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Artificial Intelligence in Self Driving Cars: Applications, Implications and Challenges

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Abstract

Artificial intelligence (AI) is being integrated in almost every field. The autonomous vehicles is an emerging sector that encourages regulators, consumers and policy makers to understand the needs, problems and applications of AI. This study focuses on the applications of AI in Self-Driving Cars. Big data collected using sensors and IoT devices allows AI to analyse the surroundings and make appropriate decisions for the movement of the car in the following steps: Data Collection, Data Processing, Path Planning and Action. The problems of conventional cars like poor road safety, lesser independence for the disabled, high costs, less productivity, traffic congestion, high travel time, and environmental pollution can be prevented with self-driving cars via the application of AI. However, AI powered self-driving cars face challenges like social acceptability, road conditions, traffic, weather, data privacy and cybersecurity. The study also covers similar challenges specific to India. This paper also includes future possibilities of Level 5 self-driving.

Keywords: Artificial intelligence, Self-Driving Cars, Challenges, Application and Big Data

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1. Introduction

Artificial intelligence (AI) uses data, computers and technology to simulate the human mind's problem-solving and decision-making abilities (Anjum, 2021). AI can be defined as "the study of agents that receive precepts from the environment and perform actions" (Harris, 2022). It is essentially the endeavour of producing systems with human-like cognitive behaviour such as the ability to reason, solve a problem, discover meaning and perceive from past experience and act accordingly. Machine Learning and Deep Learning approaches are combined in AI (Copeland, 2022). Today, AI has numerous uses. AI has increasingly gained importance due to its ability to address various problems in business. AI is making our daily lives more convenient and efficient. One of the growing applications of AI is in the field of automotive industry and self-driving cars are an excellent example of that. (Education, 2022).

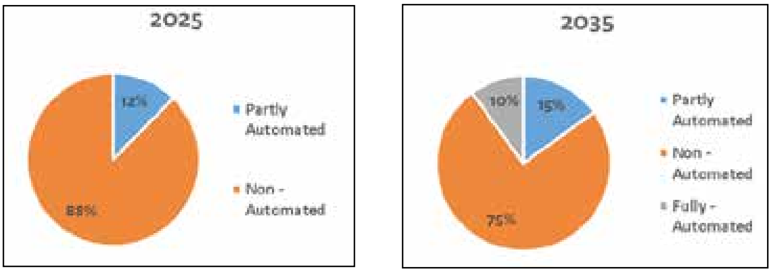
Self-driving vehicles, also known as autonomous or driverless cars, are cars or trucks which do not require human drivers to take control, for safely operating the vehicles. Such cars are composed of sensors in software to control, navigate and drive the vehicle. Self-driving cars are essentially built using artificial intelligence. In self-driving cars applications of AI can be deployed in conjunction with advanced technological innovations like GPS, radar, camera, cloud services and control signals. AI can further enhance users' experience by adding value features such as blind-spot monitoring, emergency braking and driver-assist steering (Dilmegani, 2022). The problems like poor road safety, lesser independence for the disabled, high costs, less productivity, traffic congestion, high travel time, environmental pollution associated with conventional cars can be prevented with self-driving cars (Benefits of Self-Driving Vehicles, 2018). Today the vehicles are not just machines they are intelligent, highly advanced, technological, and innovative machines. The main motivations behind research on autonomous vehicles (AV) are safe driving, increase in population and vehicles on the road, comfortable and stress free driving and effective use of available resources (Parekh et.al, 2022).

According to Bathla et.al (2021) AI powered applications play a major role in designing AVs intelligent system especially in improving the safety standards (2021). The study also emphasised that in order to implement AI in practical complex environments, the autonomous system needs to be integrated with multiple advanced technologies like Internet of Things (IoT), cloud computing and block chain. IoT lets AVs collect relevant data automatically. IoT sensors collect road traffic related data at various traffic signals and AI models use this data to take further decisions. AI powered Natural Language Processing (NLP) and speech recognition applications are used to understand the text and speech instructions in AVs. Safavi et al (2021) discuss the functioning of sensors in autonomous vehicles. Advanced neural networks are used to predict the malfunctioning of sensors such as faulty sensor prediction, identification, and isolation.

