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VIRTUAL SIMULATION OF SELF-DRIVING CAR IN CARLA

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Abstract- Autonomous vehicles (AVs), sometimes known as self-driving cars, have the potential to completely replace human-driven autos. AVs can sense their surroundings and even navigate certain roads in situations that humans find problematic. AVs are made up of software, hardware, and people, as well as their interactions. Despite extensive research on AVs, a substantial number of problems remain unresolved. The capacity of AVs to converse with other cars and pedestrians on the road is a significant challenge. Second, people's overreliance on AVs and overconfidence that no failures would occur may have a beneficial or negative impact on society.

To guarantee that self-driving vehicles are safe and acceptable by the general public, their capabilities must be adequately analyzed. Because of the inherent complexity of the driving activity, complicated environmental circumstances, and the wide range of potential driving settings, developing exact, objective metrics that capture various elements of safe driving is exceedingly challenging. An effort is made here to investigate the current state-of-the-art technology for the autonomous automobile. It also discusses technical issues, advantages, and problems that must be addressed in order to create a better system that meets the needs of the users. The paper also gives an overview of the proposed system with its architecture and implementation details.

Keywords: ***Self-driving cars, Autonomous vehicles (AVs), Object Detection, Simulator***

I. INTRODUCTION

As per the World Health Organization's yearly testimony on traffic-related injuries, Road accidents claim the lives of 1.35 million people every year [1]. The majority cause of these crashes are the result of human error [4][8]. These errors can be induced by excessive speeding, driving while intoxicated, or distractions while driving (like talking on mobile phones, messaging, chitchatting with others). Other faults include the reluctance to use seatbelts, helmets, or additional necessary safety gear [2].
These numbers demonstrate the necessity for widespread acceptance and advancement of self-driving vehicle (AV) technology. Tesla Model 3, a level 2 autonomous vehicle, was launched to the market in 2019 [7]. An autonomous vehicle is one that operates independently of human control and is capable of sensing its environment. An autonomous vehicle is also referred to as a self-driving vehicle or a driverless vehicle [4]. As a result, the number of transportation-related injuries and fatalities is projected to decrease. By boosting the safety and efficiency of road vehicles, automated driving systems (ADSs) may greatly enhance transportation and mobility.
There are numerous advantages towards adopting autonomous technology, such as a reduction in road pollution, an increase in reliability, improvement in traffic flow and reduction in congestion that eventually improve the quality of life for individuals. By the year 2022, it is estimated that, a sophisticated speed adaption systems and completely automated AVs will be available without driver backup by 2030, according to author [3]. The Internet of cars will continue to evolve as a result of this development (IoV) [3].

This research contributes to the present state-of-the-art by conducting an in-depth examination of the critical enabling AV technologies. Additionally, the advantages of implementing self-driving vehicle technology are explained. The different simulators used by the researchers are discussed. Lastly, the study addresses the difficulties that have arisen during the process of developing a self-driving car. An attempt is made to present an overview of the proposed system with its architecture and implementation strategies.

II. CHALLENGES INVOLVED IN USING AVS

Issues of hardware and software: There are a lot of things that can go wrong with a complex electronic system, like false sensors, distorted signals, and software mistakes.

Hacking for malicious purposes: Self-driving vehicles can be programmed for recreational or criminal objectives.

Increased vehicle travel: By enhancing convenience and comfort, autonomous vehicles have the potential to enhance vehicle travel and thus collision exposure.

Costs of ownership and operation: Most optional vehicle equipment, including remote starting, adaptive cruise control [40], active lane assist, safety cameras, and navigation systems, now cost several thousand dollars[6]. Table I shows the summary of the pros and cons of AVS.

Sr.No.	Benefits	Drawbacks
1	Accidental damage: Autonomous vehicles are an effective way to reduce traffic deaths and injuries.	Law: AVs may be limited by the legal definition of their responsibilities.
2	Reduced Expenses: Accurate autonomous driving can reduce fuel consumption and improve component efficiency.	Security risk: Due to their current computer-controlled functions, antivirus software may be more susceptible to network hacking.
3	Economic growth: The journey can be made more productive by engaging in non-driving activities.	Employment: Many jobs in the transportation sector will be lost as a result of AVs.
4	Comfortable and large interiors: AVs can have comfortable and roomy interiors.	Price: The initial cost of AVs is considerable, but as they gain traction, the price will reduce.

II. LITERATURE REVIEW

Object Detection→ Traffic lights, Traffic sign detection

Wang and Zhou [56] used a lightweight deep learning model to recognize traffic signal signs in dynamic photos. A dual-channel technique for detecting traffic lights in dark frames is proposed, together with a lightweight CNN model for real-time classification. A saliency model is built for dark channels in order to extract light from many hues simultaneously.
Advantage: - CNN gives the best accuracy in image classification

Yuan et al. [57] built a VSSA-NET architecture to recognize traffic signs and addressed the task as a regression and sequence classification challenge. The network architecture is built on a vertical spatial sequence attention module and a feature learning module with several resolutions. Additionally, contextual information is retrieved using a regression and classification approach with attention.

