or communication level have the potential to trigger malfunctions inside the system, ultimately leading to flawed decision-making processes. Scholars have focused their research efforts on investigating the complexities associated with ensuring the safety of autonomous vehicles[6]. Nevertheless, the current endeavors have not fully addressed the multifaceted challenges at hand in a comprehensive manner. However, each study has directed its attention towards particular aspects of safety requirements. [7] investigated the attributes and determinants that impact the evaluation of safety in autonomous vehicles. Standards and certifications were created, with a focus on continuous issues and identification of potential safety breaches. However, a comprehensive examination of the assessment criteria and the environmental factors that influence safety has yet to be conducted thus far. Another scholarly article, referenced as[8], explored the ecological requirements. The methodology employed by the researchers centers on the establishment of network and system communication that facilitates the interaction between automobiles and pedestrians. Unfortunately, this analysis fails to consider the inherent restrictions and challenges associated with vehicles, particularly in terms of resource and energy constraints at the node level. Furthermore, it is important to conduct a more comprehensive analysis of the vehicle's holistic architectural framework. This paper is structured as follows: Section 2 provides an overview of related work concerning safety issues. In Section 3, we outline the research the autonomous technology. Section 4 delves into the Communication Strategies. The exploration of Cyber Security in Automotive Technology in Section 5. Furthermore, Section 6, Threats and Failures. In Section 7, we discuss about the Smart city. Section 8 draws this discourse to a close by presenting our concluding remarks.

1.1 Abbreviations and Acronyms

As shown in table 1 that is describing 'Acronyms' existing in paper.

Table 1 : Abbreviations and Acronyms

Acronym	Full-form	Acronym	Full-form
DSRC	Dedicated Short Range Communications	IVC	Inter-vehicle connection
V2X	Vehicle-to-Everything	IMUs	Inertial Measurement Units
V2V	Vehicle to vehicle	SPaT	Signal Phasing and Timing
MIVC	Multi hop Inter Vehicle Communication	V2I	Vehicle to infrastructure
SIVC	Single hop Inter Vehicle Communication	GSM	Global System For Mobile Communication
GNSS	Global Navigation Satellite System	RSU	Road Site Unit
VRU	Vulnerable Road User	ITS	Intelligent Transportation Systems