1.1. Current Scenario of the Autonomous Vehicles Market

GreyB (2022) discussed the findings of various research reports and summarized that the self-driving vehicles market has the potential to be worth $87 billion by 2030. According to him there will be no Level 4 or Level 5 vehicles in operation by 2030. Level 2 vehicles are expected to account for 92 percent of total market share, with Level 3 vehicles accounting for the rest. He further highlighted the findings of Allied Market Research that the market might grow from $54.23 billion in 2019 at a CAGR of 39.47 % to reach $556.67 billion in 2026. It also predicts that Europe would have the highest CAGR of 42.6 % between 2019 and 2026. As shown in the Figure (1), by 2035, driverless vehicles are expected to account for 25% of total car sales, with 15% being partially autonomous and 10% being fully autonomous compared to 12.4% in 2025. As per most industry experts, North America will become the leading market for self-driving vehicles. Further, the study states that the United States will be a leader in the autonomous vehicle market.

Figure 1: *The Share of Autonomous Vehicle Sales in the Total Market (2025 vs 2035)*



Source: (GreyB, 2022)

However, McCarthy analysed research surveys and reported that there are other countries that are better prepared to adopt self-driving cars than the United States (McCarthy, 2018). As shown in Figure (2) the Netherlands has the best level of preparation for autonomous driving. The survey ranked countries based on 26 variables divided into four categories: policy and regulation, technology and innovation, infrastructure, and consumer acceptance. With outstanding infrastructure, a highly supportive government, and passionate adoption of electric vehicles, the Netherlands ranked first in the rating. Singapore ranks second, after amending its Road Traffic Act to allow self-driving cars to be tested on its streets. The United States high rank in the index is due to its intensive testing programme and because it has the largest number of businesses developing self-driving technology of any country. It scored well in technology and innovation, but performed poorly in the infrastructure and in the consumer adoption of autonomous vehicles.

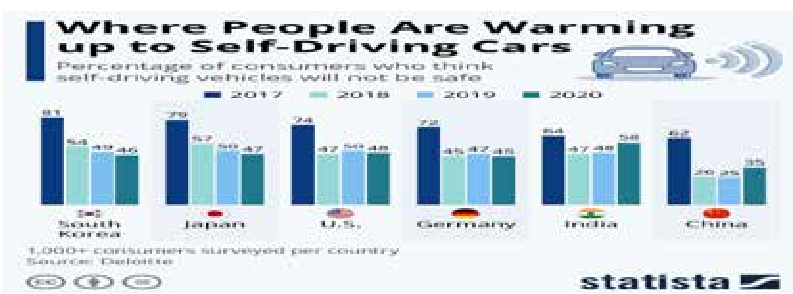
Figure 2: Countries Best Prepared for Autonomous Vehicles

Source: (McCarthy, 2018)

1.2. Consumer’s Attitude towards Self-Driving Cars

Buchholz (2020) reported in Statista the results of a survey conducted in six countries, regarding the consumer perception of the trust and safety of self-driving cars. The results are shown in Figure (3). Overall the trust in the safety of autonomous vehicles has increased over the initial three years, even though the rate of increase slowed. Improving technology led to increased trust among people of South Korea and Japan. However, accidents caused by autonomous vehicles, like Tesla that caused accidents led to doubts about the safety of self-driven cars. This is reflected in the fluctuating acceptance. The people of China have been accepting of autonomous vehicles and thus, the percentage of doubt has decreased over the initial three years. Technology concerns, however, resurfaced in the country in 2020, as they did in India.

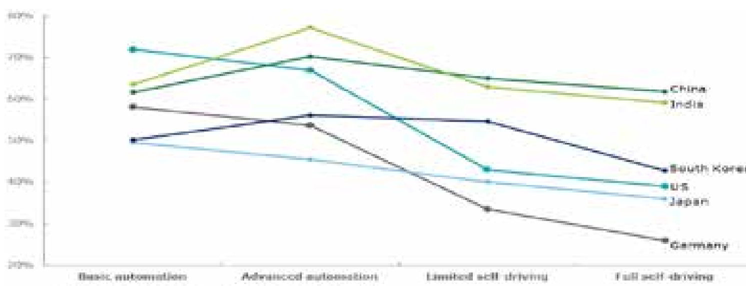
Figure 3: Percentage of Consumers who Think Self-Driving Cars will not be Safe



Source: Statista (Buchholz, 2020)

As shown in the Figure (4) that there are varying levels of interest based on levels of autonomous in vehicle technology across the global markets. Consumers in China and India appear to be the most interested in the concept of self-driving cars, whereas German consumers appear to be more sceptical of autonomous driving. Although interest in completely autonomous cars has increased in both China and the United States since 2014, the same is not true for other global markets, where interest has either remained steady or declined. In terms of generational interest, Gen Y/Z consumers are more interested in completely autonomous vehicles. Consumers are consistently concerned of the safety of driverless vehicles at the moment. If there is proven track record of completely self-driving vehicles running safely on public roads, or if it is offered by a trusted brand, then it would increase consumer support and trust towards self-driving cars.

