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IMPLEMENTATION OF REAL TIME OBJECT DETECTION FOR SELF DRIVING CAR USING HAAR CASCADE CLASSIFIER

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Abstract: The rapid evolution of autonomous driving technology has sparked significant interest in developing systems that can operate safely and efficiently in dynamic real-world environments. A critical component of any self-driving car system is its ability to perceive and detect objects in its surroundings. Accurate and real-time object detection ensures that the vehicle can make informed decisions to avoid obstacles, follow traffic rules, and interact with other vehicles and pedestrians safely. This paper explores the implementation of real-time object detection for a self-driving car using the Haar Cascade Classifier, a widely recognized machine learning technique for object detection. The Haar Cascade Classifier is based on the concept of using Haar-like features, which are simple rectangular patterns, to detect objects by analyzing the differences in pixel intensity within those regions. These features, when combined in a cascade of increasingly complex classifiers, allow for the rapid detection of objects such as pedestrians, vehicles, traffic signs, and other critical obstacles. In this implementation, we utilize a pre-trained Haar Cascade model to detect objects from the camera feed of a self-driving car, processing the video in real time. To achieve real-time performance, we optimize the algorithm by carefully adjusting parameters such as the detection scale and window size, as well as reducing false positives through post-processing techniques. The system is tested under different environmental conditions, such as varying lighting, weather, and object sizes, to assess the robustness and effectiveness of the approach in practical scenarios. The results demonstrate that while the Haar Cascade Classifier can achieve reasonable accuracy and speed for detecting simple objects in structured environments, challenges remain in more complex and dynamic situations, such as heavy traffic or poorly lit roads.

Keywords: Real-Time Object Detection, Self-Driving Car, Haar Cascade Classifier, Autonomous Vehicles, Machine Learning, Computer Vision, OpenCV, Image Processing, Traffic Sign Detection, Pedestrian Detection, Vehicle Detection, Artificial Intelligence (AI), Feature Extraction

I. INTRODUCTION

The advent of self-driving technology has the potential to revolutionize the automotive industry by enhancing road safety, improving transportation efficiency, and reducing human error. Autonomous vehicles (AVs) rely heavily on a suite of sensors, cameras, and sophisticated algorithms to navigate complex environments and interact with other vehicles, pedestrians, and road infrastructure. One of the most critical challenges in the development of self-driving cars is real-time object detection, which allows the vehicle to perceive its surroundings and make informed decisions for safe navigation.

Real-time object detection involves the identification of various objects such as pedestrians, other vehicles, traffic signs, road barriers, and obstacles in the vehicle's environment. Accurate and timely object detection is essential for tasks such as obstacle avoidance, path planning, and decision-making. Various techniques are employed to achieve object detection, with machine learning and computer vision playing pivotal roles in providing high accuracy and speed for real-time applications.

Among the various object detection methods, the Haar Cascade Classifier, a machine learning-based approach, has gained prominence for its simplicity, efficiency, and relatively low computational cost. It was first introduced by Viola and Jones in 2001 and has since become widely used for real-time face detection and other object recognition tasks. The Haar

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Cascade Classifier operates by analyzing image features, which are derived from the differences in pixel intensity within a rectangular window, to detect objects in an image or video stream. By utilizing a cascade of increasingly complex classifiers, it achieves fast and reliable object detection while maintaining high accuracy in a variety of conditions.

II. METHODOLOGY

The implementation of real-time object detection for self-driving cars using the Haar Cascade Classifier follows a structured methodology. The process begins with data collection, where relevant datasets containing images of road elements such as vehicles, pedestrians, traffic signs, and obstacles are gathered. These images are then preprocessed by converting them to grayscale, normalizing, and resizing them for consistency. To train the Haar Cascade Classifier, positive and negative samples are prepared, where positive samples contain the object of interest, and negative samples do not. The opencvcreatesamples tool is used to generate sample files, and opencvtraincascade is employed to train the classifier, producing an XML file containing the trained modelFor real-time implementation, the trained classifier is integrated with OpenCV, and a live video feed from the vehicle's camera is processed frame by frame. Each frame is converted to grayscale, and the detect. Multiscale() function is used to identify objects, drawing bounding boxes around detected items. To enhance real-time performance, parameters such as scaleFactor and min neighbours are optimized, multi-threading is used for faster processing, and lightweight implementations are deployed on embedded systems like Raspberry Pi or NVIDIA Jetson. The detection system undergoes rigorous testing under various conditions, including different lighting and weather environments, and its accuracy is evaluated using metrics such as precision and recall.

