International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

A Study on Autonomous Vehicles - Advancements, Benefits & Challenges

Dr. Supriya Rai[1], Kavana H K[2], Eklavya[3], Anjali Krishna Vg[4], Patnala Akanksha[5], Darsh Jain[6]

[1]Associate Professor, Jain (Deemed-to-be University) - Center for Management Studies - Bangalore, INDIA
[2,3,4,5,6]Students, BBA - Jain (Deemed-to-be University) - Center for Management Studies - Bangalore, INDIA

ABSTRACT

Autonomous vehicles, often known as self-driving cars, are automobiles that can function without the need for a driver and rely on a variety of cutting-edge technologies to detect their environment and make judgments.Road traffic is projected to change because of autonomous driving, with accidents and congestion being the two main externalities that will be reduced. Autonomous cars are starting to become a reality as a result of recent, major advancements in processing and communication technologies. Companies that produce autonomous vehicles have invested a lot of money in developing technology to make it completely commercially viable. Adoption of autonomous vehicle technology has several advantages and drawbacks. These problems come in the form of technical, non-technical, and legal difficulties.

This study paper offers a thorough examination of the developments, advantages, and difficulties related to autonomous cars. The study looks at how quickly self-driving technology is developing, what benefits it might have for society and the economy, and what complicated challenges need to be solved before it can be successfully incorporated into our transportation systems. This study presents a comprehensive picture of the present situation and potential futures for autonomous cars through a thorough analysis of the existing literature and case studies.

Keywords: Autonomous automobiles, Security, Reduced traffic fatalities, Self-driving cars, LiDAR sensor, AI, Navigation technology

CHAPTER 1 - INTRODUCTION

The vehicle business has grown tremendously and seen significant technological advancements over time. The improvements in the incorporation of computer systems and the computerization of mechanical and manual tasks have increased the features of vehicles, reduced reliance on human labor for the vehicles, and given rise to autonomous vehicles.

In order to run software, autonomous automobiles need sensors, actuators, sophisticated algorithms, machine learning systems, and robust processors. Based on a range of sensors placed in various places of the vehicle, these cars build and maintain a map of their surroundings.

Radar sensors keep track of the whereabouts of adjacent automobiles. Traffic lights, road signs, other vehicles, and pedestrians are all detected by video cameras. Lidar (light detection and ranging) sensors estimate distances, find road boundaries, and recognize lane markers by reflecting light pulses off the environment around the car. When parking, ultrasonic sensors in the wheels pick up on curbs and other cars.

Using these technologies, data is sensed, and the sophisticated control systems in these cars use that data to make decisions. When navigating and determining potential obstacles these systems take appropriate actions. A vehicle's smooth transition from a source to a destination while considering the neighboring vehicles on the road is made possible with the aid of traffic lights and signs that are also interpreted. The components of an autonomous automobile are shown in the *Fig (1)*

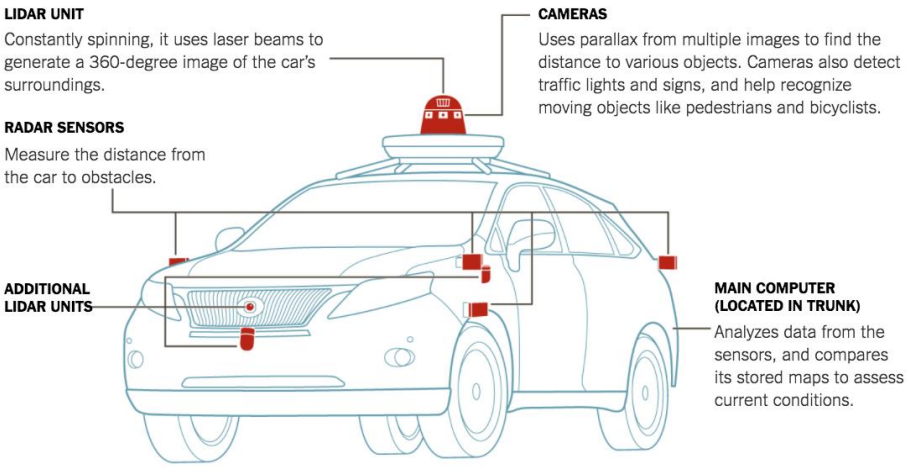


Fig (1)

BACKGROUND

HISTORY AND ORIGIN

The first autonomous vehicle (AV) was a small, three-wheeled self-propelled cart created by Leonardo da Vinci in the 16th century, which is also considered to be the first robot of any type.

Francis P. Houdina, an electrical engineer, drove a full-size radio-controlled car around the streets of New York in 1925. The project failed and the car crashed. However, attempts to automate the operation of cars increased as the number of cars increased in the decades that followed.

Industrial designer Norman Bel Geddes displayed a stunning variety of forward-thinking transportation ideas at the 1939 New York World's Fair. His "Futurama" exhibit had rooftop helipads, interstates, and semi-autonomous automobiles that could navigate them with the help of radio controls and pavement magnets. The display was sponsored by General Motors, which later developed the concept further with its Firebird line of concept automobiles over the next few decades.

By the middle of the 2010s, well-known automakers like Ford, Mercedes-Benz, and BMW as well as taxi services like Uber started utilizing self-driving technology. True autonomy, however, turned out to be more challenging to attain than initially anticipated, and many of these businesses finally stopped operating in this sector.

Tesla, which offers a Full Self-Driving package that enables autonomous hands-free operation for interstate and highway driving, is the business that is closest to putting autonomous vehicles onto the market.

LEVELS OF VEHICLE AUTONOMY

The six levels of driving automation, which range from 0 (completely manual) to 5 (totally autonomous), are defined by the Society of Automotive Engineers (SAE). The United States Department of Transportation has approved these levels.