Figure 4: Percentage of consumers who prefer different levels of vehicle automation



Source: Deloitte (What's Ahead for Fully Autonomous Driving, 2017)

2. Review of Literature

Ma et al., (2020) observed that AI advancements have sped up the development and spread of self-driving vehicles in the transportation sector. AI has become a key component of AVs for understanding the external environment and for making effective decision when in motion, thanks to the availability of extensive data from numerous sensor devices and improved computational capabilities. It is critical to understand how AI works in AV systems in order to attain the objective of full automation i.e., self-driving. Frtunikj (2018) found that data preparation, model generation, and model delivery are the three primary stages in the development of deep learning systems for self-driving vehicles. Vinkhuyzen & Cefkin (2016) observed that Autonomous Vehicles are trained by computer programs and in case of uncertainty, they don't have the capability to judge the environment like humans. Engineers need to pre define all possible situations. This can easily be done in games like chess, where the program defines all the possible ways and rules to follow, but in the case of Autonomous Vehicles it is complex as it has to deal with a real-world environment like humans do.

Faisal et al. (2019) studied and identified that Autonomous Vehicles can perform five basic operational functions when they can fully replace human drivers. These functions are localization, planning, perception, control, and management. These functions give them an advantage over conventional vehicles in platooning, eco driving, crash avoidance, lane keeping, lane changing, parking , and adapting to traffic, signals, pedestrians and other objects in the environment. Gambino et al. (2020) studied computers in a Computers are social actors (CASA) theoretical background for examining human perceptions on artificial intelligence. CASA states that humans form a social relationship with machines because they interact with computers in the same way they interact with humans. Cunneen et al. (2019) emphasised that both the safety issue and the ethical argument are concerned with predicting the societal, ethical, and legal (SEL) effects of AVs on decisional competence. The disparity, according to a critical analysis of the two approaches stem from a lack of engagement at the required meta-level to build insightful appropriate conceptual models of Autonomous Vehicles' decisional capacity, as well as a failure to consider the significant differences in how society and users understand human and computer decision-making. In reality, the automated driver actions and human driving judgments is yoked to the basic subject of AV's societal, ethical, and legal (SEL) impact. This emphasizes the importance of questioning how AV driving decisions are conceptualized.

2. Discussion

3.1. Scenario of Artificial Intelligence

Between 1940 and 1960, there was a significant interest in the connection between technological advancements and a system which can understand the combination of machines and humans. The word AI was first coined by John McCarthy in 1956. AI has drastically changed business operations today. Agriculture, education, automotive, healthcare and finance are some sectors that have shown a rapid growth. The aim of implementing AI is to replace technology and not jobs. AI's impact is not limited to businesses but voice assistants and smart robots are all around us. The use of AI based systems like chatbots and Alexa have changed every area of our lives (Council of Europe, 2022).

3.2. Levels in Autonomous Vehicles

Assis (2018) studied the research report of Society of Automotive Engineering (SAE), for autonomous vehicles and discussed that there are six levels of Advanced Driver Assistance Systems (ADAS). As shown the in the Figure (5) the steps towards a completely autonomous car are as follows:

- Level Zero: No automation, and all dynamic driving activities, such as acceleration or slowing, steering, braking, and so on, are performed by humans.
- Level One: Driver assistance via an acceleration/deceleration or steering system that uses data about driving circumstances
- Level Two: Partial vehicle automation that includes automated acceleration, deceleration, and steering
- Level Three: Conditional automation of the driving mode, which involves effective takeover by an automated driving system in response to a request from the driver
- Level Four: High automation refers to a vehicle that can handle all driving operations under specific situations without the assistance of a human driver
- Level Five: Complete automation refers to a vehicle that is capable of performing all driving jobs/functions in all conditions.

Figure 5: *Five Stages of Autonomy*

Source: (Assis, 2018)

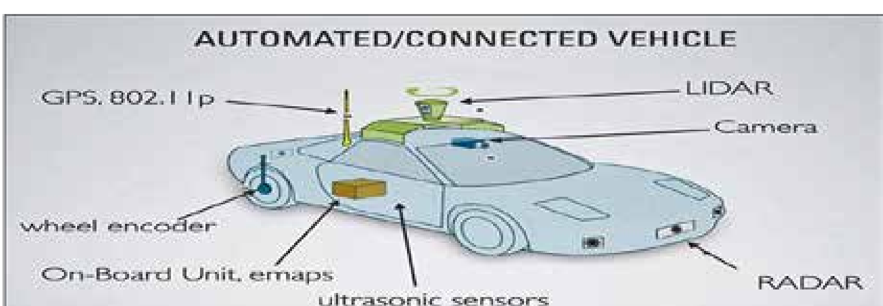
3.3. Applications of AI in Autonomous Vehicles

