

## Optimization in Self Driving Car by using Deep Transfer Learning Approach

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### Abstract

The study of mobile autonomous cars utilizing deep learning and AI is a fast-developing topic that brings together breakthroughs in artificial intelligence, computer vision, robotics, and transportation engineering. This field is an illustration of an interdisciplinary field that combines multiple fields of investigation. The objective is to invent vehicles that are suitable of driving themselves, sometimes known as driverless cars, which can navigate and make judgments without the necessity of human intervention. These vehicles utilize deep learning algorithms and other AI approaches to analyze the environment, process sensory data from a group of onboard sensors, and safely maneuver through complicated scenarios.

**Keywords:** - Autonomous Vehicle, Artificial Intelligence, Deep Learning, Driverless Car, Onboard Sensors

### 1. INTRODUCTION

Mobile autonomous cars rely on a screening of cameras and sensors to gather visual data from their surroundings. These vehicles use sophisticated artificial intelligence and deep learning algorithms for image processing. Before being used for tasks such as object detection, localisation, semantic segmentation, and lane detection, this data is subjected to preprocessing. CNNs are then fed this information. These processed photos are used by the AI system to make judgments in real time regarding the operation of the vehicle, including acceleration, braking, and steering. These decisions guarantee safe and effective navigation. These self-driving cars are continuously learning from their experiences and the data they collect in an effort to make better their driving abilities and transform the transportation industry by making it safer and more convenient.

In order to make their autonomous vehicles as accurate as possible, NVIDIA, a frontrunner in the enlargement of driverless car technology, collects a extensive of data. Real-time sensor report from cameras, Lidar, radar, and ultrasonic sensors to apprehend the environment; high-definition charts for distinguish localization and planning; GPS and IMU data for exact positioning and orientation; vehicle telemetry for monitoring performance; simulation data for scrutinize and validating algorithms; annotated datasets for training machine learning models; human-driven data to understand typical driving patterns; and usable data to inform design. NVIDIA's goal is to improve the precision of driverless cars and develop safer, more dependable autonomous driving solutions by making use of a wide variety of data sources and cutting-edge technologies.

## 1.1 MOBILE AUTONOMOUS VEHICLE

A mobile autonomous vehicle, often known as a self-driving car or an autonomous car, is a game-changing mode of transportation that is able to navigate and function without the need for direct involvement from a human driver. These cars be extant outfitted in the company of vast array of sensors, cameras, Lidar (Light Detection and Ranging), radar, and cutting-edge artificial intelligence (AI) algorithms, entitle them to observe their environment and make judgments in the moment.

One of the most important steps forward in the automotive sector, the development of mobile autonomous cars holds the promise of bringing about a wide range of positive and game-changing effects for society.

**Security:** Autonomous vehicles have the prospective to significantly reduce the number of accidents that are caused by human error, which is responsible for the vast majority of accidents that occur on roads today. These vehicles attempt to make roads safer for everyone by removing human faults such as inattentive driving, speeding, and driving under the influence of drugs or alcohol.

**Efficient:** The design of autonomous cars is centered on improving overall traffic flow and minimizing the impact of congestion. They are able to interact with one another and with the infrastructure, which results in increased efficiency in transportation and a trimming in the amount of time needed for trip.

**Accessibility:** Self-driving cars have the latent to increase potency for persons who are unable to drive due to age, impairments, or other reasons. This could include people who are unable to operate a manual vehicle. Numerous people can see an refinement in their quality of life as a corollary of this enhanced accessibility.

**Supremacy on the Environment:** Because autonomous vehicles have the aptness to improve driving efficiency and minimize congestion, they may also have the inherent to cut fuel consumption and emissions, which would have a positive mastery on the environment.

**Shared Mobility:** The technology behind autonomous vehicles may make it possible to provide services for shared mobility. People might use self-driving cars on demand rather than owning their own vehicles, which would cut down on the number of cars on the road and the environmental damage caused by those vehicles.

**metropolitan Planning:** The rise of autonomous cars is anticipated to have an impact on the forethought of metropolitan areas. It is possible that cities would rearrange their roadways, parking lots, and transit infrastructure to better handle self-driving automobiles.