1. Related Work

The objective of this part is to provide a comprehensive analysis of recent survey articles that explore the essential needs and functions involved in the design of self driving car systems. The surveys will be subjected to analysis in order to ascertain their respective strengths and shortcomings. Autonomous cars pose a multitude of obstacles, among which lies the task of accurately forecasting the conduct and efficacy of every constituent element inside their surroundings. A crucial component of this difficulty pertains to pedestrians, whose conduct is subject to change and influenced by a multitude of external circumstances. In their study, Rasouli et al.[9] discovered several factors that have an impact on pedestrian behavior. The research incorporated several aspects, such as communication with other elements, interaction with drivers, limitations imposed by the environment, and external influences, including weather and road conditions. This study has focused on a noteworthy challenge; nonetheless, its scope is limited to a particular category and might benefit from the broader inclusion of all aspects related to autonomous vehicle dynamics. Motion management is a significant difficulty that has been investigated in the context of autonomous vehicles, as discussed in a scholarly article by Aradi et al. [10]. The study specifically focuses on the application of deep reinforcement learning to address this challenge. The present investigation entailed a thorough examination of several facets pertaining to the act of driving and its multifaceted dimensions. The methodologies are systematically categorized and assessed, offering extensive perspectives on automobile models, modeling instruments, and distinct procedures throughout different phases. Despite the substantial contributions made by this work, its primary focus is on deep reinforcement learning, which limits its ability to make larger comparisons and evaluations. Autonomous cars employ a variety of sensors at different stages to collect data as the levels of automation continue to advance. In the perception phase, the focus of Rosique et al.[3]s The study primarily examines the behaviors and architecture of sensors during the perception phase. The main focus of this article is on technologies, tools, and simulators pertaining to sensors. However, there is comparatively less attention on other aspects, such as algorithms, supplementary quality criteria, and the design of environments and systems. In a particular study, Ma et al.[11] examined the incorporation of artificial intelligence inside the realm of self-driving car advancement. This study involved a comprehensive examination of the obstacles and prerequisites associated with artificial intelligence. This study investigated different methodologies rooted in artificial intelligence that are applicable in communication and network contexts. These methodologies were then categorized according to their compatibility with the needs of autonomous vehicles and simulation approaches. However, the study must address the difficulties that remain unresolved by these solutions within the system. Likewise, the analysis needs to explore the nuances of implementation challenges that may emerge as a result of the distinct attributes of autonomous cars. The study conducted by Omeiza et al.[12] examined the regulations and guidelines that regulate the handling of systemic and environmental requirements in relation to transparency and accountability in self-driving vehicles. The study involved a thorough examination of many stakeholders and their respective requirements. The challenges and concerns inherent in the design of the vehicle system were carefully identified and systematically classified. Although the safety concerns were addressed at the system level, the solutions provided needed to undergo a thorough and complete evaluation. Following the initial phases of autonomous vehicle development, it is imperative to conduct thorough and comprehensive testing. The implementation of this testing regimen serves to avoid potential mistakes and minimize the inherent risks associated with decision-making guided by artificial intelligence. In their comprehensive study, Kaur et al. [13] conducted a thorough examination of various testing tools, procedures, and a wide range of simulators. A comprehensive examination was undertaken to analyze the numerous requirements and components associated with self-driving cars. The subsequent assessment centered on the simulation tools produced from these requirements, clarifying their advantages and disadvantages. However, it is worth noting that the discussion lacked a significant focus on crucial factors that impact implementation, such as assessment parameters. In the study conducted by Sharma et al.[14], the authors generalized predictive approaches pertaining to the motion and dynamic design of self-driving car systems. This research advanced beyond the conventional by examining the impact of desired environmental conditions. The examination encompassed an analysis of planning methodologies that were supported by distinct software paradigms, as well as a thorough evaluation of constraint management inside the system. Akowuah et al.[15] extensively examined the domain of security concerns and the comprehensive nature of security attacks. The aforementioned attacks were subjected to thorough examination, and the subsequent challenges were expressed with great precision. A thorough assessment was conducted on the criteria and test platforms, revealing relevant concerns. While the implementation of targeted solutions has led to significant improvements in system-level safety, it is important to acknowledge that there are still certain safety aspects that need to be thoroughly investigated by these solutions. The examination of scalability concerns in attack investigations is imperative due to the different and dynamic settings of autonomous cars. Additionally, it is crucial to assess the scalability and compatibility of physical, constant-based attack detection methods to optimize resource allocation. In their study, Kim et al. [16] undertook a comprehensive examination of the many attacks that are directed at autonomous cars. The attacks mentioned above were systematically classified, and appropriate precautions were subsequently implemented. The study carefully examined intrusion detection techniques and conducted a thorough assessment of design strategies supported by artificial intelligence solutions. Although the article covers a wide range of topics, it would have been beneficial to provide more detailed explanations of assessment methodologies and criteria. In their study, Qin et al. [17] explored the domain of accident prevention and the corresponding algorithms in order to enhance safety measures. The identification of accident scenarios was based on the internal structure, hardware, and physical components of the vehicles. A thorough analysis of their control mechanisms followed this. Still, it is important to note that this study only looked at the first stages of designing the inside of vehicles. It did not look at things like the environment, the difficulties of communication, or the limitations of data collection.

When we look at all of these works together, One of the primary obstacles encountered in our research is the comprehensive assessment of network-level solutions. Table 2 provides a concise overview of the main subjects addressed in the corpus of relevant scholarly investigations.

Table 2 : displays the surveys that are relevant to autonomous cars.