Level 0 (No Driving Automation): Most modern automobiles are Level 0: manually operated. Although there may be technology in place to assist the driver, the "dynamic driving task" is provided by the person. The emergency braking system is one such instance; as it doesn't "drive" the car, it is not considered to be automated.

Level 1 (Driver Assistance): The lowest level of automation is this. The car has a single automatic system for steering or accelerating (cruise control). Because the human driver oversees the other parts of driving, including steering and braking, adaptive cruise control, which allows the vehicle to be kept at a safe distance behind the next car, is classified as Level 1.

Level 2 (Partial Driving Automation): This refers to ADAS, or advanced driver assistance systems. The car has steering and acceleration/deceleration controls. Because a human is seated in the driver's seat and can take over the vehicle at any time, this automation falls short of self-driving in this instance. Level 2 systems include Cadillac (General Motors) Super Cruise and Tesla Autopilot.

Level 3 (Conditional Driving Automation): Level 3 cars are capable of "environmental detection" and autonomously making judgments, like accelerating past a stationary object. However, they still require human override. If the system is unable to complete the task, the driver must stay attentive and prepared to take over.

Level 4 (High Driving Automation): Autonomous driving is possible with Level 4 vehicles. But they can only do this in a small area (often an urban setting where top speeds approach an average of 30 mph) until laws and infrastructure change. Geofencing is the term for this. As a result, ride sharing is the primary focus of most Level 4 cars currently in use.

Level 5 (Full Driving Automation): The "dynamic driving task" is no longer necessary with Level 5 vehicles. Level 5 vehicles won't even have pedals for braking or acceleration. They will be unrestricted by geofencing and capable of performing any task that a skilled human driver is capable of. There are various places throughout the world where fully autonomous vehicles are being tested, but none are presently accessible to the public.

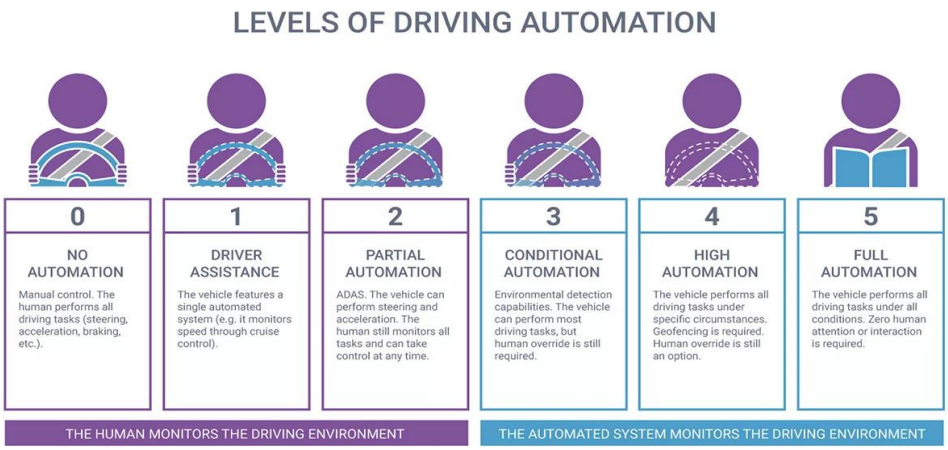


Fig (2)

FEATURES INCLUDED IN AUTONOMOUS VEHICLES

Sensor Technology: To find objects, people, and other cars in their environment, autonomous vehicles use a variety of sensors, including LiDAR, radar, cameras, and ultrasonic sensors.

Machine Learning and AI: Vehicles are now equipped with sophisticated artificial intelligence algorithms that allow them to interpret sensor data, learn from various situations, and gradually improve their driving habits.

Connectivity: Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication allows vehicles to communicate with one another and with infrastructure, enhancing traffic management and safety.

Mapping and Localization: Vehicles can position themselves accurately on the road and navigate with the help of high-definition maps used in addition to GPS and other localization methods.

Decision-Making Algorithms: In order to navigate crossings, change lanes, and react to unforeseen circumstances, algorithms use sensor data analysis to make decisions in real-time.

AUTONOMOUS VEHICLE TRENDS

1. **Internet of Vehicles:** The internet of vehicles (IoV) allows for real-time information gathering from the environment so that the driver or the vehicle's controllers can take the appropriate action. When it comes to creating IoT-based sensor and radar systems that detect data and trigger responses, automotive businesses like Motional are at the forefront.

   The Internet of Vehicles has advanced significantly, with cars now using sensors and radar technologies to obtain data such as traffic updates, weather alerts, parking lot information, etc. Due to its highly sensitive transmission and reception capabilities, LiDAR has found important applications in the AV system for studying the environment in real time.

1. **ADAS:** The successful development of an autonomous vehicle depends on the ability to react to innate traffic changes and steer the vehicle around areas where there are likely to be collisions with obstacles. To attain higher degrees of self-driving transparency, significant advancements in ADAS, or advanced driver assistance systems, are necessary. Important ADAS solutions have been developed by tech behemoths like Bosch, working with Mercedes Benz to release the technology as a driver-assist model.
2. **Artificial Intelligence**: The foundation of autonomous vehicles' automation is deep learning. The ability of AVs to make calculated decisions is based on a variety of training models and real-time data collection. Deep learning and artificial intelligence advancements in recent years have made it possible for self-driving cars to react to dangerous circumstances and overcome obstacles-tracking issues brought on by weather. AI-encoded programs that are incorporated in the vehicle's sensors and actuators are making route planning and optimization more efficient.
3. **AV Cyber Security:** Through the internet, the vehicles are linked to numerous systems, including grids, electrical networks, and other vehicles and infrastructure. The likelihood of cyber threats and vulnerabilities is therefore extremely high.