Even though mobile autonomous cars have a lot of potential and promise, there are still different parts and concerns that need to be addressed:

There is a concern for safety, despite the fact that autonomous vehicles have the power to be safer than cars operated by humans, there have been instances in which self-driving cars have been engaged in accidents. The developers place a high premium on making certain that these automobiles are both safe and reliable.

**Admissible and Directorial Issues:** The advent of self-driving automobiles presents a number of legal and authoritarian subjects to contend with. It is the duty of governments and politicians to design proper laws and regulations to control their operations, as well as issues pertaining to

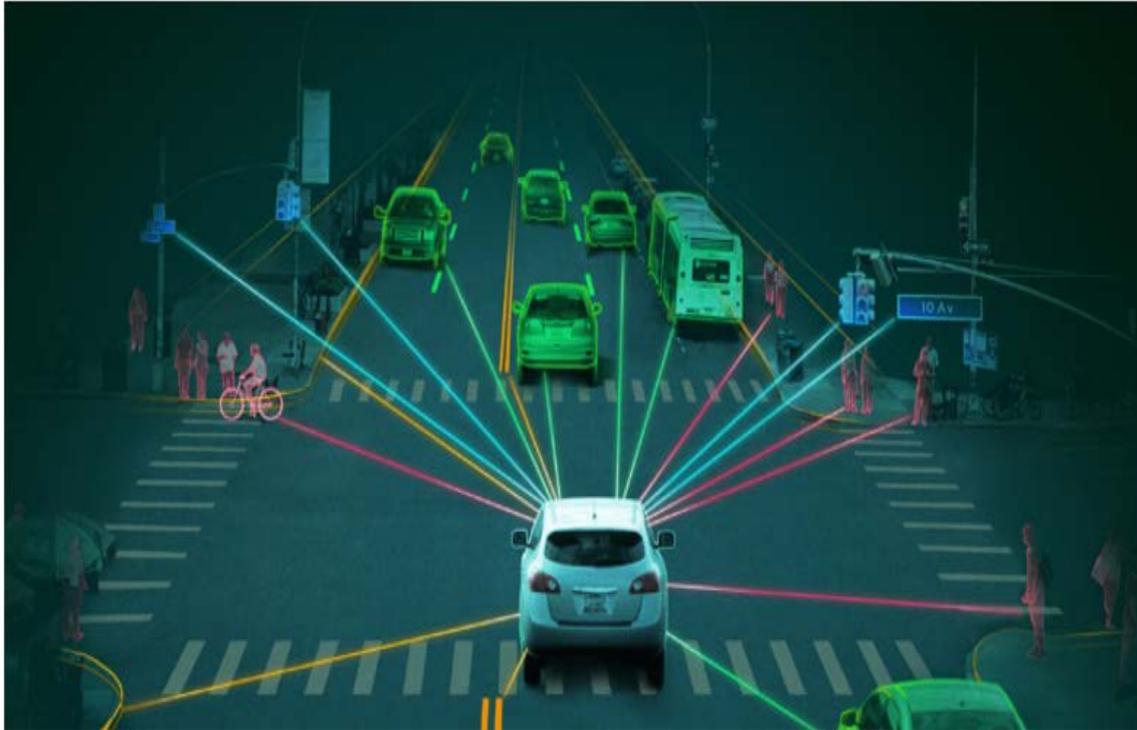
**liability and insurance:** Ethical Conundrums The use of autonomous vehicles may provide difficult ethical conundrums in certain circumstances, for instance the question of how to classify well-being of the vehicle's occupants that of pedestrians at the of a probable accident. Cybersecurity: As a result of their greater connectedness, autonomous vehicles are more susceptible to cybersecurity risks. It is essential to protect these vehicles from being hacked and from having their data compromised.

**Public Acceptance:** There are still worries about safety, privacy, and control, therefore it will be a huge challenge to convince the general public to trust and use self-driving technology. The concept of fully autonomous vehicles may one day become a reality in the not-too-distant future as technology continues to improve and more research is carried out. If this occurs, it will radically alter the way that anyone travel and the entire transportation system. Nevertheless, in order to overcome the obstacles and realize the full potential of mobile autonomous vehicles, it will be necessary for governments, companies, and the general public to work together.