To build an autonomous vehicle that drive like humans, producers require to furnish these vehicles with combined sensory and cognitive functions. Further, they need to be provided with the operational capabilities that humans use while driving a vehicle **(**Gadam, 2019). AI for autonomous vehicles includes three steps: i. Data collection ii. Path planning iii. Action.

i. Data Collection

As shown in figure (6) automotive vehicles use sensor devices like lidars, radar, camera to collect data from the vehicle and the environment. This data includes objects on the road, traffic, road infrastructure and other vehicles.

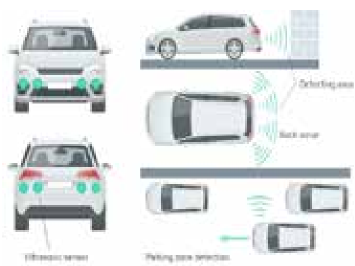
Figure 6 : *Components of Autonomous Vehicle*

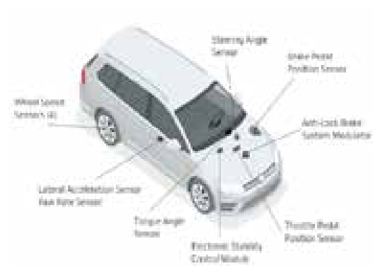


Source: The role of artificial intelligence in autonomous vehicles, 2020 (Hristozov A, 2020)

- **Ultrasonic:** Ultrasonic sensors, also known as SONAR (SOund NAvigation Ranging), use ultrasound waves to send and receive signals from nearby objects. Autonomous Vehicle Technology Report (2020) explains that the transducer is the main component of the ultrasonic sensor. It receives a digital signal as output from Engine Control Units (ECU). Actually, analogue signals that are amplified and converted as digital signals. This is used for measuring the position of the objects close to the vehicle when parking (Jahromi, 2021).

Fig 7: Ultrasonic sensors applications Fig 8: Speed and angle sensors applications





Source: How Sensor Fusion for Autonomous Cars Helps Avoid Deaths on the Road (2018, May 3)

As shown in Figure (7) ultrasonic sensors can play a very significant role in AV safety systems. They utilize sound waves, identify the distance of the nearby objects like bats and notifies the vehicle's autonomous system. This system is useful for applications like blind spot detection and parking. As shown in Figure 8, speed sensors are used to find out the speed of wheels by measuring the acceleration with a different axis and the steering angle sensors record the exact position of the front wheel. Finally these data are communicated to the driving safety system. When the vehicle travels through a tunnel and geolocation is lost then speed and angle sensors provide vehicle's current position based on previously known data. This is known as "Dead Reckoning". (intellias.com)

- **Cameras:**

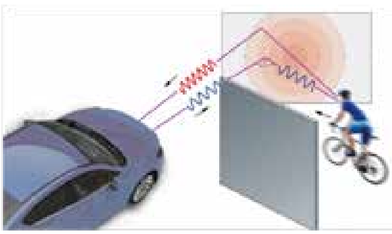
  As shown in Figure (9), the data is collected through high resolution cameras, depth cameras, and different types of sensors which are placed on each side of the car (left, right, front, and rear) to get a 360-degree view of the environment. Most new cars today already use cameras for assisted parking. Khayyam et al. (2019) discussed that computer vision algorithms are used to analyse the signals from various sensors and cameras. The image produced from these cameras are transformed from lower to higher level of information. Computer vision segments classify the physical objects and finally reconstructs 2D images into 3D.

Figure 9: Cameras in AVs

Source: Carnegie Mellon University (All-In-One Drive)

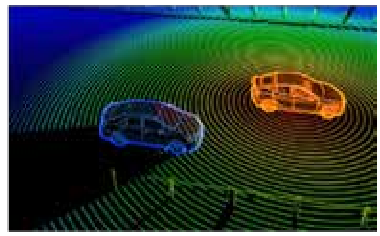
- **Radar:** Princeton University research team developed algorithms to identify potential hazards using radio waves, as shown in Figure (10). Further, Kocić et.al (2018) discussed that Radar stands for Radio Detection and Ranging. Radars play a crucial role in autonomous vehicles for this radio waves technology is used to detect short- and long-range depth. This is used for collision warning and avoidance, blind spot warning and adaptive cruise control.

