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ARTIFICIAL INTELLIGENCE IN AUTONOMOUS VEHICLES USING PERCEPTION AND CNN ALGORITHMS

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ABSTRACT –

Artificial Intelligence has great significance in autonomous vehicles. Autonomous vehicles can be used for people with disabilities allowing them to live the life they want without any discomfort in their transportation. More than 85% of accidents occur due to behavioral errors of the driver, hence Autonomous vehicles can drastically reduce the error and can also assist the driver during emergency conditions This paper explores the important role of Artificial Intelligence in autonomous vehicles. Artificial Intelligence plays a major role in autonomous transportation. The artificial collects the data from every sensor present in the vehicle and processes the data. The extracted data is given as input to the driving mechanism of the vehicle. Artificial Intelligence also plays an important role in decision-making according to the environment the car is in. Although existing systems can implement autonomous driving the proposed system also has a perception algorithm to observe the objects, pedestrians, and other traffic present in the environment the vehicle is in. Hence with a perception algorithm, Artificial intelligence can make quicker real-time decisions.

Keywords: Artificial Intelligence (AI), Autonomous Vehicles (Avs), Perception Algorithm.

1. INTRODUCTION :

Mercedes-Benz and Bundeswehr University Munich's Eureka Prometheus Project in 1987 and Carnegie Mellon University's Navlab and ALV projects in 1984 made way for the introduction of the first self-sufficient and truly autonomous cars with appeared in the 1980s. In the early stages, the self-driving cars used automatic Land Vehicle in Neural Network (ALVINN) used neural networks to detect lines and navigate. Those vehicles were limited by slow processing processors and insufficient data. Self-driving cars must make quicker decisions and observe the environment in which the vehicle is present. After the growth of Artificial Intelligence, these vehicles were equipped with AI. The AI is connected to every sensor present in the vehicle and processes the data collected from the sensors. These collected data are processed complex algorithms are used and AI makes the decisions in real time.

FIG 1. Autonomous vehicle

2. LITERATURE SURVEY :

Many autonomous vehicles uses many wide variety of algorithm for mobility. Most of the systems majorly focus on road lane detection in the early stages. To be accurate and fast these vehicles must process huge amounts of input data and require powerful processing software for execution. The vehicles that don't have perception sensors and algorithms fail to understand the surroundings in which the vehicle is in. Most of the existing system

struggles to understand the object around its environment. The wrong assumption is perception leads the software to make wrong real-time decisions. To avoid this confusion in the proposed system perception sensors play a major role. The decision-making task is performed by the AI. Safety is the major concern in autonomous vehicles. So, when AI is incorporated with vehicle software it can make decisions effectively and reliably. The vehicle must predict other vehicles present in its environment. The vehicle software must process the data from sensors and make quicker and real-time decisions. Vehicles must identify pedestrians and other vehicles in a shorter time. To achieve this CNN algorithm can be used to process pixels present in an image and provide input to the driving mechanism of the vehicle. Data collected by the CNN algorithm are intense and software cannot process and make real-time decisions. AI and chips can be used to make process time lesser and make quicker decisions. Software present in autonomous vehicles plays a major role as it is considered the brain of the vehicle. To understand human gestures or complex traffic scenarios CNN is incorporated with perception sensors for a better understanding of the environment in which the vehicle is in. AI can be implemented and by providing proper training AI can make real-time decisions and can make the drive of an autonomous vehicle safe and reliable.

3. METHODOLOGY :

Autonomous vehicles majorly rely on sensors, algorithms, and powerful processors to execute the software. With the help of sensors, the autonomous vehicle can create a map based on its surroundings. AI is used to process huge amounts of data faster and more accurately and makes quicker decisions in real time.

a) Sensor Data Processing:

The sensor provides data on the road, pedestrians, and other vehicles in the surroundings. Sensors carry the important task of letting the vehicle if any object is present ahead and around the vehicle. Sensors provide a huge amount of data which is then processed by AI. Each sensor present in the vehicle may use a different AI algorithm, to communicate results with software.

b) Path Planning:

Navigation or trajectory of vehicles is planned with path-planning techniques. Proper path planning can be used to avoid traffic congestion ahead of the path. AI plays a major role in collecting data and planning a route for vehicles. AI can consider factors dynamically while executing a path. Path planning enables autonomous vehicles to find the safest and most convenient path from point A to point B.

c) Path Execution:

After planning the path, the planned path is executed. The vehicle can navigate by detecting pedestrians, and other vehicles ahead in its path. AI helps vehicles to make real-time decisions. The decision-making algorithm helps the AI collect data from the sensor during path execution and make decisions based on it. Some of the decision-making algorithms are

- Support vector Machine (SVM)
- Decision Trees
- Deep Reinforcement Learning

CNN Algorithm

A Convolutional Neural Network (CNN) is a type of deep learning algorithm. CNN is commonly used in computer vision applications. CNN captures the relationships between pixels in an image. Convolution, Pooling, and activation functions are a series of operations CNN does. The use of CNN in autonomous vehicles is their ability to process and recognize images. Autonomous vehicles use cameras, radar, and lidar sensors to gather data about the environment around the vehicle. Using the image captured by the camera CNN can map the pixels present in the image. The input is processed by the AI and the object is detected. Thus, CNN can help to identify objects and allows AI to make decisions based on the provided input by the CNN algorithm.