Using object suggestion, Zhu et al. [58] developed a system for detecting and recognizing traffic signs. CNN is used to narrow the scope of the search for traffic signs, and then R-CNN and Edge Box algorithms are used for detection and classification.

Vehicles, Pedestrians Detection

In [45], object orientation was frequently detected by combining the HOG feature vector with a Support Vector Machine (SVM) classifier. The HOG-SVM has demonstrated outstanding success in object detection. Due to the greater relevance of humans, it is vital to distinguish other things from autonomous vehicles.

Advantage: - Despite its significant time commitment, the HOG approach [45] has proven to be effective in the identification of pedestrians.

Wang et al. [53] introduced pedestrian detection using the semantics of body parts and information gathered from the surrounding environment, as well as complicated occlusion handling, resulting in very accurate localization findings that boost the safety of AD.
Ouyang et al. [54] provided a system for pedestrian detection that combines deep feature extraction, deformation and occlusion handling, and classification. This framework contributes to enhancing the safety of AD.

Cai et al. [55] offered another strategy in which they constructed complexity-aware cascade training for pedestrian identification. They used cascade and CNN to improve pedestrian recognition speed.

Raja Muthalagu1 et al. [46] created it to detect the safe driving region in front of a vehicle. On-board cameras are used to operate the car, use CNNs to learn from the driver's input. This strategy can be utilized to learn to drive by imitating a human driver. The mechanism kept the car in the lane and can recognize and classify traffic signs. As a result, it can find a road sign or another car and determine their distance.
Limitation: - Changes in the weather, shadows, and road conditions make the system [46] unable to distinguish between lanes.

Shuvendu Roy et al. [47] presented an automated approach for detecting emergency vehicles on a busy road using CCTV footage. The approach has demonstrated excellent performance in recognizing and classifying emergency vehicles. Training a car detector that only outputs images of automobiles is done using the object detector. Which will be used to determine whether the vehicle is an emergency vehicle or an ordinary vehicle. This is accomplished through the use of YOLO-V3.
Limitations: - YOLO-V3 sometimes fails to recognize small items and has difficulties detecting close objects.

Snowfall increases traffic crashes by 19% and injuries by 13%. A typical AEB system was tested on both high and low tire-road friction conditions by Ioana Koglbauer et al [72]. Adapting AEB systems to road friction could considerably increase their ability to avert crashes. A high level of perceived safety and confidence among occupants is required for automated driving features. An AEB application case is utilized to examine drivers' evaluations based on road conditions in order to create future driving functions.
Advantages: -
1. The proposed system increased drivers' safety, trust, and utility of AEB.
2. Adaptive AEB can help reduce traffic accidents and injuries.

Limitation: - Limitations of the system are not clearly mentioned.

Mo et al. [67] talk about three things. The first problem is passing along marketable vehicles on two-lane roadways. The move's efficiency is assessed in terms of cost and safety. Second, a heuristic strategy for selecting overtaking space and time is proposed. Estimating the early expectation's sensitivity to existing overtaking participants' position and speed to optimize overtaking speed distribution, the finite element approach is applied. This is done via adaptive model predictive control.
Limitation: - This study only looks at straight routes with no extra forces (e.g., gusts of wind). On top of that, the road should also have some mild vertical curvature, so it doesn't work well with very steep curvature

III. PROPOSED METHODOLOGY

Object detection is a task in computer vision that involves identifying the presence, location, and type of one or more objects in a given photograph. It is a challenging problem that involves building upon methods for object recognition.
This system puts forward a one-stage for object detection algorithm based on YOLOv3, which improves the detection accuracy. The main idea of our work is to develop a better solution for autonomous driving by detecting lane, objects, traffic signals and emergency vehicles. YOLO v3 is used to detect different kinds of objects. YOLO v3 is much faster than other networks and maintains accuracy.

1. Driverless car setup: CARLA is an open-source simulator used for autonomous driving. Autonomous cars are equipped with many sensors like ultrasonic, GPS, cameras, radars, accelerometers and gyroscopes. They provide information that is used for determining the safe path to the desired destination, preferably also the optimal one with respect to distance and time needed to reach the place. Decision-making is vital in self-driving cars. In order to make a decision, the car should have enough information so that it can select the necessary set of actions.

2. Camera Capture Module: The task is to predict self-driving cars steering wheel actions based on the input of a camera placed in front of the car. Camera capture module helps to record a video.

3. Pre-processing: Without pre-processing we can’t get 100% accuracy, so we have to pre-process the images and then send for further process to clean. Pre-processing involves converting the frame into other format (gravy scale, binaries image and so on).

4. Apply Noise Removal Techniques: Noise represents unwanted information which deteriorates image quality. Noise can degrade the images at the time of capturing or transmission of the image. Before applying image processing tools to an image, noise removal from images is done at highest priority.

When you want to detect something then you have to remove noisy pixels from image, so we have to do this pre-process on frame (image).

5. Object Detection using YOLOv3: The camera saves its images along with the measurements in order to train the data. The camera provides vision to the car, as it drives on a variety of tracks that have sharp and smooth turns, road bumps, trees and traffic lights. The simulated cameras provide images in front of the vehicle as it drives on a variety of tracks that have sharp and smooth turns along with lane detection, road bumps and trees. The YOLOv3 technique helps to detect objects like vehicle, traffic signal, and emergency vehicle, human.