   AV-based cyber security advancements make it more certain that malicious and hostile parties are unable to break into the system and bring about system failure or loss of vehicle control. Many businesses are implementing VPN-based networks to safeguard data transmission and reception and provide higher security measures.

RECENT ADVANCEMENTS IN THE INDUSTRY

September 2021

Ford Motor Company collaborated with Argo AI and Walmart to launch autonomous vehicle in major cities of US that includes Miami, Austin, Texas, and Washington, D.C. that provide service that use Ford self-driving test vehicles paired with the Argo AI self-driving system to deliver Walmart orders to the potential customers.

September 2021

AB Volvo had partnered with Aurora to reveal a prototype long-haul autonomous truck for the North American region. It was based on the Aurora driver technology with automotive sensors that detect the surroundings and make it suitable for autonomous driving.

April 2022

BMW unveiled its new 7 Series with extensive ADAS. This new model will focus on core BMW strengths such as superior driving dynamics and combine them with improved passenger car comfort and equipment levels related to car connectivity and ADAS. Thus, this launch would help BMW to capture the market and increase their core sales.

May 2022

Mercedes launched the SAE L3 drive pilot system. The system allows drivers to hand over control to the vehicle and allows hands-free control on certain roads and at certain speeds. This launch is aimed at creating awareness regarding L3 driving that would increase the sales of vehicles equipped with L3 system.

BENEFITS

1. **Greater Road Safety:** According to government statistics, driver mistakes or behavior accounts for 94 percent of accidents. For instance, the NHTSA reports that fatigued drivers are twice as likely to make mistakes. Driver-assist features like lane departure alerts and blind spot monitoring can help prevent collisions, and it is anticipated that as automatic emergency braking becomes more frequently used, rear-end collisions, the most frequent type of collision, would drastically decrease. Higher degrees of autonomy may make drivers less inclined to engage in risky and hazardous driving practices. The biggest hope may be lessening the destruction caused by drunk driving, which accounts for around one-third of all current traffic fatalities. All passengers could safely engage in more productive tasks, like checking email, in a fully automated vehicle.
2. **Reduced Congestion:** Roadway delays are reduced when there are fewer accidents or collisions. AVs are programmed to keep a regular and safe distance between cars, which can lessen the frequency of stop-and-go waves that cause traffic gridlock for no discernible reason. According to University of Texas researchers, platoons of closely spaced autonomous vehicles might cut down on traffic-related delays on highways by 60%.
3. **Environmental Gains:** Reduced congestion reduces greenhouse gas emissions and saves fuel. Automated driving systems could lessen needless braking and acceleration, which wastes gasoline. To reduce air, drug and fuel consumption, vehicles with fully autonomous driving systems may be able to move closer together. According to one estimate, a group of automated vehicles on the highway may use 10% less gasoline. The demand for all types of electric vehicles may increase because of automation and car sharing. The economic attraction of electric cars is increased when they are used

more frequently throughout the day thanks to car sharing, which also allows for the pooling of any upfront battery expenditures.

4. **More Productivity:** Less traffic means shorter commutes. In the future, AVs might make it convenient to drop off passengers at their location—whether it's an airport or a shopping center—while the car parks itself. In vehicles with the highest levels of automation, people could engage in other activities like reading, napping, or playing with kids. Business fleets might streamline supply chains and travel routes with the help of AVs for cheaper, more effective deliveries.
5. **Greater Independence:** Automated vehicles can support people with impairments in leading the life they want. People with disabilities are capable of being self-sufficient. The freedom of older people can be improved by these vehicles. AV ridesharing could lower the cost of personal transportation and increase mobility.
6. **Better Land Use:** Since AVs can drive more closely together and require less road space, the capacity of the highway might be enhanced without the need for development. A better use of land may result from AVs. Automated vehicles used for ridesharing may result in less of a demand for parking, particularly in cities.
7. **360° vision:** Autonomous vehicles can view their surroundings in a 360° range, which is twice as much as people, who can only see 180° in front of them. This is possible because of high-precision technology.

LIMITATIONS

1. **Security issues:** The potential for hacking is one of the drawbacks of self-driving cars. They would need to use the same network protocol for automated automobiles to communicate and work together. But if a lot of automobiles are connected to the same network, they may be hacked. On congested highways, even a minor hack could cause significant harm by resulting in collisions and gridlocked traffic.
2. **High cost of implementation:** The infrastructure for autonomous vehicles depends on 5G network coverage, which is still expensive. As a result, it might take governments a long time to invest in enough infrastructure to support autonomous vehicles at their best.
3. **High cost of vehicles:** Although there has been a huge reduction in the price of manufacturing their tools, these reductions have not gone far enough to make them a financially viable choice for the typical household. It will take some time before they become a common occurrence that the middle class can afford.
4. **Machine error:** While most people agree that self-driving cars will probably prevent fewer accidents from occurring, they do not entirely eliminate the possibility of accidents brought on by machine mistakes. Additionally, if the software or any other component of the car malfunctions, an autonomous vehicle may place the driver in greater risk than if the driver took personal control of the car.
5. **Infrastructure:** Infrastructure issues will become a clear need due to the drastic transformation that AVs will bring to the current transportation system. AVs frequently require clear lane markings, locations to store the driving-related data, and, if they use power, a more robust charging network. The system can become unusable in its early stages if the obstacles are not sufficiently anticipated.