Author	Years	weaknesses	strengths
Rosique et al.[3]	2019	Constrained to the domains of sensors, the perception phase, and simulators.	The authors highlighted significant research challenges that now exist and proposed potential avenues for future research in the pursuit of creating completely autonomous cars.
Rasouli et al.[9]	2019	This study exclusively focuses on accidents involving pedestrians and does not explore other contributing factors.	The factors were properly thought through within the framework of the methodology, and all of the approaches were carefully examined, taking into account software and hardware needs as well as different levels of automation.
Ma et al.[11]	2020	The researchers directed their attention toward a particular domain of applications.	This study offers further perspectives on prospective opportunities pertaining to the integration of artificial intelligence (AI) with other developing technologies.
Aradi et al. [10]	2020	The scope of this phenomenon is constrained to a single field and confined to specific methodologies.	This study offers a comprehensive analysis of the hierarchical motion planning problem and provides a detailed explanation of the fundamental principles behind deep reinforcement learning (DRL). This study examines the current advancements in autonomous driving and organizes them based on the many activities and levels involved in the system.
Omeiza et al.[12]	2021	The primary emphasis of the authors was directed towards standards and protocols.	It aims to supply researchers with the fundamental knowledge necessary for them to explain the provisions of autonomous driving and is written with such researchers in mind.
Kaur et al. [13]	2021	Within the scope of this paper, simulation needs have been discussed; however, evaluation criteria still need to be taken into account.	They determine the most important requirements that a good simulator should meet. In addition to that, they offer a comparison of the simulators that are typically utilized.

Akowuah et al.[15]	2021	There remain certain safety considerations that necessitate further examination in light of the proposed solutions that have been presented.	The primary focus of authors in the field has been on examining security and threat management strategies pertaining to various components within autonomous cars.
, Kim et al. [16]	2021	While the essay encompasses a broad spectrum of subjects, it would have been advantageous to offer more elaborate elucidations of assessment procedures and standards.	The classification of autonomous attacks encompasses three distinct groups, including autonomous control systems, components of autonomous driving systems, and vehicle-to-everything communications.
Qin et al. [17]	2021	It is crucial to acknowledge that the scope of this study was limited to the initial phases of vehicle interior design. The study failed to consider environmental factors, communication challenges, data acquisition limitations, and communication complexities.	In addition to tracking the intended path during normal operation, the proposed algorithm ensures vehicle stability to prevent and mitigate collisions.
Sharma et al.[14]	2021	While this article does offer a software-related viewpoint, its scope is confined to the mobility of vehicles and their contribution to accidents.	This comprehensive survey offers researchers in the field of motion and driving behavior planning for autonomous vehicles a readily available source of information on the latest technology.

In conclusion, these academic projects show how changing it is to look into nonfunctional criteria since each one adds a new aspect to the wide range of problems and solutions that come up with autonomous vehicle systems. By looking at existing survey articles, it is clear that safety issues need to be thoroughly investigated in all the areas that are covered in these publications. The majority of the incidents that have been discussed pertain to security problems or proposed solutions. The evaluation of accident prevention entails the process of isolating external variables and placing reliance on the structural integrity of the vehicle as a whole.

2.Autonomous Technology

To enable driving automation, the autonomous vehicle uses several different technologies. These technologies include sensor fusion, computer vision, localization, path planning, and Drive Control[18].

2.1.**Sensor fusion**

Developing an autonomous car that can effectively perceive its surroundings is significant. Multisensor fusion is currently a required technique in all Autonomous driving systems to get around individual sensor types' limitations, boosting the system's overall efficiency and dependability. There have been a variety of sensor fusion approaches implemented in autonomous. These techniques combine data from many sensor types (such as camera, RADAR, and 800 LIDAR) to explore their characteristics and improve the surrounding's perception[19].

2.2. **Computer vision**

Many research institutes and businesses have collaborated to develop computer vision systems for autonomous vehicles. Because of this, computer vision has attracted significant scientific attention. By analyzing the shapes of roads, automobiles, and people, computer vision systems in self-driving cars can obtain reliable information about where to go and what to avoid. This information can be obtained by detecting the shapes of the roads, cars, and people as in figure 2 [20]. Additionally, vision systems excel at carrying out all these complex and associated functions because the images acquired by a vision camera provide a wealth of information about the vehicle's environment[21]. Image improvement is a crucial step in image preprocessing. Using visuals is an efficient way to communicate visual data[22]. Sometimes, digital photos are disturbed by unwanted signals referred to as noise. In digital image processing, noise removal is a top research priority. Noise usually degrades images during capture and training, and many modern imaging tools encounter images with noise. Systems designed to identify road lanes can discern the markers using image processing methods such as color amplification, Hough transform, and edge identification [23, 24].