## **1.2 DRIVERLESS CAR**

Autonomous or self-driving automobiles, also referred to as driverless cars, represent a groundbreaking development in the automotive industry. These vehicles have the capability to operate and give directions without any person's intervention, relying on advanced technologies like a sensor, artificial intelligence, machine learning algorithms. By utilizing a composition of sensors like cameras, GPS, LiDAR, radar, driverless cars gather data about their surroundings. This data is then processed by onboard computer systems, equipped with machine learning algorithms that interpret and understand the environment, including the occupancy of other vehicles, footslogger, traffic signs, and road infrastructure. Machine learning is a key player in enabling driverless cars to make appropriate action. Through training on large amounts of content, including real-world driving scenarios, these algorithms learn to identify patterns, recognize objects, predict behaviors, and respond in real-time. This repetitious learning process allows the vehicles to continually boost their execution and modify to various driving conditions. Driverless cars offer numerous potential benefits. They have the capability to enhance road safety by reducing human errors, a leading cause of accidents. Additionally, these vehicles can optimize traffic flow, minimize congestion, and improve fuel efficiency through advanced route planning and coordination with other vehicles. They also provide opportunities for accessible and convenient transportation for persons who are not able to drive.

However, the widespread adoption of driverless cars faces several challenges. Ensuring safety is paramount, requiring rigorous testing and validation to handle unexpected situations effectively. Legal and framework of the law must be established to govern the operation of independent vehicles on public roads. Ethical considerations, cybersecurity, and public acceptance also need to be discreetly inscribed to ensure a smooth integration of driverless cars into the transportation ecosystem.



**Figure 1 AUTONOMOUS VEHICLE**

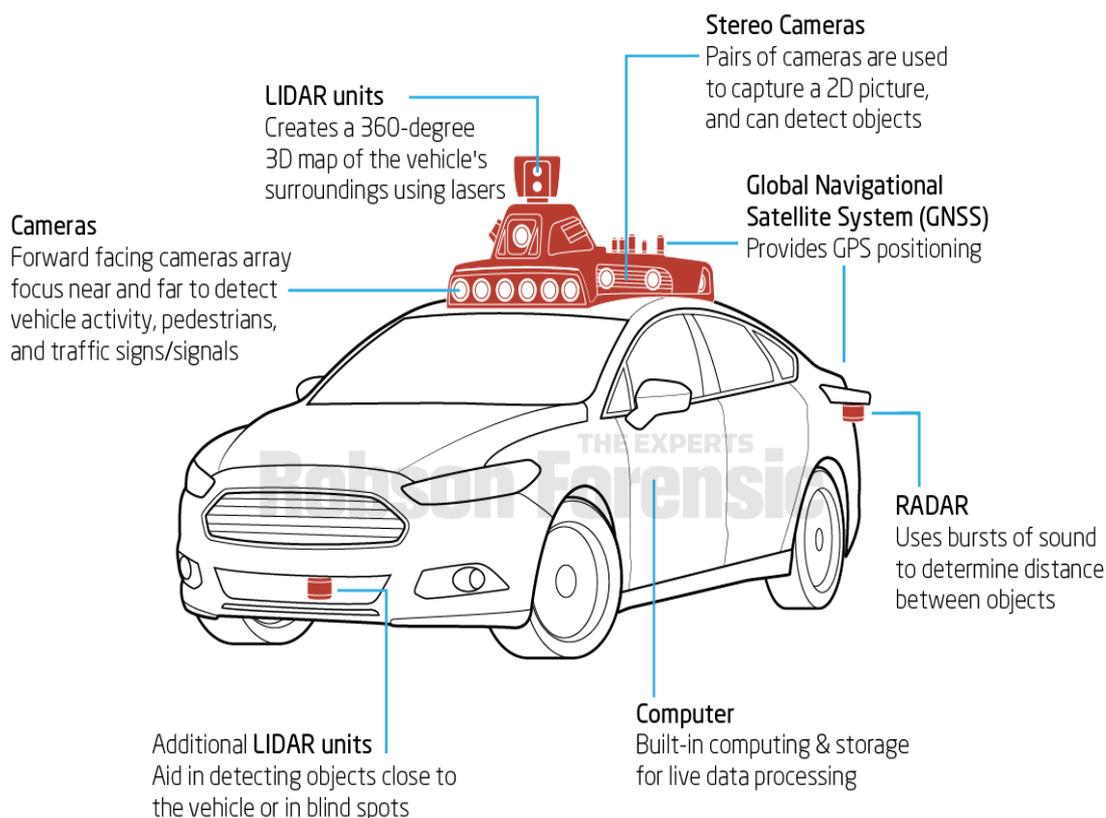
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<https://www.linkedin.com/pulse/revolutionizing-autonomous-cars-power-lidar-technology>