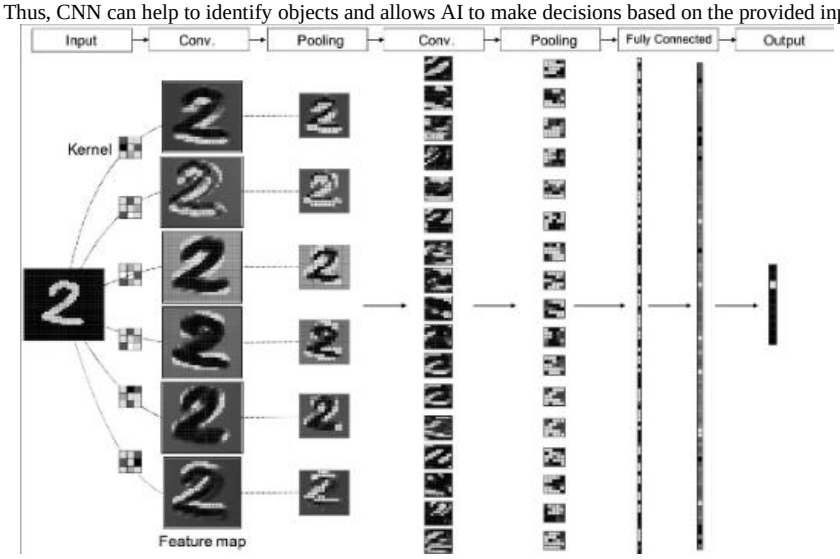

FIG 2. The basic working of the CNN algorithm

On corresponding to kernel the CNN computes a map by convoluting the kernel on input image feature maps. The pooling of the feature map is done to reduce the size of the feature map. Geometrical variations such as slight translation and rotation of the input image can be absorbed. The feature map is

extracted by a repeated process of convolution and pooling. The extracted feature map is input to fully connected layers, and the probability of each class is finally output.

4. PROPOSED SYSTEM :

The system that is being proposed consists of a perception algorithm which is helpful for AI to study or observe the environment in which the vehicle is present and also a CNN algorithm to capture images by camera used for perception sensor and map the pixel of the image and provide input to driving mechanism of the vehicle. Perception means observing or understanding the environment. The perception algorithm allows vehicles to observe the real world like humans do. It helps AI to detect and classify objects which in turn makes AI make quicker and better decisions. In the real world, the AI in autonomous cars must detect pedestrians, other vehicles around them, and traffic signals and evaluate and give input to the driving mechanism. To achieve such a level of perception autonomous vehicles must have three main sensors.

1. Camera
2. LiDAR
3. RADAR

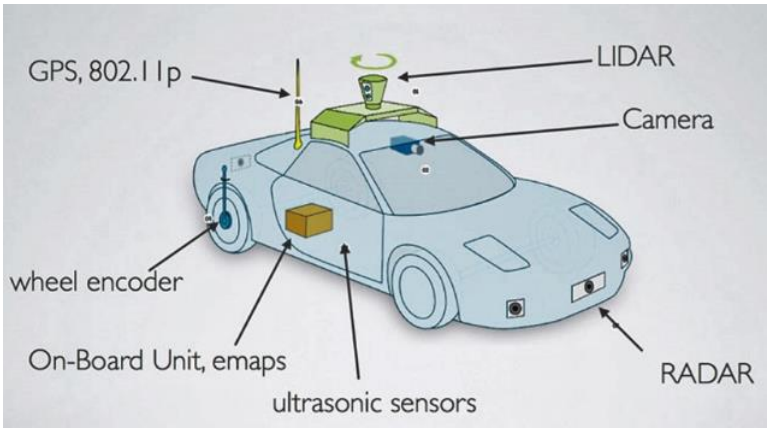

FIG 3. Perception sensors

Camera

The vision of the vehicles is provided by the camera. The camera enables multiple tasks like segmentation, classification, and localization. The cameras must be high-resolution and they must represent the environment accurately. 360-degree view of the vehicles is derived by a combination of cameras from different sides of the vehicle: front, back, left, and right to view the surrounding environment of the vehicle. A wide-range view and more focused perception are provided by these cameras.

LiDAR

LiDAR uses light pulses to detect the range. A rotating LiDAR sensor mounted at the top of the vehicle can monitor about 50–60-meter range around the vehicle. The data is collected and AI is used to process these data. After processing It can create a three-dimensional map or view of the vehicle. Combining the cameras AI can also predict pedestrians, traffic signals, road signs, and other vehicles that are next to the vehicle. All this processing happens in a fraction of a second by AI and provides input to the car driving mechanism.