CHAPTER 2 - REVIEW OF LITERATURE

- **Title: Safety of autonomous vehicles**

Author: Jun Wang, Li Zhang, Yanjun Huang, Jian Zhao, Francesco Bella
Journal of advanced transportation 2020

In this article, the levels of automation are reviewed according to the role of the automated system in the autonomous driving process, which will affect the frequency of disengagements and accidents when driving in autonomous modes. Additionally, the public on-road AV accident reports are statistically analyzed. The results show that over 3.7 million miles (about 5954572.8 km) have been tested for AVs by various manufacturers from 2014 to 2018.

This literature review summarizes the safety-related issues for AVs by theoretical analysis of the AV systems and statistical investigation of the disengagement and accident reports for on-road testing, and the findings will help inform future research efforts for AV developments.

- **Title: Autonomous vehicles: theoretical and practical challenges**

Author: Margarita Martínez-Díaz, Francesc Soriguera
Transportation Research Procedia 2018

This paper investigates people's preferences for owning and using autonomous vehicles. They surveyed 721 individuals in Israel and North America and asked them to choose their preferred commuting option: using their current car, buying a privately-owned autonomous vehicle (PAV), or using a shared-autonomous vehicle (SAV). The study also identified five factors that influence people's attitudes towards AVs, such as technology interest and environmental concern.

Overall, it seems like there are still hesitations towards adopting autonomous vehicles, with 44% of participants uncertain about their choice.

- **Title: Social behavior for autonomous vehicles**

Author: Wilko Schwarting, Alyssa Pierson, Javier Alonso-Mora, Sertac Karaman, Daniela Rus
Proceeding of the National Academy of Sciences 2019

This paper presents a framework that integrates social psychology tools into controller design for autonomous vehicles. Its key insight utilizes Social Value Orientation (SVO), quantifying an agent’s degree of selfishness or altruism, which allows them to better predict driver behavior. It models interactions between humans and autonomous agents with game theory and the principle of best response. Its unified algorithm estimates driver SVOs and incorporates their predicted trajectories into the autonomous vehicle’s control while respecting safety constraints. It also studies the common-yet-difficult traffic scenarios: highway merging and unprotected left turns.

- **Title: The Effect of Autonomous Vehicles on Traffic**

Author - Bernhard Friedrich
Springer, Berlin, Heidelberg 2016

Autonomous vehicles provide new mobility opportunities for groups of people that thus far have been partially or entirely excluded from participation in public life due to mobility restrictions. In addition to the benefits that autonomous vehicles potentially provide their users, the social benefits that would come with their proliferation are of interest. For it is clear that autonomous driving does not lead to a loss of safety or efficiency of road transport but rather improves them. This paper considers the traffic impact of

autonomous vehicles, looking specifically at the efficiency of using the existing infrastructure. provide a preliminary assessment of the potential for optimizing the efficiency of traffic flow that potentially includes autonomous vehicles.

- **Title: AI, you can drive my car: How we evaluate human drivers vs. self-driving cars**

Author: Joo-Wha Hong, Ignacio Cruz, Dmitri Williams

Computers in Human Behavior 2021

This study tests how individuals attribute responsibility to an artificial intelligent (AI) agent or a human agent based on their involvement in a negative or positive event. In an online, vignette experimental between-subjects design, participants (n = 230) responded to a questionnaire measuring their opinions about the level of responsibility and involvement attributed to an AI agent or human agent across rescue (i.e., positive) or accident (i.e., negative) driving scenarios. Results show that individuals are more likely to attribute responsibility to an AI agent during rescues, or positive events.

Also, we find that individuals perceive the actions of AI agents similarly to human agents, which supports CASA framework's claims that technologies can have agentic qualities. Implications of findings for practical applications and theory are discussed.

- **Title: Towards a Viable Autonomous Driving Research Platform**

Author: Junqing Wei, Jarrod M. Snider, Junsung Kim, John M. Dolan, Raj Rajkumar and Bakhtiar Litkouhi

This paper presents an autonomous driving research vehicle with minimal appearance modifications that is capable of a wide range of autonomous and intelligent behaviors, including smooth and comfortable trajectory generation and following; lane keeping and lane changing; intersection handling with or without V2I and V2V; and pedestrian, bicyclist, and work zone detection. Safety and reliability features include a fault-tolerant computing system; smooth and intuitive autonomous-manual switching; and the ability to fully disengage and power down the drive-by-wire and computing system upon E-stop. The research is based on how the vehicle has been tested extensively on both a closed test field and public roads.

- **Title: Research Paper on AI in Driving**

Author: Bhavesh Ajaykumar Shukla, Prathamesh Gorakhnath Khose, Students, MCA, ASM IMCOST College Thane

International Journal for Research 2022

The study sheds insight on the development and effects of artificial intelligence (AI) on the automotive sector by examining the relationship between AI and self-driving cars. In addition to establishing the idea of self-driving cars and their reliance on sensors, cameras, radar, and AI, the article gives a thorough summary of the topic. A major strength is the potential for a quantitative investigation of AI's impact on the advancement of self-driving cars. Intriguingly, the finding of a significant shift in technological application after 2009 points to a crucial turning point in this field.

A holistic approach to the subject is also shown by the paper's acknowledgment of the social, legal, and ethical implications of self-driving cars. Overall, the research paper offers valuable insights into the growth of AI technology in autonomous vehicles, emphasizing both the benefits and challenges.

- **Title: A Review on Autonomous Vehicles: Progress, Methods and Challenges.**

Author: Darsh Parek, Nishi Poddar, Aakash Rajpurkar, Manisha Chahal, Neeraj Kumar, Gyanendra Prasad and Woong Cho

New Advances and Challenges in Communication Networks 2022

This study offers a thorough analysis of autonomous vehicles, covering key areas and technology. It explores course planning, motion control, vehicle cybersecurity, and public trust in addition to environment and pedestrian detection.