Figure 10: How radar allows cars to spot hazards around corners



Source: Princeton University (2020b)

Figure 11: The Lasers for Lidars used in Self- Driving Cars

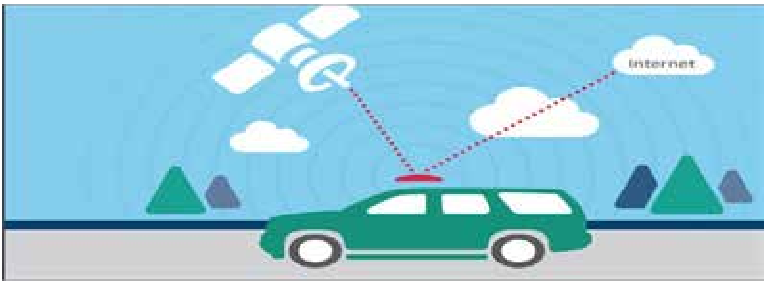


Source: Azo Materials (Mukund, 2018)

- **Lidar:** As shown in Figure (11), Light Detection and Ranging (LiDAR) is a sensor system used to measure different ranges, like radar, but it operates using light waves instead of radio waves. It operates almost like the human eye. It uses laser signal to determine the time required for the reflected signal to return to the receiver from the target. Dilmegani (2022) observed that Lidar is a non-contact range-finding technique which projects optical signals to the target and estimates the distance by processing the reflected signal. Khayyam et al (2019) discussed that LiDAR sensors use active light pulses from the vehicle's environment to detect road borders and identify lane markings.

- **GPS:** Figure (12) shows how the Global Positioning System (GPS) identifies the vehicle location and its destination with the help of satellite and internet. Royo et.al (2019) explains that GPS uses the signal from a network of satellites in a known location that emit signals at precisely known times, as well as information on the atmosphere and satellite speed, to compute the distance between the automobile and each satellite, and thus estimate the car's position. To offer more accurate positioning than is achievable with GPS alone, signals from GPS satellites are combined with readings from tachometers, altimeters, and gyroscopes.

Figure 12: GPS used Self-Driving Cars



Source: Medium- How do self-driving cars know where they are? (2018)

- **DSRC:** The Figure (13) shows the Dedicated Short-Range Communications (DSRC) from Vehicle to Vehicle. Li (2012) found that autonomous vehicles collect data from the surrounding environment by communicating with other vehicles to make decisions. The major technologies enabling the burgeoning market of Intelligent Transportation Systems (ITS) are wireless vehicular networks, operating on Dedicated Short-Range Communications (DSRC) frequency bands.

Figure 13: Dedicated Short-Range Communications from Vehicle to Vehicle

Source: Paul Myles (2019)

Figure 14: Computers in Self-Driving Cars

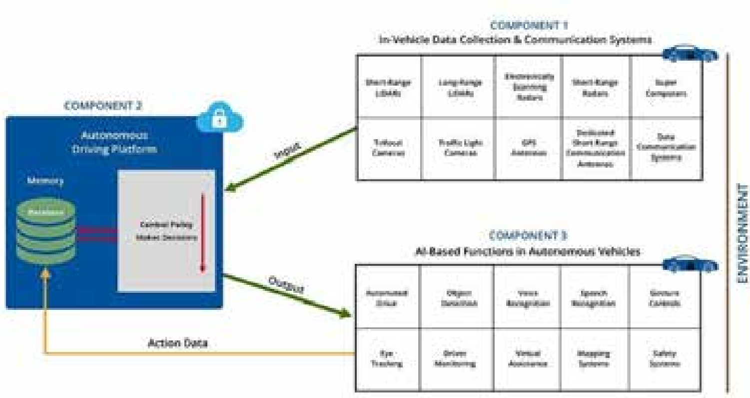
Source: (Aakash, 2016)

- **Central Computer:** The figure (14) shows the high powered computer in self- driving cars. Khayyam et al (2019) discussed that the computers in self-driving cars can be termed as the brain of the vehicle. It collects data from various components and helps in managing overall vehicle direction. The computer processes the data collected and makes decisions that help in controlling the steering, accelerator and brakes.

- **Data Processing**

The figure (15) shows the data processing system in autonomous cars. In AV the car's software processes input data, primarily from sensors, to provide the necessary signal values for controllers, ensuring that the car is moving safely in all scenarios. Sensors detect any road, traffic, vehicles and other obstacles like humans by collecting all the relevant information about the objects. Further, these sensors have higher perception than humans. Extremely sophisticated sensors and extensive algorithms are required to achieve safe, autonomous driving. Machine learning techniques and neural networks are used to classify objects in the video data. It is essential that the variety of sensors have distinct hardware/ software modules. This enables concurrent data processing and, as a result, faster decision-making. Each sensor unit can run its own AI algorithm and then transmit its findings to other devices or to the central processing computer.