### **1.3 FEATURE OF AUTONOMOUS VEHICLE**

1. **Automation:** Autonomous vehicles, also known as driverless cars, have the power to operate without any person's interference. They utilize advanced sensors, cameras, radar, and other technologies to grasp their nearby and make decisions autonomously.
2. **Sensing and Perception:** Driverless cars employ a composition of sensors, such as LiDAR, radar, cameras, and GPS, to figure out their environment. These sensors enable them to find out and interpret objects, road conditions, traffic signals, and obstacles in real-time.
3. **Decision-making and Planning:** Autonomous vehicles rely on innovative algorithms and artificial intelligence to establish and plan their actions. They analyze sensor data, interpret traffic regulations, and calculate the most efficient routes to give the directions on road safely and effectively.
4. **Communication:** Driverless cars have the expertise to make contact with other vehicles, infrastructure systems, and pedestrians. This communication facilitates information exchange, coordinated movements, and improved traffic flow and safety.
5. **Safety Features:** Autonomous vehicles prioritize safety and incorporate multiple redundancies in critical systems. They are equipped with advanced collision avoidance technologies and can react quicker than human drivers in certain situations.

6. **Data-driven Learning:** Driverless cars continuously learn and enhance their performance through machine learning algorithms. They gather and analyze extensive contents from genuine driving scenarios to refine their decision-making capabilities and make adjustment to driving conditions.
7. **Connectivity:** Autonomous vehicles are often connected to the internet or other networks, enabling access to real-time traffic updates, map enhancements, and software upgrades. Connectivity also enables remote monitoring and control for enhanced safety and maintenance.
8. **Energy Efficiency:** Driverless cars are designed to optimize fuel efficiency or energy consumption. They analyze traffic patterns, adjust their speed, and utilize predictive algorithms to minimize energy usage and reduce emissions.
9. **Transportation accessibility** may improve with the use of autonomous cars, such as the elderly or those with disabilities. They offer the prospect of improved mobility and independence.
10. **Integration with Smart Infrastructure:** Driverless cars can integrate with smart infrastructure systems, including intelligent traffic signals and vehicle-to-infrastructure communication. This integration facilitates better coordination and efficiency in traffic flow, reducing congestion and improving overall transportation infrastructure.



**Figure 2 FEATURE OF SELF DRIVING VEHICLES**

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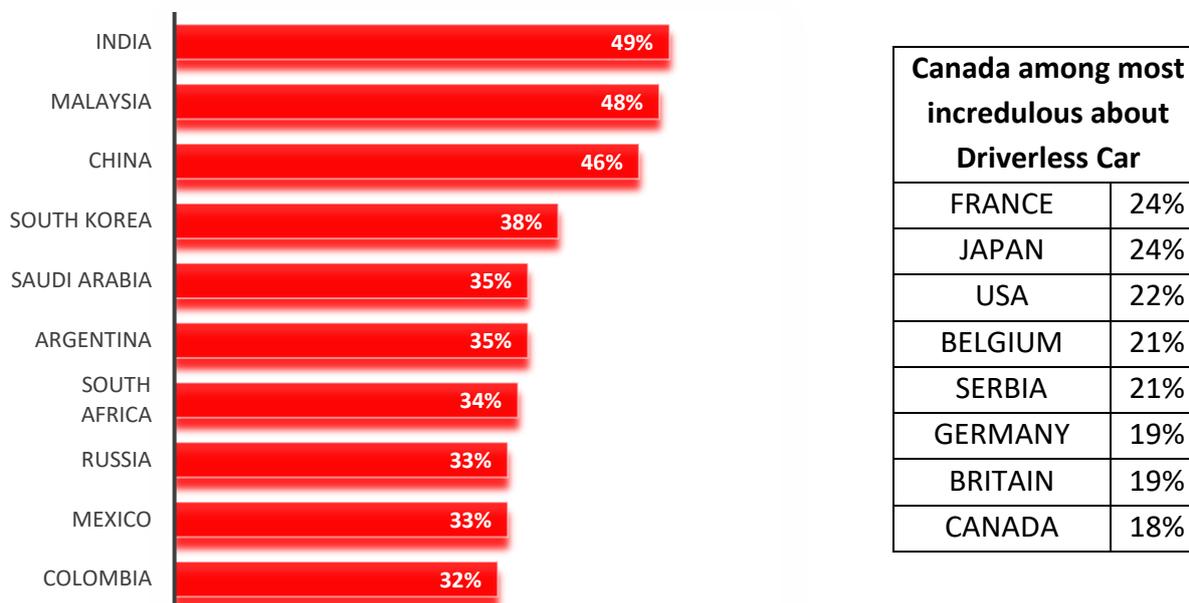
<https://www.robsonforensic.com/articles/autonomous-vehicles-sensors-expert>