The importance of deep learning methods like CNNs and CNNs is discussed along with sensor technology like LiDAR, RADAR, cameras, GNSS, and ultrasonic sensors. The importance of motion control and planning is emphasized in the study, which also discusses trajectory planning, overtaking, and steering control.

Concerns about cybersecurity are also discussed, underlining the necessity of stakeholder cooperation to secure the security of autonomous systems. A major issue is public trust, which emphasizes the value of openness and comprehension of customer opinions. Future research problems and directions are outlined in the paper's conclusion.

- **Title: Autonomous vehicles: A study of implementation and security**

Authors: Firoz Khan, R. Lakshmana Kumar, Seifedine Kadry, Yunyoung Nam, Maytham N. Meqdad

International Journal of Electrical and Computer Engineering (IJECE) 2021

Autonomous vehicles have been invented to increase the safety of transportation users. These vehicles can sense their environment and make decisions without any external aid to produce an optimal route to reach a destination.

Even though the idea sounds futuristic and if implemented successfully, many current issues related to transportation will be solved, care needs to be taken before implementing the solution. This paper will look at the pros and cons of implementation of autonomous vehicles. The vehicles depend highly on the sensors present on the vehicles and any tampering or manipulation of the data generated and transmitted by these can have disastrous consequences, as human lives are at stake here. Various attacks against the different type of sensors on-board an autonomous vehicle is covered.

- **Title: Understanding autonomous vehicles: A systematic literature review on capability, impact, planning and policy**

Author: Asif Faisal, Md Kamruzzaman, Tan Yigitcanlar, Graham Currie

The Journal of Transport and Land Use 2019

Advancement in automated driving technology has created opportunities for smart urban mobility. Automated vehicles are now a popular topic with the rise of the smart city agenda. However, legislators, urban administrators, policymakers, and planners are unprepared to deal with the possible disruption of autonomous vehicles, which potentially could replace conventional transport.

There is a lack of knowledge on how the new capabilities will disrupt and which policy strategies are needed to address such disruption. This paper aims to determine where we are, where we are headed, what the likely impacts of a wider uptake could be, and what needs to be done to generate desired smart urban mobility outcomes. The methodology includes a systematic review of the existing evidence base to understand capability, impact, planning, and policy issues associated with autonomous vehicles. The

review reveals the trajectories of technological development, disruptive effects caused by such development, strategies to address the disruptions, and possible gaps in the literature.
The paper develops a framework outlining the interlinks among driving forces, uptake factors, impacts and possible interventions. It concludes by advocating the necessity of preparing our cities for autonomous vehicles, although a wider uptake may take quite some time.

CHAPTER 3 – METHODOLOGY

SCOPE

This research paper's scope includes an examination of the goals and possible societal advantages of autonomous vehicles. It explores important topics like cost-cutting, accessibility, environmental sustainability, efficiency improvement, and safety enhancement. The study also discusses a number of other difficulties, such as those pertaining to infrastructure, data security, job displacement, public acceptance, cybersecurity, ethics, and regulations. The main objective is to address major concerns about the safety, efficacy, and societal impact of autonomous cars while offering insights into their thorough understanding and efficient use.

OBJECTIVES

- This paper aims to review the advancement of autonomous cars focusing on the various sensors deployed in them along with the different communication technologies employed. Therefore, the objectives of this survey are as follows: To identify and describe the different types of sensors used in AVs.
- Reduce traffic, cut transportation costs (in terms of vehicles, fuel, and infrastructure) Improve walkability and livability. Free up parking lots for other uses (schools, parks, community centers).
- Autonomous vehicles are capable of navigating traffic and busy roads without the assistance of human controllers or decision-makers. Autonomous vehicles increase passenger comfort by releasing the passengers from the responsibility of operating a vehicle. For demographics who have historically been mostly or entirely excluded from participation in public life because of mobility issues; autonomous vehicles offer new options for mobility.
- Beyond whatever benefits they might provide to their users, the social benefits of widespread use of autonomous vehicles are intriguing. For it is abundantly clear that autonomous driving enhances rather than decreases the effectiveness or safety of road transit.
- The objective of this work is to develop an online opinion among people and to know what they think about the autonomous vehicles regarding the following
  - The safety
  - Efficiency
  - Environmental sustainability
  - Accessibility
  - Cost reduction

DATA USED FOR THE SURVEY

Ten questions make up the Google Form used for our survey on autonomous vehicles, which aims to collect information on a variety of AV-related topics. Through the examination of open-ended questions, recurrent themes, viewpoints, and opinions surrounding AV technology are found in the qualitative

analysis of the survey responses. A fuller comprehension of participants' attitudes, worries, and expectations surrounding autonomous vehicles is made possible by this qualitative method.
Furthermore, statistical data, such as averages or percentages, on subjects like safety perceptions, readiness to utilize autonomous vehicles, or acceptance-influencing factors are produced by the examination of closed-ended questions in quantitative analysis. These numerical insights into the prevalence of opinions or trends among respondents are provided by the quantitative data.
Together, qualitative and quantitative analyses offer a comprehensive understanding of public perceptions and attitudes toward autonomous vehicles, informing your research paper's findings and conclusions.