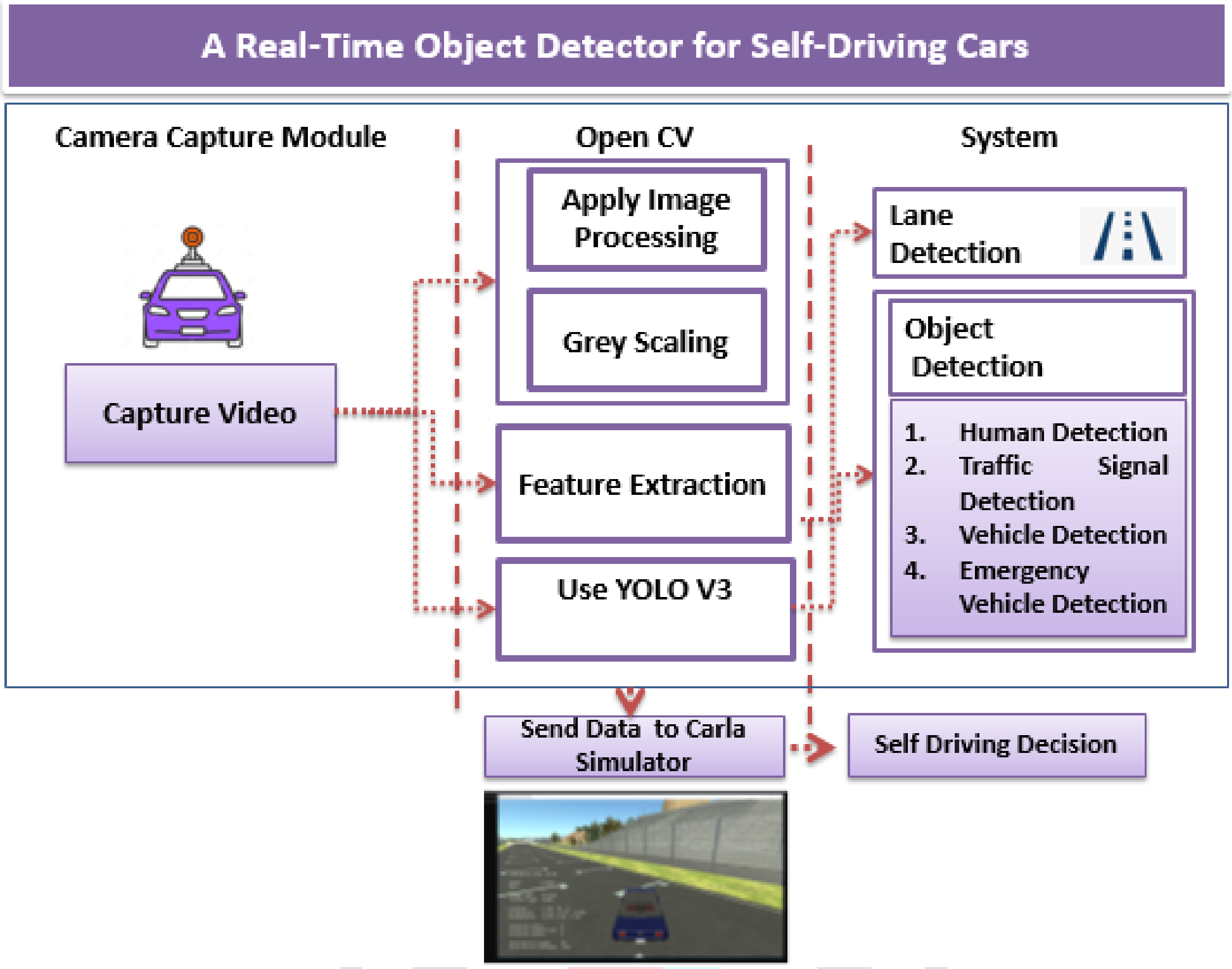

Figure: - System Architecture

VI. RESULTS

Figure: - Graphical User interface

V. CONCLUSION

Autonomous vehicles will aid in the resolution of transportation issues. Entrepreneurs predict autonomous vehicles to be reliable, affordable, and widespread by 2030, resulting in huge savings and advantages. Although there are valid reasons for distrust. The most enthusiastic forecasts are given by industry insiders, based on their involvement with disruptive technology like digital cameras, smartphones, and personal computers. They often neglect major challenges to self-driving vehicle improvement and overstate possible profits.

A look at the current status of autonomous vehicle technology is the focus of this article (AV), paying special emphasis to the standard sensor technologies now in use and previous research efforts in this area. The advancement of these vehicles will enable the achievement of higher safety standards, less environmental pollution, and more social fairness. So, having the right infrastructure isn't the only thing that can make this happen. As a result, it is important to set up the fundamental aspects that smart cities of the future must possess so as to accept the novel technologies offered by AV. This article will discuss the work done so far in the area of driverless car. An attempt is made to present an overview of the proposed system with its architecture and implementation strategies.

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