#### **1.4 INTEREST IN AUTONOMOUS VEHICLES**

The level of interest and excitement shown by Indians towards the expansion of self-driving or autonomous cars or vehicles is enormous. Several things may be contributing to this extremely high level of interest. To begin, India is home to a sizable number of tech-savvy people who enthusiastically embrace the most recent and cutting-edge developments. The nation has emerged as a center for the occurrence of new technologies as a result of its flourishing startup culture and quickly expanding technology economy. Second, the urban areas of India frequently have significant traffic congestion, which causes commuting times that are both inconvenient and time-consuming. Commuters in India are quite enthusiastic about the prospect of using autonomous vehicles because of the potential for these vehicles to improve traffic flow, cut down on travel times, and minimize congestion. In addition, India's high rate of motor vehicle collisions makes road safety a very serious issue in that country. People are very interested in the potential for autonomous driving technology to reduce the number of accidents did by human mistake and to increase overall road safety. There is reason to believe that self-driving vehicles could dramatically cut down on the number of accidents that occur on tour and save countless lives.

The manufacturing of autonomous vehicle technology also holds the budding to improve mobility and accessibility for traditionally underserved populations, such as the elderly and persons living with impairments. Self-driving cars have the potential to empower individuals and improve their quality of life by supplying them with a method of transportation that is dependable and convenient. The United States is currently grappling with a growing number of environmental issues, which has contributed to the growing interest in autonomous electric vehicles. Indians are fetching more conscious of the effects that air pollution has on public health, and as a result, they are becoming more interested in the concept of adopting environmentally friendly self-driving electric vehicles as a strategy to reduce carbon emissions and battle environmental deterioration. The steps taken by the Indian government and the policy support it has provided in the direction of clean energy and sustainable transportation have further fueled the desire for self-driving technology. The public's attention and curiosity have been piqued by the many different incentives and programs that are designed to promote electric and autonomous automobiles. The public's perspective has been significantly influenced by the widespread coverage and attention given to the topic of autonomous driving technology in the media. Extensive reporting on successful pilot projects in other countries as well as extensive research on the potential benefits of self-driving cars have aroused curiosity and excitement among Indians. In spite of the fact that there is a significant amount of interest in autonomous driving technology in India, it is essential to recognize that the successful adoption of autonomous vehicles will be contingent on the resolution of regulatory challenges, the maintenance of cybersecurity, and the development of public trust in the safety and dependability of self-driving vehicles. Despite this, the enthusiasm that Indians have shown toward autonomous driving technology demonstrates that they are open to embracing game-changing breakthroughs that have the potentiality to completely reshape the strategy that transportation will be done in the future.

**GRAPH SHOWS HOW INDIANS EAGAR ABOUT DRIVERLESS CARS**



**Figure 3 COUNTRIES EAGER ABOUT DRIVERLESS CARS (According to the survey of IPSOS)**

**2. TECHNOLOGIES USED IN AUTONOMOUS VEHICLES**

The unification of enhanced machine learning algorithms into autonomous vehicle systems plays a critical role in improving their performance, accuracy, and safety. By harnessing advanced algorithms and techniques, autonomous vehicles can effectively distinguish their adjacent, make intelligent conclusions and navigate autonomously with precision and dependability.