PROBLEMS/CHALLENGES FACED

Surveys related to autonomous cars may encounter issues such as participant bias, limited understanding of the technology, and varying comfort levels with automation. Additionally, framing questions accurately to capture nuanced opinions, ensuring a diverse and representative sample, and accounting for social desirability bias are common challenges. Technological advancements and public perception can also
Challenges faced:

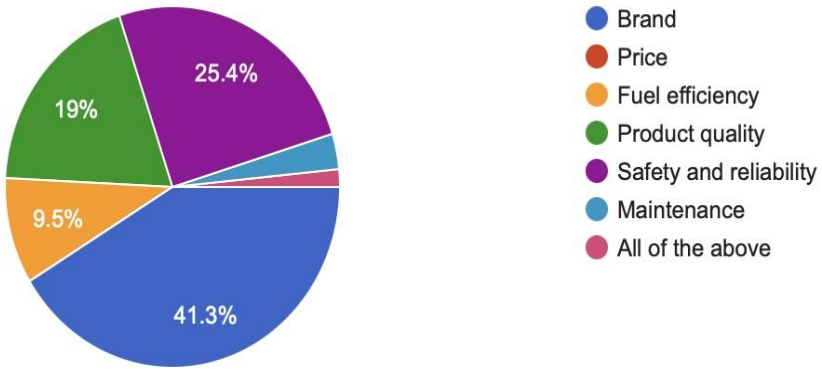
1. Complexity of Technology
2. Safety and Ethical Considerations
3. Regulatory and Legal Landscape
4. Human Factors and User Acceptance
5. Interdisciplinary Nature

People often express concerns about the safety of automated cars, uncertainties surrounding technology failures, ethical considerations in decision-making by autonomous systems, potential job displacement for drivers, privacy issues related to data collection, and the overall adjustment to a new paradigm of transportation. This research paper addresses these concerns which is essential for the successful integration of automated cars into society.

CHAPTER 4 - FINDINGS/DATA INTERPRETATION

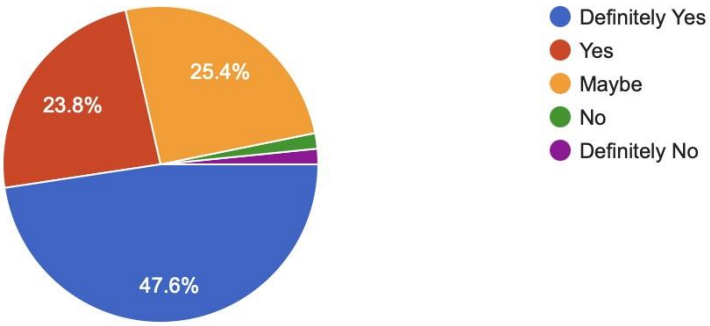
Result of the Survey conducted on ‘A Study on Autonomous Vehicles - Advancements, Benefits & Challenges’. We recorded about 63 responses from people who own or plan to own an automated vehicle and the results of it are as follows:

1. What element do you think is the most important when you are buying cars?



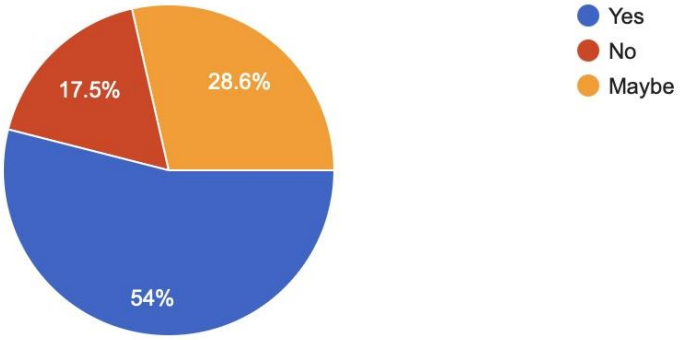
The survey reveals that brand reputation holds the utmost importance for car buyers, constituting 41.3% of preferences. Safety and reliability closely follow at 25.4%, indicating a strong emphasis on trustworthiness. Product quality ranks next at 19%, emphasizing the desire for durable and well-made vehicles. Fuel efficiency, at 9.5%, suggests a growing concern for environmental and economic factors. Additionally, considerations such as price and maintenance collectively represent the remaining aspects of importance, highlighting the comprehensive nature of car purchasing decisions among consumers.

2. To what extent is your possibility to buy Automated cars when you want to buy a car?



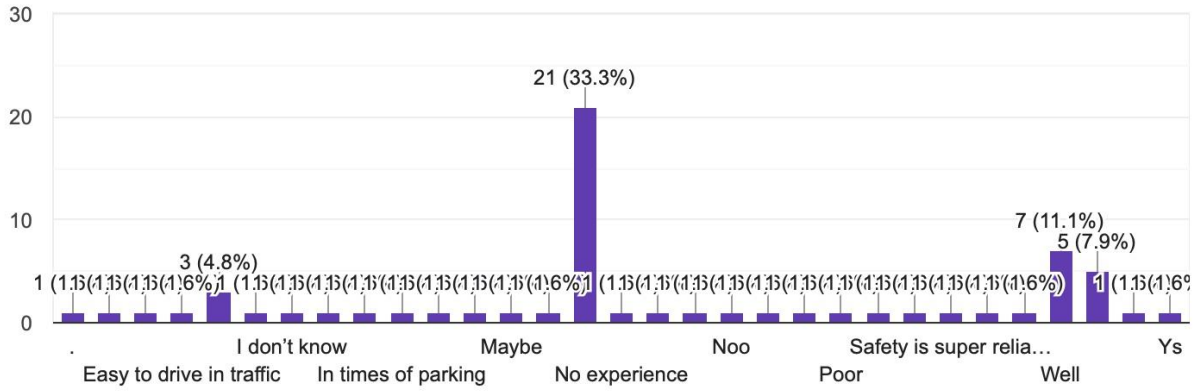
When considering purchasing a vehicle, a significant percentage, 47.6%, are clearly inclined to choose autonomous cars, according to the survey. Furthermore, 23.8% answer "yes" with a positive leaning. There are still 25.4% who are willing to consider the option and respond "maybe." Remarkably, answers that indicate "no" or "definitely no" make up the alternatives that are still available. These findings imply that respondents have a high degree of interest in and openness to buying automated vehicles, and a substantial number of them indicate a strong inclination or consideration for adoption in the future.

