Chapter 2

Literature Review

2.1 Introduction

ITS have emerged as a transformative technology in the field of transportation. With their potential to revolutionize the way we travel, self-driving cars have attracted significant attention from researchers, policymakers, and industry leaders. This literature review aims to provide a comprehensive overview of the existing literature on self-driving cars, exploring the advancements, challenges, and implications associated with this groundbreaking technology. In recent years, self-driving cars have become a focal point of innovation and research in the automotive industry. The concept of vehicles capable of navigating and operating without human intervention has captured the imagination of scientists and engineers alike. The development of self-driving cars is driven by advancements in artificial intelligence, sensor technologies, and computing power, which enable these vehicles to perceive their surroundings, make decisions, and maneuver on the road.

The potential benefits of self-driving cars are vast and encompass various aspects of transportation. Foremost among these benefits is the promise of improved road safety. Human error contributes to the majority of accidents on the road, and self-driving cars have the potential to significantly reduce these incidents through their advanced sensing capabilities and real-time decision-making algorithms. Furthermore, self-driving cars have the potential to increase accessibility to transportation for individuals who are unable to drive, such as the elderly or disabled. By providing a reliable and convenient mode of transportation, self-driving cars can enhance mobility options and empower individuals who may have previously faced limitations in their ability to travel independently.

2.2 “Autonomous Car: Current Issues, Challenges and Solution”

The first radio-controlled automobiles were created in 1920 and presently it comes with many significant changes. Later, self-driving automobiles with identical electrical guidance systems first appeared in 1960. Vision-directed autonomous cars were a key technological milestone in the 1980s, and we still employ comparable or updated kinds of vision and radio-guided technology trends. However, these autonomous vehicles face many challenges and issues in their development process. According to a survey by the RAC Foundation, the cars 96% of the time is spent in parking because of the security and protection of cars. These fully automated cars always connect to your mobile or command. Then it has high security. Autonomous cars can also help in the transportation of products, which can be made more dependable and efficient by their usage. Although self-driving cars have several advantages, they face certain hurdles in their development and commercialization.

One of the most significant problems is the need for a legal framework and laws. There may be times on the road when an autonomous system is unable to decide whether to rescue its passengers or other pedestrians and as well as vehicles. Making a rapid and sensible judgment under such situations is difficult. Many individuals prefer to drive and would find it difficult to relinquish control of their vehicles. Interacting with human-driven vehicles on the same route poses additional hurdles for autonomous vehicles. Another issue with self-driving cars is determining who will be held accountable for damage to the car manufacturer, the car's occupants, or the government.

2.2.1 State of The Art of Autonomous Vehicle

To execute software and navigate between locations without a human operator, autonomous vehicles require a mix of sensors, actuators, machine learning systems, and complicated and powerful algorithms. Car navigation is accomplished by the use of a navigation system, which is outfitted with a GPS and a geographic information system to capture location information such as latitude and longitude. The location system determines the relative vehicle location using an inertial navigation system. An electronic map stores data regarding traffic and road infrastructure. Path planning is generally accomplished by map matching, which estimates the car's location.

Autonomous vehicles can be divided into six levels according to their technology as shown in figure 2.1.

Levels of autonomous vehicles:

1. In **level 0** there is no automation. All tasks are done by the driver.
2. In **level 1** there it works as Driver Assistance presence of standalone car components such as Electronic Stability or Automatic Braking.
3. In **level 2** partial automation is happen while integrated automated elements such as steering, acceleration, lane-keeping, and adaptive cruise control. The driver, on the other hand, must always be active in driving and watch the environment.
4. In **level 3** driver can entirely deactivate certain of the vehicle's critical functions under specific situations, but he or she must always be ready to assume control of the vehicle with early warning. This is called the conditional automation level.
5. In **level 4** the vehicle is capable of performing all driving duties. The driver may or may not have the ability to operate the car.
6. In **level 5** a fully automated car which vehicle can conduct all driving operations under all settings and conditions.

