Autonomous Driving: Enhancing Mileage, Road Safety with AI

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Abstract. The aim of this paper is to solve the problems in driving by introducing autonomous features into vehicles. An autonomous vehicle is a vehicle that can operate and drive itself without any human interference, with the help of sensors, to sense its surroundings and navigate itself. An autonomous vehicle is equipped with an automated driving system that is designed and trained by humans to allow the vehicle to respond to surroundings in a way that a human would act. In this paper, we develop a program with the help of AI/ML to detect roads, traffic signs, traffic conditions, and Surroundings and act according to them by altering the steering, acceleration, and braking. We plan to achieve this by taking input from a series of sensors and training the model to act accordingly. In this paper, we train neural networks with the help of human behavior. So, the model tries to mimic human behavior and human actions in a given situation.

1. Introduction

The transportation and logistics sector is an important industry sector. It is the backbone of the economy that deals with the movement of products and people. Transportation keeps the massive infrastructure running.

Vehicles have been updated and upgraded since their introduction. Motor companies kept on innovating and introducing new technologies to make the vehicles more secure (seat belts, airbags), and comfortable (infotainment, GPS). With time, vehicles are facing more accidents even though advancements in the industry.

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Vehicles are driven by humans and are prone to human errors. Humans are distracted while driving. It may be due to advertisements, mobile, sleep, etc.The objective of this paper is to integrate AI/ML into the vehicle to drive autonomously and enhance the efficiency, safety, and sustainability of our transportation systems.

2. Literature Survey

Autonomous vehicles are an emerging technology that has the potential to transform the way we live, work, and travel. A literature study on autonomous vehicles has become an essential area of research for scholars, industry professionals, and policymakers. We will discuss the values, studies, and predictions surrounding the literature study of autonomous vehicles[1][2].

One of the values of autonomous vehicles is that they can potentially improve road safety. According to (NHTSA) National Highway Traffic Safety Administration, more than 90% of accidents are caused by human error[1]. Autonomous vehicles, which are equipped with advanced sensors, cameras, and algorithms, can reduce the risk of accidents caused by human error. A study by the RAND Corporation predicted that if autonomous vehicles are adopted on a large scale, they could potentially save millions of lives and billions of dollars in economic losses[2].

Autonomous vehicles are a fascinating technology that has the potential to totally change the way we transport ourselves and our goods. Research and development in this field have been extensive and have yielded a wealth of insights and knowledge [3, 4].

Perception is one of the crucial areas of investigation in autonomous driving technology. It deals with the ability of the car to detect and understand the world around it using sensors such as cameras, lidar, and radar. Improving the accuracy and reliability of these sensors has been a priority for researchers, with machine learning algorithms and deep neural networks being employed to enhance their performance.

Control and planning is another area of great importance in autonomous driving technology. It deals with the vehicle's ability to navigate and make decisions in real time, optimizing its trajectory and behavior while maintaining safety and efficiency. A variety of algorithms have been developed to accomplish this, including model predictive control, reinforcement learning, and genetic algorithms.

Human factors, such as user acceptance, trust, and human-machine interaction, are also an important area of research. Investigating the factors that affect people's perceptions towards autonomous vehicles, such as the level of automation, the reliability of the technology, and the potential benefits and drawbacks, is essential for creating a user-friendly and successful product.

Lastly, regulatory and legal issues are vital considerations in autonomous driving technology. Policymakers and governments must develop appropriate regulations and laws to ensure the safety and reliability of autonomous vehicles while balancing innovation and economic growth.

As technology continues to advance and mature, it is likely that more exciting breakthroughs will emerge in this field. The future of autonomous driving is incredibly bright, and I am confident that it will have a transformative impact on our society and our world. Autonomous vehicle technology has advanced significantly over the past decade, with several companies and research organizations developing prototypes and deploying pilot papers. Existing autonomous vehicle systems can be broadly categorized into two types: fully autonomous and semi-autonomous systems[7].

Fully autonomous systems, also known as Level 5 autonomy, do not require any human intervention and can operate in all conditions and environments. These systems use a combination of advanced sensors, cameras, and algorithms to perceive the environment and make driving decisions. Currently, there are no fully autonomous vehicles available for commercial use, but several companies, including Waymo, Cruise, and Uber, are testing and developing these systems. Fully autonomous systems have the potential to significantly improve road safety, reduce congestion, and provide mobility solutions to people with disabilities and those living in areas without access to public transportation.