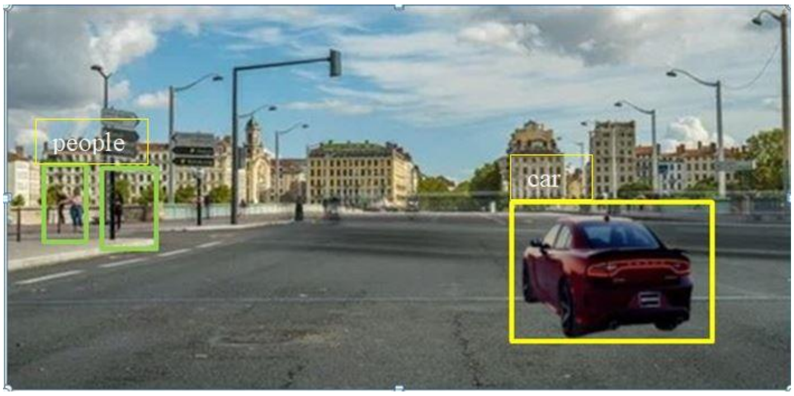

Figure 2 : One of the features of computer vision is the "camera", and it is used to detect objects by distinguishing between a vehicle and a human[20].

2.3 Localization and mapping

Localization and mapping have been popular research topics for many years. It has progressed from inside, stationary mapping for mobile robot applications to outdoor, dynamic, high-speed mapping and localization for autonomous vehicles. Researchers must determine how to measure the environment while traveling to build reliable maps for indoor navigation. Requires the robot to determine its position around obstacles and walls while simultaneously building (and storing) an accurate map[25].

Localization and mapping typically employ a variety of sensors, such as GPS, IMU, LiDAR, and cameras, to produce accurate and trustworthy findings. Despite the availability of exact and reliable GPS sensors, it is normal for GPS signals to encounter obstructions or interruptions under certain environmental conditions. The localization system is expected to incorporate additional sensors, such as IMUs (Inertial Measurement

Units), that combine accelerometers, gyroscopes, and magnetometers to compensate for GPS signal loss. IMUs need help to offer a worldwide vehicle position. Hence, they are typically paired with a GNSS (Global Navigation Satellite System) system[26].

2.4.**Path Planning**

Planning is the stage of decision-making between perception and control. In autonomous driving, autonomy relies significantly on critical decision-making. This can be achieved by embedding planning algorithms and scenario detection and decision-making modules into the middleware of an autonomous vehicle's navigation system. Planning aims to offer cars safe, collision-free routes to their destinations, considering vehicle dynamics and maneuverability in the presence of barriers, traffic restrictions, and road borders[27].

2.5.Drive Control

Tesla has implemented Traffic-Aware Cruise Control to regulate the vehicle's speed effectively while incorporating autosteer functionality to ensure that the vehicle remains within the designated lane. Furthermore, it can execute automatic lane changes to transition between different lanes. The enhanced autopilot system facilitates the vehicle's guidance throughout the journey on a highway, starting from the on-ramp and concluding at the off-ramp. Includes providing recommendations for lane changes, navigating interchanges, automatically activating the turn signal, and ensuring the vehicle takes the appropriate exit. When the autosteer is engaged, it assists the car in moving to an adjacent lane on the highway. It also identifies the traffic lights and stop signs, slows the car and stops automatically in the city[18].