Figure 15: Data Processing in Autonomous Cars

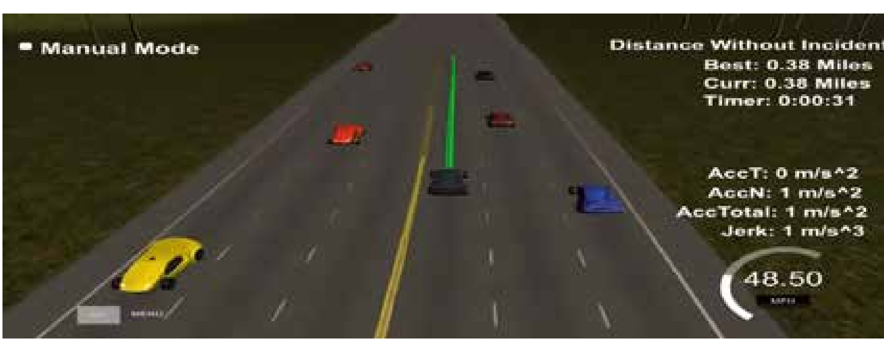


Source: (Gadam, 2019)

ii. Path Planning

Path planning for AV is defined as finding the safest, most convenient, and economically profitable paths from point A to point B by utilising previous driving experiences, which helps the AI agent make better decisions in the future. As shown in the figure (16) multiple-model route planning algorithms for manoeuvring target tracking are used to forecast the behaviour of all objects in the environment and the roadway. The estimate of the trajectory of each item is estimated based on this, allowing Advanced Driver Assistance Systems (ADAS) the capability to react quickly. These algorithms analyse numerous alternative actions for each object at the same time, then connect them with updated on-road observations received over wireless network finally, the programme determines the likelihood of each possible object motion. After that, high-probability movements are employed to construct the predicted trajectory. Following the definition of trajectories, path planning technology decides the most appropriate vehicle behaviour (Path Planning for Autonomous Vehicles (2018).

Figure 16: Path planning



Source: Path Planning for Autonomous Vehicles (2018)

iii. Action

The AV is able to recognise items on the road, steer through traffic, parking spots, barriers, entertainment, traffic signals, bicycles, people, working zones, weather patterns, and other cars, by navigating according to the AI agent's decisions, and safely arrive at its destination. AI powered control systems such as brake, steering and gesture controls, voice recognition, economic fuel, safety system, eye tracking and other driving monitoring systems are also being installed in autonomous vehicles. The AV process loops, which include data gathering, path planning, and action, will be repeated on a regular basis.

3.4. Benefits of AI in Self-Driving Cars

Automation has the capability to minimise the number of accidents on the roadways. Driver behaviour or error cause 94% of crashes, and autonomous vehicles can help reduce driver error. Higher levels of autonomy may lower the impact of unsafe and harmful driving habits. The most promising use may be in lowering the damage caused by intoxicated driving, drugged driving, unbelted car occupants, speeding, and distraction. Highly automated cars have the potential to minimise both fuel use and carbon emissions. As the vehicles will communicate with other Autonomous vehicles and road infrastructure team can get quick responses and this leads to fewer traffic congestions. Fewer traffic congestions save fuel and cut greenhouse gas emissions that happen due to unnecessary idling (Benefits of Self-Driving Vehicles, 2018).

It may become one of the safest, thanks to AI and its ability to detect a driver's vital signs and behaviours like, body movement, temperature or even increases in respiration. The autonomous vehicle would comprehend the problem based on this data and send a message to the nearest hospital informing them that a patient in distress is on his way. An individual driving on a Missouri highway experienced a pulmonary embolism and had to manually redirect the vehicle with autopilot to the hospital. The semi-autonomous autopilot capability saved the individual's life, and completely autonomous vehicles will save a large number of lives in the future (The Futuristic Health Benefits of Self-Driving Cars). When it comes to driving, disabled persons have to rely on others. Self-driving cars are especially useful for them. Tesla's summoning capability permits vehicles to exit the parking lot and travel to the owner. In the future, such features and innovations will allow disabled individuals to be nearly self-sufficient in their daily lives. In terms of the efficiency of AI-driven automobiles, we can expect to reach the goal of zero-emission vehicles, with the majority of vehicles being electric or hybrid (Dubizzle, 2022).