Semi-autonomous systems, also known as Level 2-4 autonomy, require some level of human intervention and can operate in specific conditions and environments. These systems use a combination of advanced driver assistance systems (ADAS) and sensors to assist the driver in controlling the vehicle. Examples of semi-autonomous features include(ACC) adaptive cruise control,(LDW) lane departure warning and automated parking.

Several researchers are using methods like canny edge detection to detect the road edges, using CV2 to find the center of the road for video input and follow the center, following the car in front.

3. Methodology

This section outlines the approach employed in the presented system, as depicted in Figure 1. The figure illustrates the conceptual framework of the proposed system, visually capturing the underlying structure and organization of the system's design.

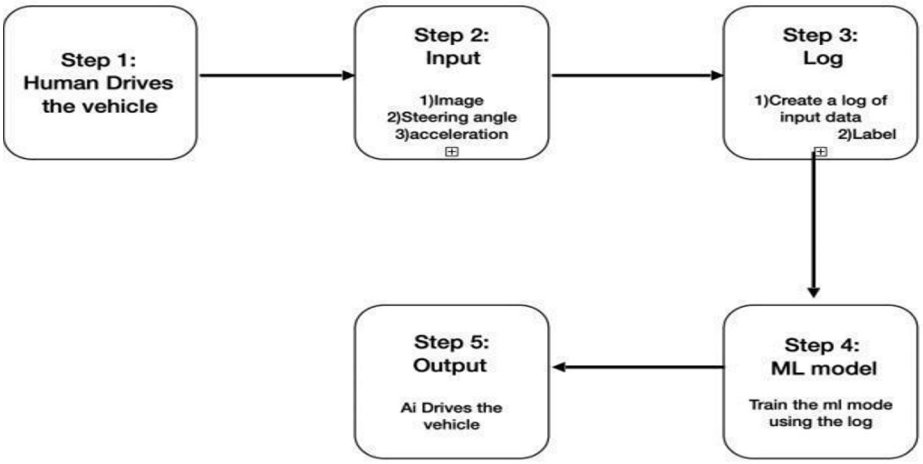

Fig:1 Conceptual framework

In step 1, humans drive the vehicle. Human drives because humans have an understanding of driving. This is also called behavioral cloning because we try to record human behavior and clone it.
In step 2, the program records or takes input from human behavior. The program takes images, steering angle, acceleration, brake, and fuel level [8].

In step 3, the program creates a log, as shown in the above image. We train the ai model using tensorflow and keras(CNN) [7-8].
In step 4, the trained ML tries to drive the vehicle. It tries to replicate human behavior (behavioral cloning).

right	steering	throttle	reverse	speed
C:\Users\Win 10\Desktop\benign\IMG\right_2019_07_22_20_38_15_382.jpg	0.0	0.0	0	0.000079
C:\Users\Win 10\Desktop\benign\IMG\right_2019_07_22_20_38_15_526.jpg	0.0	0.0	0	0.000082
C:\Users\Win 10\Desktop\benign\IMG\right_2019_07_22_20_38_15_669.jpg	0.0	0.0	0	0.000078
C:\Users\Win 10\Desktop\benign\IMG\right_2019_07_22_20_38_15_802.jpg	0.0	0.0	0	0.000078
C:\Users\Win 10\Desktop\benign\IMG\right_2019_07_22_20_38_15_937.jpg	0.0	0.0	0	0.000080

Fig 2: creating log.

The log shown in figure 2 pertains to recorded instances of behavior classification. These behaviors encompass actions like "going straight," "turning left," and "turning right," alongside associated attributes such as "speed" and "throttle." This log serves as a record of the vehicle's operational states, providing insights into its movement decisions, velocity, and control inputs.

4. Implementation

In the proposed system, first, humans drive the vehicle (behavioral cloning). After gathering the required data, the CNN[6] is trained using TensorFlow, and Keras is allowed to operate autonomously. First, we are implementing virtually (no damage, economical, easy to optimize). We have used a servo and NodeMCU to represent the steering angle.