RADAR

A radar system is used to calculate the distance between vehicles and objects accurately. The radar is mounted on the front and rear bumper of a vehicle. 24, 74, 77, and 79GHz are the frequencies in which most autonomous vehicles operate. RADAR can also operate over long ranges and has robust performance in extreme weather conditions.

CNN (Convolutional Neural Network) is a subset of machine learning. CNN uses an artificial neural network which is used to recognize images and process the pixels in captured images to data. CNN is used in autonomous vehicles to map the pixels of image caught by the camera present in an autonomous vehicle process it and provide input to the driving mechanism. CNN-based object detection can handle multi-class objects hence it is suitable for the perception of vehicles. CNN algorithm plays a major role in range detection, pedestrian, and object detection. CNN algorithm gives input to the throttle and steering mechanism and controls the vehicle. Level 2 autonomous vehicles can be implemented using the CNN algorithm.

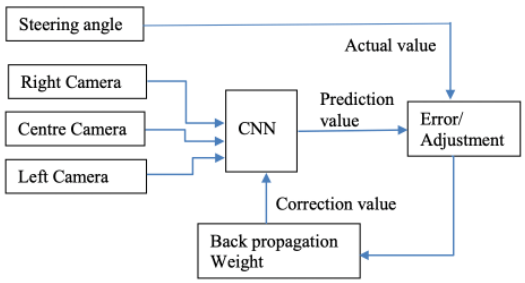

FIG 4. CNN in Autonomous Vehicle

The data is processed by the CNN to identify objects such as other vehicles, pedestrians, road signs, and traffic lights. The network then uses this information to make decisions about how to control the vehicle, such as determining the best route or avoiding obstacles.

5. RESULTS AND DISCUSSION :

In this proposed system, the autonomous vehicles can understand the surrounding environment it using a perception algorithm. The data is collected from perception sensors which AI process the data and understand the environment similar to human and make quicker real-time decisions. However, the AI may fail to understand real-world scenarios and misjudge them. For example, AI may stop the vehicles if it recognizes a flock of birds on the road failing to understand that birds will fly away when vehicles approach. AI may slam the brake if any bag or clothes flies in front of the sensor of the vehicle. Since a large number of vehicles share the network there may be a susceptible hack. Small damage in the software of the vehicle may cause collision between vehicles or misguidance of the vehicle. One of the main limitations is that CNN requires a large amount of data to be trained effectively. This can be a challenge, as it can be difficult to gather enough data to train the network effectively. Another limitation is that CNNs can be computationally expensive. CNN requires a lot of processing power to run, which can be a challenge for an autonomous vehicle that needs to be able to operate in real-time.

6. FUTURE WORK :

The system can be enhanced in the future providing a detailed and real-life training model for AI. We can develop new techniques to improve the accuracy and speed of CNN. We can add additional layers to the network for better accuracy and precision. The use of Generative Adversarial Networks (GANs) in autonomous cars is another development in autonomous cars. GANs can be used to generate synthetic data, which can be used to train the CNN and improve the accuracy. As technology continues to advance, the use of CNNs in autonomous cars will likely continue to evolve and improve.

7. CONCLUSION :

In the proposed system many technologies and sensors were used to improve the precision and reliability of Autonomous Vehicles (AVs). The goal of the study is to improve the detection and decision-making of an autonomous vehicle in a real-time environment. Since the proposed system works in a systematic order drastic number of accidents can be aborted since more than 85% of accidents are caused due to negligence of the driver driving the vehicle. The performance and decision-making of AI can become more reliable and they perform at a high level of accuracy at 95% using perception and CNN algorithms. U.S. annual vehicular fatality rate was 38,824 in the year 2020 94% of crashes are due to human error. AVs have the potential to reduce vehicle crashes by 90%, and they can potentially save approximately $190 billion per year. We analyzed and compared accident data of self-driving cars versus traditional cars by “Crash rate per million miles driven,” self-driving cars always end up with a lower accident rate. The SHRP 2 NDS data set and crash levels from one to three, where level one is the worst type of crash, which involves airbag deployment and injury. For level two crashes there is no airbag deployment or injury. Level three crashes involve physical conflict with another object or vehicle, but with physical damage that does not meet level one or two. By providing more training datasets and countering more real-life situations AI can learn and accuracy can be increased. AVs have the potential to reduce human error and decrease deaths.

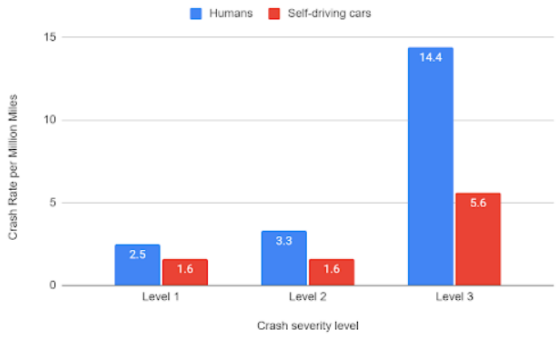

FIG 5: Performance of AV’s

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