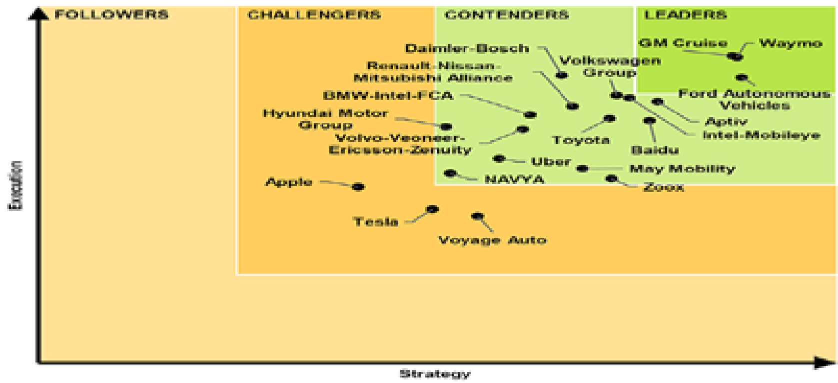
3.5. Players in Autonomous Vehicle Market

Today, over 250 autonomous vehicle firms are working towards making self-driving or driverless cars a reality, including automakers, technology providers, service providers, and tech start-ups. The figure (17) shows the major players in this autonomous vehicle ecosystem. As shown in the figure (18), in terms of execution and strategy, the players of the AV market have been divided into leaders, contenders, challengers and followers. Waymo and Google have pioneered a lot of progress in all aspects of autonomous driving. For a long time, the companies has been conducting tests and trials. Furthermore, Google is a top technological company in terms of patent filings. Since autonomous driving is primarily based on software technology, Google, being a huge company in that sector, is at the forefront (GreyB, 2022).

Figure 17: Autonomous Vehicle Ecosystem

Source: (GreyB, 2022)

Figure 18: Autonomous Vehicle Leaders



Source: Navigant Autonomous Leaderboard, 2019)

4. Challenges

AVs have become a reality today after several years of research and development, however, there are still huge challenges in the design and implementation of autonomous systems. As the level of autonomy increases in AVs, the challenges also become tougher. Challenges related to data perception, localization, planning, control, and prediction must be addressed. Parekh et.al (2022) discovered that the main challenge is in the implementation of technology in the complex real world environment. Further, non-technological factors such as customers' trust and their behaviour also play a major role in deciding AV's future success.

Road and traffic conditions are unpredictable and differ from place to place. Lanes are not clearly defined, there are potholes, mountainous and tunnel routes without clear external signals for direction. Weather Conditions are also unpredictable and constantly change from area to area. AVs must be able to function well irrespective of the weather conditions, be it sunny, rainy, stormy or clear. Its effect on the functionality of the car must be addressed, as failure or downtime is not an option.

i. Traffic Conditions keep changing. AVs would be subject to a variety of traffic circumstances once they are on the road.

There would be other cars, AVs and humans around them. Traffic could be highly controlled and self-regulated, or it could be erratic and unregulated when people are breaking rules and driving rashly. Events or conditions may occur unexpectedly. Even a few centimetres per minute of mobility matters in congested areas.

ii. Radar Interference from different AVs on the road will hinder navigation of self-driving cars. When there are several such AVs present on the road together, it will be a complex and difficult task to differentiate between its own signal and the signal reflected from another vehicle. Even if there are numerous radio frequencies available for radar, it is unlikely that this frequency range will be sufficient for all cars manufactured.

iii. Big Data Analytics is a challenge as poor data management can significantly stifle innovation. It is necessary to implement both training and decision-making systems for large amounts of AV data (Khayyam et al., 2019).

iv. 3D Map Creation is a complex task. Usually, self-driving car companies feed map data to the car's system after conducting a trial run on the road using a sophisticated machine learning algorithm. However, if the passenger chooses to visit a site not included in the navigation system, the self-driving car may not be able to provide the required guidance. Moreover, even after the time-consuming 3D maps are created, self-driving cars may still face difficulty due to changes in the traffic signals or construction work. (Tata Elxsi , 2022)

v. Complex Social Interactions required for driving are still difficult for self-driving cars. Driving is a highly social activity that involves complex interactions with other drivers, bikers, and pedestrians for which humans rely on their general intelligence. Robots lack this sense. Drivers face different driving circumstances that include vision, communication, managing four-way junctions, or a cop directing cars around a scene of the accident.

vi. Data privacy and cybersecurity is another challenge, as such cars can be easily hacked and disrupted. For example, if the car industry tries to build systems that allow various automobiles to communicate with one another on the road, like if one receives a message to slam on the brakes, he should be able to safely trust that message as that is the very basis of Vehicle-to-Vehicle communication (V2V). However, safeguarding that system may be incredibly challenging (Plumer, 2016).