**2.1 OPTIMISED MACHINE LEARNING ALGORITHMS ARE BEING INCLUDED INTO DRIVERLESS CAR SYSTEMS**

- **Algorithm Selection and Optimization:**  
 Machine learning algorithms must be carefully chosen and optimised in order for autonomous vehicle systems to be developed. Algorithms such as deep learning, reinforcement learning, and Bayesian networks are all the time in work to enhance perception, decision-making, and control processes. Through optimization, these algorithms are fine-tuned to improve parameter settings, computational efficiency, and real-time responsiveness.
- **Perception and Sensor Fusion:**  
 Machine learning algorithms are utilized to process data from a multitude of sensors, cameras, LiDAR, radar, GPS. By fusing information from these sensors, autonomous vehicles can accurately perceive their surroundings, detect objects, and interpret road conditions. Enhanced algorithms bolster the accuracy and reliability of perception systems, enabling the vehicle to

make informed decisions.

- **Object Detection and Recognition:**

In order to recognise and identify items on road, for instance automobiles, pedestrians, and obstructions, machine learning techniques are essential. Enhanced algorithms refine object detection accuracy, minimizing false positives and negatives and ensuring reliable identification of relevant objects in real-time.

- **Path Strategy and Decision-making:**

Optimized machine learning algorithms contribute to efficient path strategy and decision-making for self-driving vehicles. These algorithms look over sensor data, circumstances of rush, and navigation objectives to find the optimal path and make intelligent selections in real-time. Optimization enhances the speed, accuracy, and regulation of path planning algorithms, resulting in secure and more essential navigation.

- **Predictive Analytics and Enhanced machine learning**

algorithms leverage predictive analytics to assess the way of acting other road users and evaluate potential risks. By identifying important data and real-time observations, these algorithms can anticipate and answer to potential hazards, enabling proactive and safer driving strategies.

- **Training and Learning from Real-world Data:**

Optimized machine learning algorithms utilize extensive real-world data to train autonomous vehicle systems. Algorithms be taught from diverse driving scenarios, circumstances of rush on road, and traffic patterns to improve execution over time. Optimized learning processes enhance the adaptability, responsiveness, and intelligence of autonomous vehicles, validate them to handle a extensive of situations.

- **Testing and Validation:**

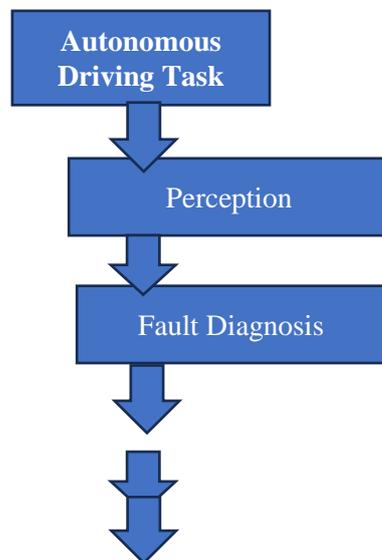
Enhanced machine learning algorithms undergo rigorous testing and validation to ensure their reliability and safety. Extensive simulations, controlled environments, and real-world testing are conducted to evaluate algorithm performance across various scenarios, including different weather conditions, traffic densities, and road types.

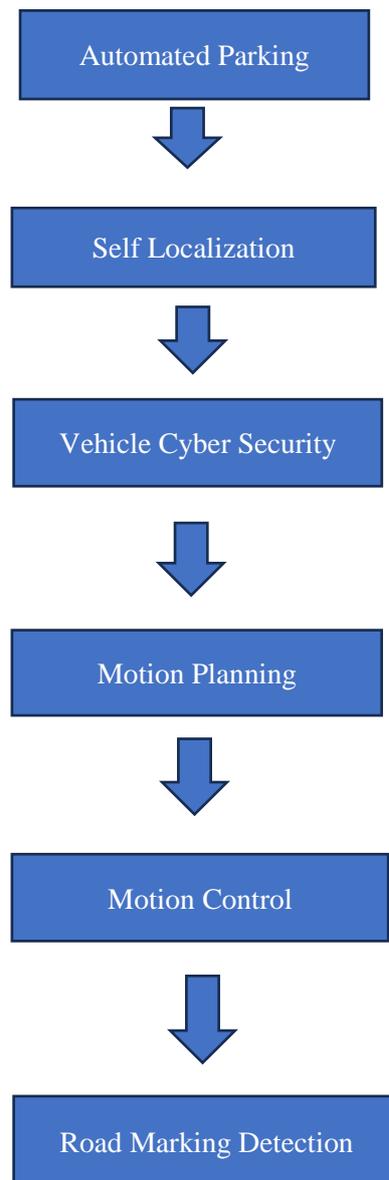
Pedestrian Detection

Traffic Sign Detection

to find the optimal path and real-time. Optimization and regulation of path planning and more essential navigation.