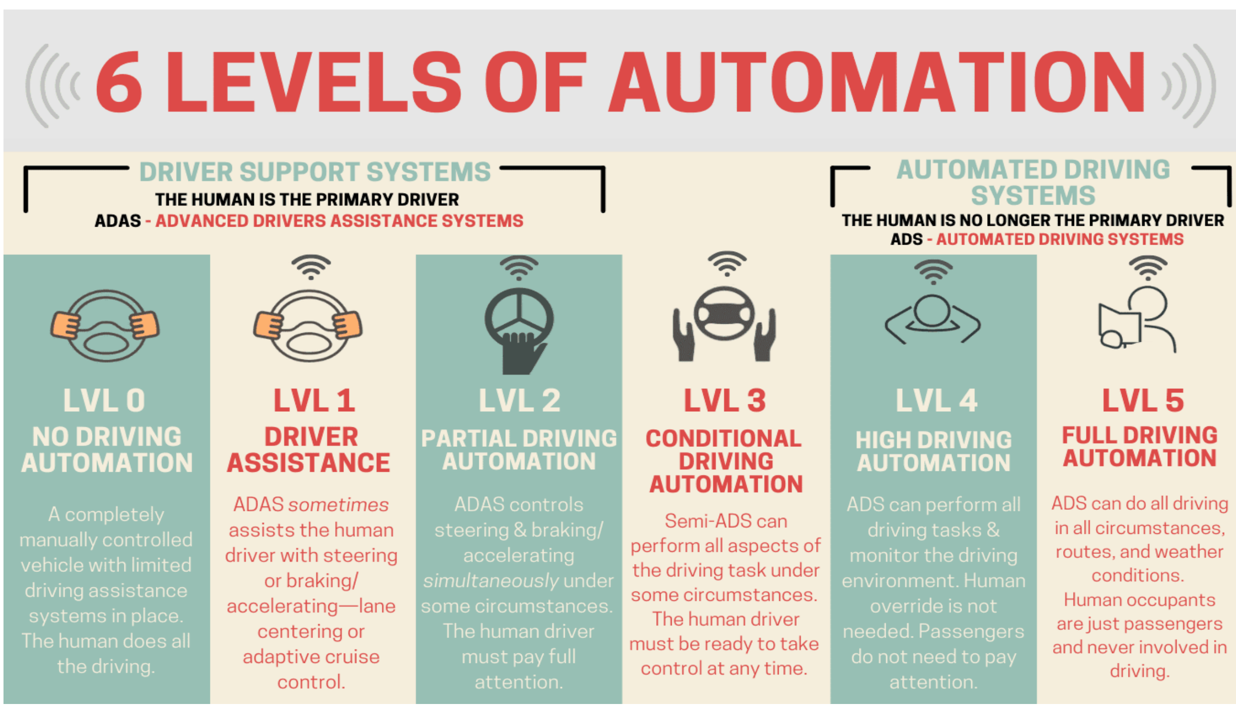

Fig.2.1: Levels of Automation

2.2.2 Existing Systems

Ford is one of the most pioneering and ambitious auto companies, looking to launch a highly automated automobile as soon as possible. It aims to have a fully autonomous vehicle on the road at the first near future. Additionally, it has taken a number of strategic actions in this direction. Ford announced its plans to for constructing a testing center near Miami. According to the Audi corporation, the company's autonomous automobile would make use of NVIDIA's AI technology. A new system, known as Autonomous Intelligent Driving, is used across the whole Volkswagen brand. Audi then partnered with Cognata Ltd, a maker of systems for autonomous vehicle simulation, to hasten the development of autonomous vehicles. These are two examples and of course there are a lot of systems.

2.2.3 Issues and Challenges

There are many problems associated with automated cars. While developing these companies should have to find solutions. Now let's see what are these existing issues and challenges:

A. Reliability and Safety

The technology must be tested for many million kilometers before it can be fully commercialized. The distance traveled by automobile determines the system's dependability. To achieve a 95 % equivalency to a human driver, an autonomous automobile needs to go around 291 million miles without causing any fatalities. The amount of "challenging/difficult" miles is another consideration for a full safety test. The first fatal accident happened in March 2018, when a Level-4 Uber prototype collided with a person crossing the street. There were two noteworthy items in the NTSB report. First, the test vehicle's autonomous emergency braking system was turned off. Second, the pedestrian was spotted but incorrectly recognized as a person. The incident comes as questions are raised about the safety and maturity of self-driving technology.