vii. Regulations for a completely autonomous system do not exist. As per the current automobile regulations, the human driver is liable for any accidents or he takes over in case of any emergencies. In AVs the software makes all the decisions and choices, because of this occupants may not be alert and will generally be in a relaxed mode. Attention might require sometimes, if they don't act on time, it may be too late to get out of the situation.

viii. Social acceptability related to self-driving cars is a main topic of discussion today. There have been several serious accidents involving the current models of automated cars, including those of Tesla. The acceptability of such cars concerns not only those considering buying the car but also others sharing the same roads. The general public must be included in decisions about the deployment and use of self-driving vehicles or such a technology may be rejected (McDermid, 2020).

4.1. Indian Scenario

The world is preparing to commercialise self-driving cars. However, India has a long way to go. A policy decision is just one of several obstacles that self-driving cars must overcome before entering India. Adoption of self-driving cars is challenging due to the following reasons. The Indian government has taken a firm stance against the introduction of driverless automobiles in the country, stating job loss as the key reason. According to the government, India has 40 lakh drivers, with a driver shortage of 25 lakh. The government does not want to compromise on employment opportunities for qualified drivers, stating that the implementation of this technology may threaten the jobs of approximately one crore Indians. Furthermore, the government considers that the necessary infrastructure required to accommodate this technology is currently lacking in the country.

Indian roadways are not favourable for self-driving cars as compared to those in the western countries. Indian cities such as Delhi and Mumbai have roads that are congested at all hours of the day. Furthermore, drivers in India do not adhere to traffic regulations. They disregard traffic signals and do not drive in allocated lanes. A self-driving car is not trained to anticipate such reckless and dangerous driving behaviour. There are concerns about the economic viability of launching driverless cars in India, as corporations are concerned about their high research and development (R&D) expenditures and the consequent commercial viability. In KPMG's Autonomous Vehicle Readiness Index 2019, India was ranked 24th out of 25 countries. This shows that the country is not ready for the introduction of self-driving cars.

Despite the challenges, India is in dire need of self-driving cars. Even if the terrible traffic deadlocks and congested roads of India are overlooked, India ranks third in road accident deaths globally. In India, there is one death caused by a traffic accident every four minutes. Furthermore, twenty children under the age of 14 die of road accidents every day. According to experts, autonomous, IoT-enabled vehicles have the potential to significantly reduce the number of car accidents. Also, when intelligent machines do the driving, there is no place for human mistakes.

Future Scope

During the covid-19 pandemic period, delivery services experienced a significant increase as individuals shopped online for meals, groceries, and other products. The technology of AV has the potential to alter how items are transported from warehouse to storefront, meals are delivered from restaurants to our front door, and packages are delivered from merchants to our mailboxes. While COVID-19 pandemic proved the importance of AI powered technological applications. (GreyB, 2022)

Even though automobile companies are manufacturing level 4 self-driving cars, the production is limited to only a few units, as the public is still sceptical of purchasing them. However, in the next ten years, the production will increase and most will opt for self-driving cars, as the future requirements demand people to buy autonomous vehicles. In terms of the efficiency of AI-driven automobiles, it can be anticipated that AVs support zero-emission, with the majority of vehicles being electric or hybrid (Dubizzle, 2022). Level 5 autonomous seems impossible as of now. From more than 60 companies that applied for permits in order to test their driverless cars in California, only six were granted permission to test their vehicles without drivers on public roads. However, since testing is currently in the process, it will take more than a decade for this to come to fruition and adapt to different roads of different cities (Bellan. R, 2022).

5. Conclusion

The study has given an overview the applications of AI in self-driving cars. It has also summarised the challenges, public perception and current scenario of the Autonomous Vehicles market. It is anticipated that by 2030, autonomous vehicles will account for 25% of all vehicles on the world's roadways. Advanced technology and sensors are used by driverless automobiles to navigate the road safely. Multiple video cameras and sensors allow these vehicles to read road signs, recognise road boundaries, traffic lights, and the positions of other vehicles. All of this data is analysed and processed in a central control system, which subsequently manages the steering and movement of the car at a safe distance from other vehicles. Currently, a lot of research and development (R&D) work is being done in this field, all over the world. Companies such as Google, Tesla, Mercedes, Ford, Nissan, Volkswagen, and Hyundai are leading the way by utilising cutting-edge technology such as artificial intelligence, machine learning, and robotics engineering. Many start-ups in India are also exploring self-driving technologies.

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