Risk Assessment: algorithms leverage predictive





**Figure 4 AUTONOMOUS DRIVING CAR TASKS**

### **3. RESEARCH METHODOLOGY**

The Methodology employed in this study encompassed several key steps in the origination and training of a neural network for autonomous driving, utilizing a dataset with specific parameters. Each step was meticulously executed to ensure a robust and effective model capable of generalizing track behavior.

#### **1. Defined Network Path:**

In this phase of the research, the neural network architecture was defined with careful consideration of layers, connections, and parameters. The objective was to create a structured model that could effectively process the incoming data.

## **2. Binned 25-Valued Numbers:**

To preprocess the steering data, a unique binning approach was applied. Specifically, 25-valued numbers were binned using an odd number to achieve a centred distribution. The resulting histogram data frame was divided by the number of bins, and this process was limited to 400 samples. Notably, the steering data was centred at 0, ensuring a balanced representation of steering angles.

## **3. Removed Biased Samples:**

To address biases in the dataset, a meticulous approach was taken. A removal list was defined, and samples were systematically removed by iterating through each bin of the steering data. After shuffling the dataset, selective removal of data was performed, particularly focusing on uniformly structured segments. This strategic removal aimed to achieve a more uniform distribution of steering angles, minimizing biases towards straight driving and enhancing the model's adaptability.

## **4. Loaded and Manipulated Images:**

The images corresponding to the defined features were loaded into arrays and subjected to manipulation. The process involved defining image and steering location lists, iterating through empty image paths, and utilizing the cut data as an index with the iloc selector on the data frame. This step ensured the effective alignment of image data with steering information.

## **5. Split and Stored Image Numpy Arrays:**

The pre-processed image data, now in the form of numpy arrays, was systematically split and stored. This step facilitated the organization and management of the data for subsequent stages of the implementation process.

## **6. Generalized Track Behavior:**

One of the significant challenges encountered during the research was the need to train the car to navigate Track 2 without creating a model tailored to every track. Given the impracticality of collecting extensive weather and road data, a crucial strategy was to generalize track behavior. Image preprocessing and enhancement, often referred to as augmentation, played a pivotal role in achieving this generalization.

## **7. Processed and Enhanced Images:**

The final steps involved thorough image processing and enhancement. This encompassed cropping images, converting them to the YUV colour format, applying Gaussian blur for noise reduction, resizing for ease of processing, and normalizing pixel values. These preprocessing techniques were instrumental in refining the dataset, ensuring that the model could effectively learn and generalize behavior across diverse scenarios, including Track 2 challenges.

## **4. CONCLUSION**

In order to evaluate the data and come to judgments that will ensure safe and reliable autonomous driving, the platform utilizes deep learning algorithms and neural networks. NVIDIA, along with other businesses in the autonomous vehicle market, continuously works on increasing the performance of their deep learning models by optimizing accuracy, precision, recall, losses and other essential metrics. This is done since the technology behind driverless cars is extremely competitive and rapidly growing. The purpose of this project is to develop

autonomous driving systems that are more resilient and capable, with the ability to handle complicated real-world scenarios with a high level of precision and safety.

- Competing Interests: - Not Applicable

- Funding Information: - Not Applicable

- Author contribution: - As a research scholar, data collection, material preparation, analysis and manuscript preparation were performed by Priya Tiwari (Corresponding Author) and guided by Dr. Kuntal Barua.

- Data Availability Statement: - As a research scholar many research articles studied for better understanding about the subject, some of the key work are: -

- “Autonomous Cars: Research Results, Issues, and Future Challenges,” [4] found to do work in appropriate direction.
- Feature of self driving vehicles, <https://www.robsonforensic.com/articles/autonomous-vehicles-sensors-expert>
- Studied other researchers work already done in this direction studied from: - <https://www.researchgate.net>

- Research Involving Human and /or Animals: - Not Applicable

- Informed Consent: - I declare that this work and topic is approved by Research Development Committee of SAGE University, Indore for further research purpose and some content used here for reference purpose only that mentioned in reference and in manuscript also.

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