We are using a simulator because it is easy to access, easy to find and correct errors and cost-effective. The input image is captured while driving shown in figure 3.

Fig 3: Input image captured while driving.

5. Results

The diagrams, Figure 4 and Figure 5, depict the implementation of a servo mechanism in an autonomous car. In Figure 4, the servo is illustrating right steering as the car initiates a right turn. Conversely, Figure 5 displays the servo indicating left steering as the autonomous car executes a left turn. In summary, the Autonomous Driving paper has the potential to revolutionize the way we travel and significantly improve the efficiency and safety of our transportation systems. This technology offers a promising solution to some of the most pressing challenges facing the automotive industry, such as fuel consumption, traffic congestion, and road safety.

The development of autonomous vehicles is still in its early stages, and there are significant challenges that must be overcome before this technology becomes widespread. However, continued research, innovation, and investment in this field will pave the way for a more sustainable and connected future where autonomous vehicles are an integral part of our transportation infrastructure.

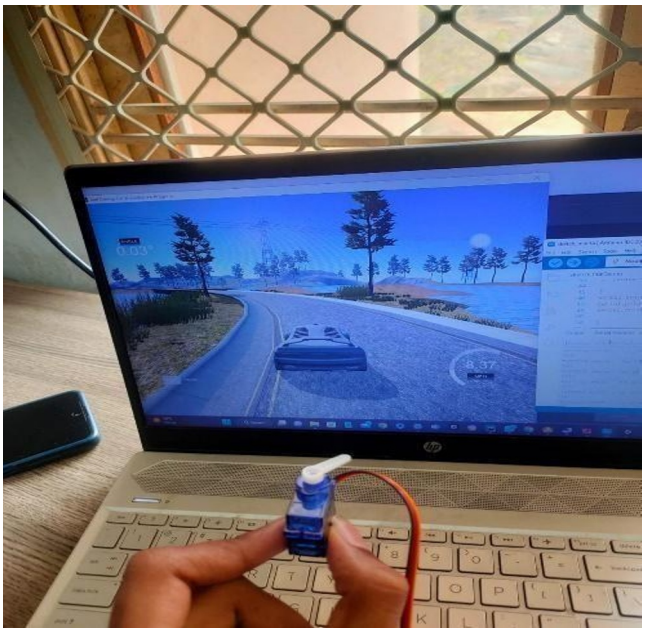

Fig 4: servo showing right steering when autonomous car is turning right.

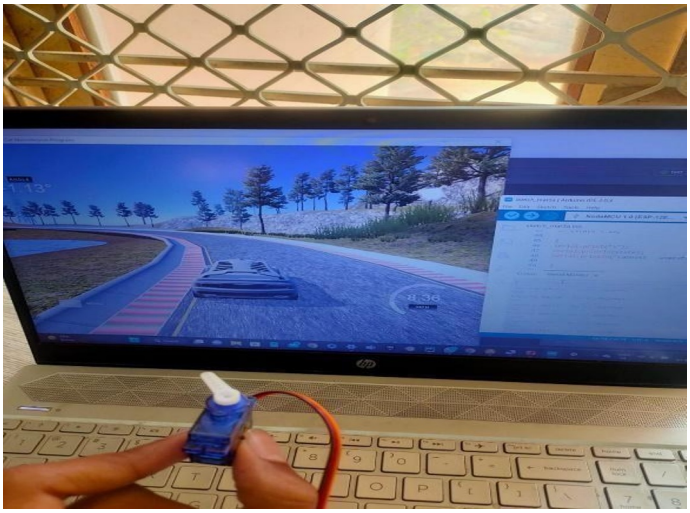

Fig 5: Servo showing left steering when autonomous car is turning right.

6. Conclusions and Future work

In conclusion, in this paper, we have explored an exciting new technology in transportation that has the potential to significantly enhance the efficiency, safety, and sustainability of our transportation systems. With continued innovation and investment, autonomous vehicles may soon become a common sight on our roads, transforming the way we travel and live.

In future work, We will try to implement real-life prototypes and try to research new sensors and technology like lidar. We can even try to create a road database to understand road conditions and routes. We can add cloud service and also add communication between the vehicles[9].

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