3.Communication Strategies

Research and development of intelligent transportation systems and applications based on ground vehicles have been sped up because of increased connectivity between ground vehicles. Connected and autonomous cars, or CAVs, can connect with the roadway infrastructure via V2I (Vehicle To Infrastructure) communication. Enables traffic light signal and timing SPaT (Signal Phasing and Timing)-based vehicle speed planning, which helps to conserve fuel and improves mobility. CAVs are also equipped with V2V (Vehicle To Vehicle) technology, which enables them to communicate with one another. Communication between vehicles allows for the exchange of information such as position, speed, and acceleration among CAVs operating in the same area. DSRC (Dedicated Short Range Communications), commonly known as (IEEE802.11p), is a Wireless Local Area Network (WLAN) protocol having a dedicated bandwidth of 75 MHz. Several V2I, V2V, and V2X (Vehicle-to-Everything) applications have successfully implemented DSRC for the automobile industry's communication requirements. In addition to being inexpensive and simple to build, DSRC-based systems are also technologically advanced enough to be relatively inexpensive. Because of the narrower coverage area and selective admittance of peer cars into the network, DSRC provides excellent peer identification[28].

3.1.Vehicle-to-Vehicle Communication

The primary objective of V2V is to enhance the efficiency and dependability of communication while reducing reliance on global systems for mobile communication GSM (Global System For Mobile Communication) networks. The utilization of traditional communication systems such as Vehicle-to-Infrastructure (V2I) is widely acknowledged to depend on their fundamental communication through third-party infrastructure, such as GSM[29, 30]. Also, Inter-vehicle communication IVC (Inter-vehicle connection), alternatively known as inter-vehicle information sharing, facilitates communication between vehicles by exchanging pertinent information about traffic congestion, accidents, and speed limits. This technology, called inter-vehicle communication (IVC), enables vehicles to establish communication channels and exchange pertinent information regarding traffic congestion, accidents, and speed limits[31]. V2V communication can establish a network by interconnecting various nodes, which are vehicles, through a mesh topology, whether partial or complete[32]. Inter-vehicle communication systems can be categorized as single-hop SIVC (Single hop Inter Vehicle Communication) or multi-hop MIVC (Multi hop Inter Vehicle Communication) systems based on the number of hops utilized[33]. Systems are categorized as either single-hop (SIVC) or multi-hop (MIVC), corresponding to the number of hops used for inter-vehicle communication[29].

3.2.Vehicle-to-infrastructure communication

The term "vehicle-to-infrastructure" (V2I) refers to the communication between motor vehicles and the many pieces of equipment that make up road infrastructure. According to him, there are several different V2I system designs that are comparable in terms of significant components, specifically:

On-Board Unit or Equipment (OBU or OBE) for a vehicle
RSU (Road Site Unit) or RSE stands for Roadside Unit or Equipment.
Channel of communication that is secure.

The OBU serves as the vehicle's representative in V2I communication. This particular component facilitates communication between the vehicle and other vehicles nearby and between the vehicle and the Roadside Units (RSUs). The RSU is a crucial component in facilitating Vehicle-to-Infrastructure (V2I) communication. The device is connected to a network designed explicitly for Vehicle-to-Infrastructure (V2I) communication. It can be strategically positioned at various locations, such as intersections, petrol stations, pedestrian crossings, or other relevant sites. In addition to the transmission and reception of messages, the system may also encompass the task of prioritizing messages exchanged between vehicles[34].

3.3.Vehicle to Pedestrian Communication

V2P is an umbrella term incorporating all vehicle-to-vehicle communications. By enabling V2P for VRU (Vulnerable Road User) s, they can become active participants in

ITS (Intelligent Transportation Systems) and facilitate various safety and convenience applications. VRUs have varying characteristics, including pace, mobility, and travel patterns. VRUs are distinguished from one another by their defining qualities, including speed, mobility, and travel patterns. For instance, there is a significant distinction between bicycles and pedestrians in that bikes must come to a complete stop at red lights. In contrast, pedestrians are permitted to cross the street simultaneously. To create an efficient V2P system, the system's developers must consider the mentioned variables. The characteristics are capable of being converted into design criteria that are suitable for a V2P system. Hence, having well-specified standards may aid in overcoming the many difficulties associated with VRU integration. Requirements can be divided into various categories[35].