3. Do you think that automated cars make journeys quicker?



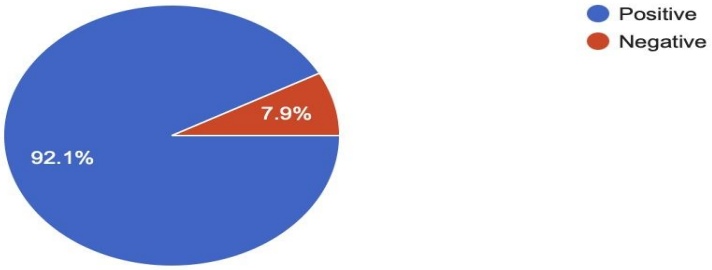
The survey indicates a general view of increased efficiency, with 54% of respondents believing that driverless automobiles speed up travel times. On the other hand, 17.5% of respondents disagree, indicating doubt about the benefits of driverless cars in terms of speed. In contrast, 28.6% are unsure, which could be the result of a complex viewpoint or a need for additional knowledge. This range of viewpoints highlights how diverse people's perceptions are on how driverless car technology could affect travel times.

4. Have you encountered any unexpected situations where the automated system performed exceptionally well or poorly?



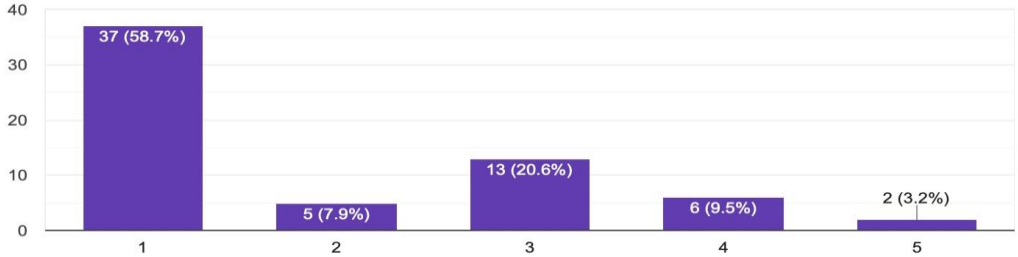
The majority of users report no significant encounters with unexpected situations where automated systems performed exceptionally well or poorly. This suggests that, overall, automated systems are meeting expectations or at least not causing notable issues. While there may be occasional outliers, most users seem to have had smooth experiences with automated systems, reflecting their effectiveness in various contexts and tasks.

5. Do you think automated cars will have a positive or negative impact on overall traffic and transportation systems?



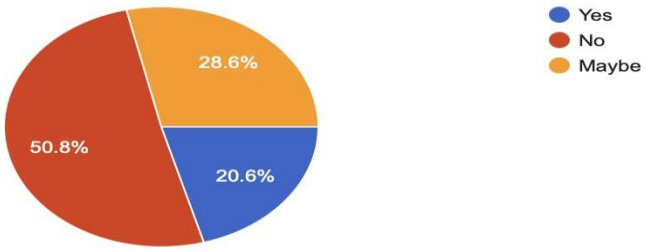
In accordance with the statistics presented, 92.1% of respondents think automated vehicles will improve traffic and transportation systems overall, while 7.9% disagree. This suggests that the majority of people strongly support automated automobiles' beneficial effects on traffic and transit and it also indicates that there is a general expectation of advantages including better traffic flow, more efficiency, and increased safety.

6. How easy do you find it to park an automated car?



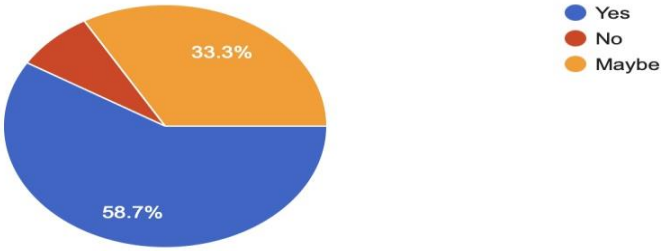
According to the research, 58.7% of respondents considered it easy to park an autonomous vehicle, with 20.6% finding it moderately easy. 7.9% of respondents reported some difficulty, while 13.7% (9.5% + 3.2%) said they found it very tough or somewhat challenging. The majority of responders appear to regard parking automated automobiles to be generally not too difficult.

7. Did you face any difficulties or challenges while driving in inclement weather conditions?



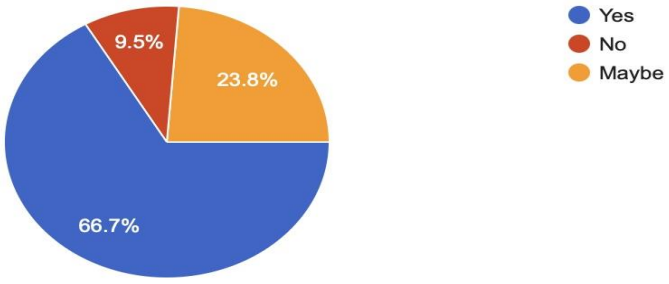
The data suggests that a significant portion, 20.6%, of respondents have experienced difficulties or challenges while driving in inclement weather conditions. On the other hand, the majority, 50.8%, have not faced such challenges. The remaining 28.6% responded with "maybe," indicating some uncertainty or variability in their experiences with driving in adverse weather conditions. This information highlights the diversity of experiences individuals have when navigating inclement weather while driving.