B. Testing and Validity

Because the system is complicated, and each choice made by the software directly affects human life, autonomous systems need extensive testing. The ISO 26262 standard establishes a framework for vehicle-guidance systems that takes functional safety into account. The V– model has been used in the automobile industry for a long time and is the worldwide ISO 26262 standard. Traditional validation and testing methods are impractical for autonomous systems. Machine learning has the potential to be more powerful in terms of developing a comprehensive system that aids in decision-making. Fail-safe systems must include at least two separate, redundant subsystems so that if one fails, the other can take over.

C. Legal Challenges

One of the most critical criteria for the deployment of autonomous cars is a legal framework and laws. Another issue is determining who is responsible in the event of an emergency collision. There is no driver involved, then there is a big problem with who gets the responsibility. If there is an accident met and one person dies the court has no idea, who wants to give punishment. This is the biggest issue in an autonomous vehicle.

D. Orientation

Several variables contribute to the orienting issues that autonomous cars confront. The real-time image processing and machine learning method used in Tesla automobiles offer several advantages. It enables the vehicle to respond to changing environmental circumstances. Despite its complexity, this solution eliminated the vehicle's reliance on outdated maps. LIDAR is used by companies such as General Motors and Mercedes-Benz to build comprehensive 3-dimensional maps of their surroundings. Despite the hefty expenses, this approach is exceedingly dependable and successful. The complexity of autonomous vehicle systems is reduced by building intelligent settings.

E. Data Privacy

Two hackers remotely hijacked a Jeep Cherokee in 2015, while this year a group of hackers hijacked a Tesla Model S, sparking concerns that a massive attack may paralyze a whole city. Additionally, a list of best practices for automobile cybersecurity was released. Draft rules are starting to develop as authorities become aware of these problems.

G. Technical Barriers

An onboard computer system combines all the data and makes judgments continuously, many times per second, on whether the vehicle can drive to a new place using complex algorithms. There is still much work to be done before this navigation system can be trusted in any setting or weather. The location of the vehicle on the map must be accurate and trustworthy in real-time, together with environmental data. Because technology is built on optical systems, some scenarios have proven to be quite difficult. For instance, disguised lane lines, nighttime, inclement weather, bridges, sunlight that blinds drivers, obscured lighting, unique signs, four-way intersections, hand gestures and head nods, obstructed GPS signals, etc. Improving maps, sensors, and computer algorithms are necessary to successfully handle these circumstances.

2.3 Conclusion

Our project offers solutions to the problems mentioned in the previous study. When we talk about:

A) **The reliability and safety issue,** our project primarily aims to build trust among customers in this system and assure them of their safety if they use this system in their lives. The core focus of the project is to protect citizens in the best possible ways and means.

B) **The testing and validity issue,** we have developed two subsidiary systems driving (self-driving and Remote-driving system) that can be used interchangeably in case of driver fails, and we will discuss this in detail in the upcoming chapters.

C) **The navigation issue,** it is also addressed through the use of tools, software, and algorithms that significantly contribute to steering the vehicle in the best possible way to avoid traffic accidents and ensure the driver's safety.

D) **Data privacy and confidentiality,** it is also addressed through the use of authentication and authorization subsystems, this is for ensuring the confidentiality of customer data should be one of the top priorities.

Summary

In this chapter, a study is reviewed, and it discussed smart transportation systems and the significant advancements in artificial intelligence in the field of transportation. The study also highlighted the problems and challenges that any organization or leading company in this field may face and how to address these issues and avoid them in the future. The study indicated that self-driving cars have many distinguished aspects, including enhancing road safety and not only targeting the sick but also the elderly and people with disabilities. This chapter also included the solutions provided by our project to demonstrate reliability and safety for anyone using these cars.