4.Cyber Security in Automotive Technology

Artificial Intelligence (AI) and Machine Learning (ML) methodologies have been employed to address a diverse range of challenges within the in-vehicle domain [36, 37]. These methodologies have emerged as viable solutions for intricate application domains. The security of in-vehicle networks is considered one of the most intricate application domains[38]. Recent studies have demonstrated that machine learning (ML)-based approaches have successfully mitigated security concerns within in-vehicle networks[39]. The contemporary intelligent vehicle network is characterized by wireless communication between vehicles or infrastructure, which has led to increased connectivity. However, this expansion in connectivity has also resulted in the widening of security vulnerabilities, rendering the network susceptible to various attacks[40, 41]. Furthermore, numerous scholars have made substantial contributions in this domain by utilizing machine learning methodologies and their variations to construct security frameworks to detect potential attacks and mitigate various security concerns in contemporary vehicular networks. Cryptographic methods have been proposed as ways to deal with different security challenges. Traditional authentication methods for in-vehicle networks include password protection, key-based authentication, and biometric security measures. The fundamental drawback of cryptographic methods for addressing in-vehicle network security challenges is their inability to verify whether the transmitted value is authentic or fake with sufficient precision. Additionally, low-powered vehicle security systems often use cryptographic techniques[42].

5.Threats and failures

Depending on the extent of automation, passenger safety may be compromised by various hazards and dangers. A vehicle's assistive technologies are needed for the driver to control the vehicle completely. As a result, alerts and warning systems are available if there is a malfunction or the driver fails to exert control (for example, brakes, steering wheel). A malfunction or malicious external control of the warning module could be damaging, yet the driver has complete control over the vehicle. Contrary to the fact that the vehicle is fully automated, if it is subjected to damage or malicious external interference without letting the driver intervene in an emergency, this could endanger the safety of the passengers. In addition, it can impact particular applications (such as connectivity with cloud or edge infrastructure), which is essential for vehicle communication with other vehicles and systems. Also, the 5G network, one of the modern networks still unavailable in many countries, causes a significant problem. In addition, the Internet's weakness could be one of the biggest problems for self-driving cars, putting the safety of their passengers at risk[43]. In the context of a cyber-physical system, the goal of safety is to protect the system from accidental failures to minimize dangers, while the primary objective of security is to keep the system safe from threats that are carried out intentionally. The safety and protection provided by autonomous vehicles encompass the safety of the mechanical system and the electrical and electronic (E/E) system. Taking into consideration E/E When it comes to autonomous cars, it is essential to balance safety with security since any malfunctions or assaults might result in a loss of protection[44].

6. Mart city

The idea of "smart cities," which is based on ICT, the Internet of Things, and computers (CS), or information management, is supported by the interconnectedness of devices and their real-time communication (IS)[45]. The so-called "smart city" notion encompasses many critical and widely used technologies, such as intelligent transportation and smart parking. Smart cities are more efficient and clever since they assist the car to the parking lot without spending time seeking parking spots, which often creates traffic congestion. Specific Internet-accessible programs can fix this issue. Moreover, smart cities are distinguished by offering their inhabitants innovative, high-quality goods and services and information about all city areas[46].

7. **Conclusion**

The automobile industry has experienced a substantial transformation due to the emergence of autonomous vehicles (AVs), which may be attributed to notable technological developments and continuous innovation. The integration of many tools and technologies, including cameras, radar, GPS, and multiple sensors, has significantly contributed to improving the operating efficiency of autonomous vehicles (AVs). This integration has led to advancements in safety, reduced traffic congestion, and decreased environmental pollution. Nevertheless, there are some difficulties with the development of autonomous vehicles (AVs). Of utmost importance are the vulnerabilities present in networks and the threats to cybersecurity, wherein hacking presents significant hazards to the safety of vehicles and the security of passengers. The inclusion of robust security systems within autonomous vehicles is important in order to protect against any hostile intrusions and technical manipulations. To sum up, the ability of self-driving cars to become a reality depends on the growth of smart city infrastructures, such as fast internet connections, advanced traffic control systems, and up-to-date maps of cities. The establishment of a harmonized ecosystem will enhance the operational efficiency of autonomous vehicles (AVs), thereby enabling smooth, safe, and effective transportation across various metropolitan environments.

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