8. Does the LiDAR sensor really help you in automated vehicles?



The data indicates that a significant majority, 58.7%, believe that LiDAR sensors do help in automated vehicles. Only a small percentage, 8%, expressed a contrary opinion, suggesting skepticism about the effectiveness of LiDAR sensors. Meanwhile, 33.3% responded with "maybe," indicating some uncertainty or variability in their perception of the impact of LiDAR sensors on automated vehicles. Overall, a considerable portion of respondents acknowledge the potential benefits of LiDAR technology in enhancing automated vehicle capabilities.

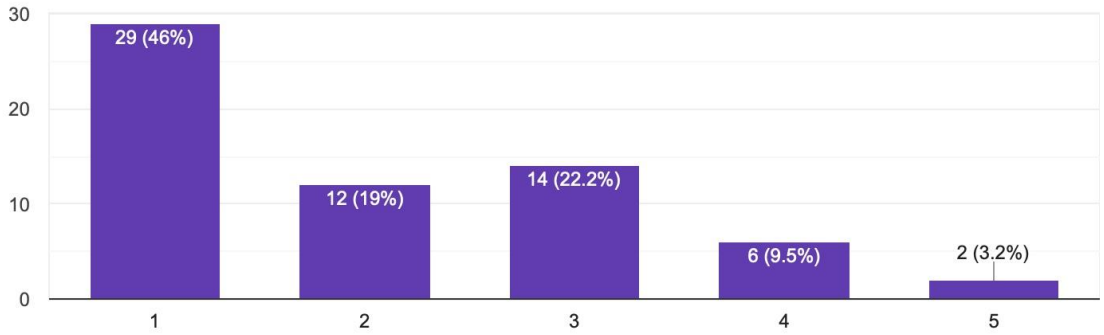
9. Do you like the primary technology for navigation in automated cars?



With 66.7% expressing a good opinion, the data indicates a significant overall positive feeling regarding the principal technology for navigation in automated cars. 9.5% of respondents had an unfavorable opinion

and expressed a disdain for the main navigation technology. In response, 23.8% of respondents said "maybe," suggesting that they were not sure or inconsistent in how much they liked the technology. Even while most respondents express approval, it's interesting to note that some are still unsure or have misgivings about the navigation technology in driverless vehicles.

10. How do you evaluate Automated car's overall quality? (1 being very good; 5 being very bad)



According to the survey, a sizable majority—46%—think that automated automobiles are of very good overall quality, while only 19% think it is good (2). 22.2% give it a neutral rating (3), reflecting a divided opinion. Only 3.2% of respondents rank the quality as extremely poor, while a lesser percentage, 9.5%, thinks it is only moderately subpar (4). The findings indicate that people have a generally positive opinion of driverless automobiles, yet a sizeable percentage expressed neutral opinions, suggesting that there is still space for improvement despite people being generally satisfied with their performance.

CHAPTER 5 – FINDINGS AND CONCLUSION

The study on autonomous vehicles reveals several key insights. Firstly, safety and reliability are crucial factors, with 25.4% of participants emphasizing these aspects. Additionally, brand reputation significantly influences purchasing decisions, with 41.3% considering it when buying cars.

The study indicates a notable interest in electric cars, with 47.6% expressing the possibility of buying one. Furthermore, a majority (54%) believe that automated cars contribute to quicker journeys. Interestingly, many participants lack experience with unexpected situations related to automated cars, suggesting potential positive impacts on traffic and transportation systems.

The survey highlights positive perceptions of automated car features, including 58% finding them easy to park, 50.8% expressing confidence in facing challenges in bad weather, and 58.7% recognizing the benefits of LiDAR sensors. Additionally, a significant majority (66.7%) praise the primary technology for navigation.

While overall satisfaction with the autonomous vehicle experience is positive, with 46% expressing contentment with the quality, the study provides a comprehensive view of public opinions and preferences in the realm of autonomous vehicles.

In conclusion, the study on autonomous cars provides a multifaceted view of public perceptions and preferences. The findings reflect a positive inclination towards safety and reliability, as well as a significant consideration of brand reputation in the decision-making process. The evident interest in electric cars suggests a growing awareness of environmental sustainability among consumers.

Moreover, the study indicates an optimistic outlook on the potential benefits of autonomous technology, with a majority of participants believing it can make journeys quicker. The limited experiences with

unexpected situations related to automated cars hint at a developing trust in the reliability of these systems and the potential positive impact on traffic and transportation systems.

The positive reception of specific features, such as ease of parking and confidence in adverse weather conditions, underscores the gradual acceptance and integration of autonomou technologies into everyday life.

Additionally, the acknowledgment of advanced technologies like LiDAR sensors and primary navigation systems highlights the importance of robust technological infrastructure in shaping positive user experiences.

While the overall satisfaction with the quality of autonomous vehicles is encouraging, it is evident that consumer attitudes are evolving. As technology continues to advance, these insights provide valuable guidance for industry stakeholders in addressing consumer expectations and refining autonomous vehicle technologies for a future where they are likely to play an increasingly prominent role in the automotive landscape.

REFERENCES

1. https://www.hindawi.com/journals/jat/2020/8867757/
2. https://www.pnas.org/doi/abs/10.1073/pnas.1820676116
3. https://www.sciencedirect.com/science/article/abs/pii/S0747563221002673
4. https://www.ijraset.com/best-journal/research-paper-on-ai-in-driving
5. https://ijece.iaescore.com/index.php/IJECE/article/view/24593/14905
6. https://www.sciencedirect.com/science/article/pii/S2352146518302606
7. https://link.springer.com/chapter/10.1007/978-3-662-48847-8_16
8. https://ieeexplore.ieee.org/abstract/document/6629559
9. https://www.mdpi.com/2079-9292/11/14/2162
10. https://www.jtlu.org/index.php/jtlu/article/view/1405