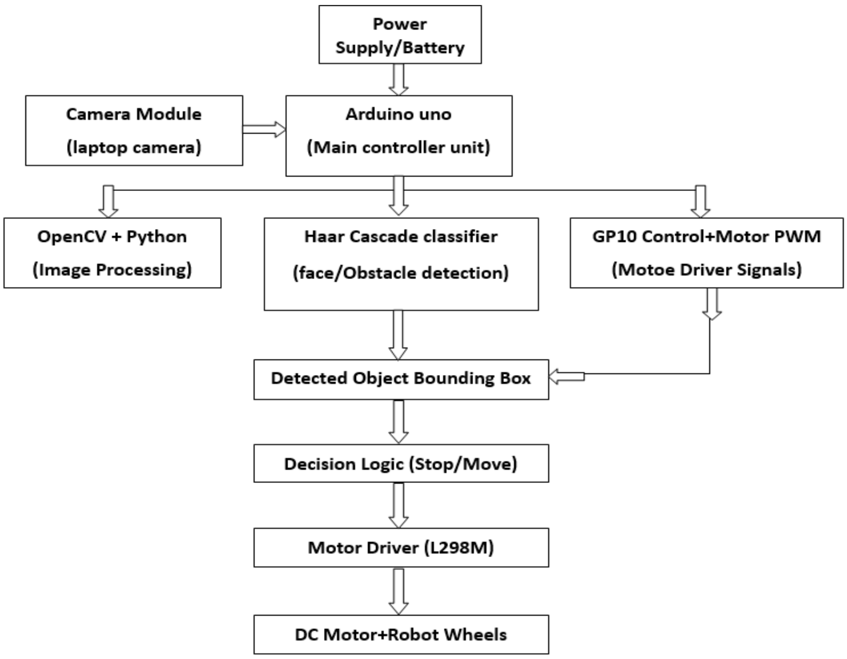

Fig 1. Block diagram of Implementation Of Real Time Object Detection For Self Driving Car Using Haar Cascade Classifier

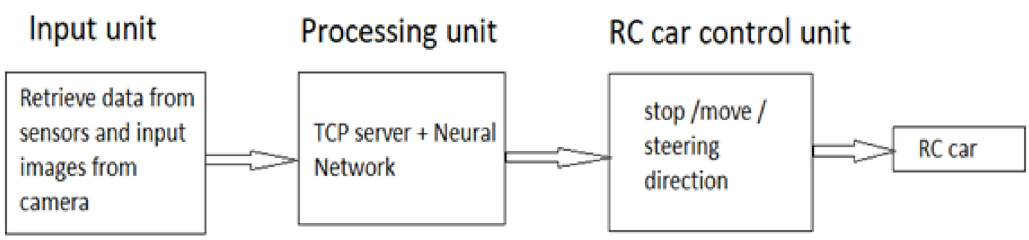

Fig 2 Control flow diagram

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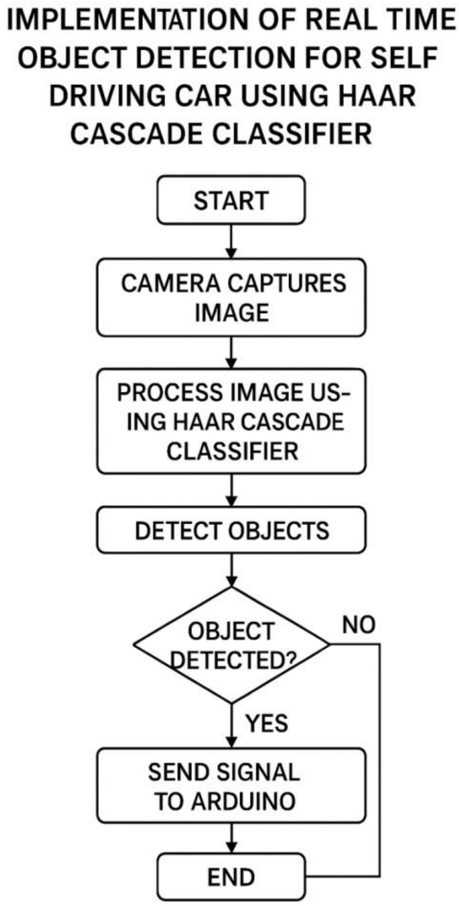
III. IMPLEMENTATION



IV. RESULT

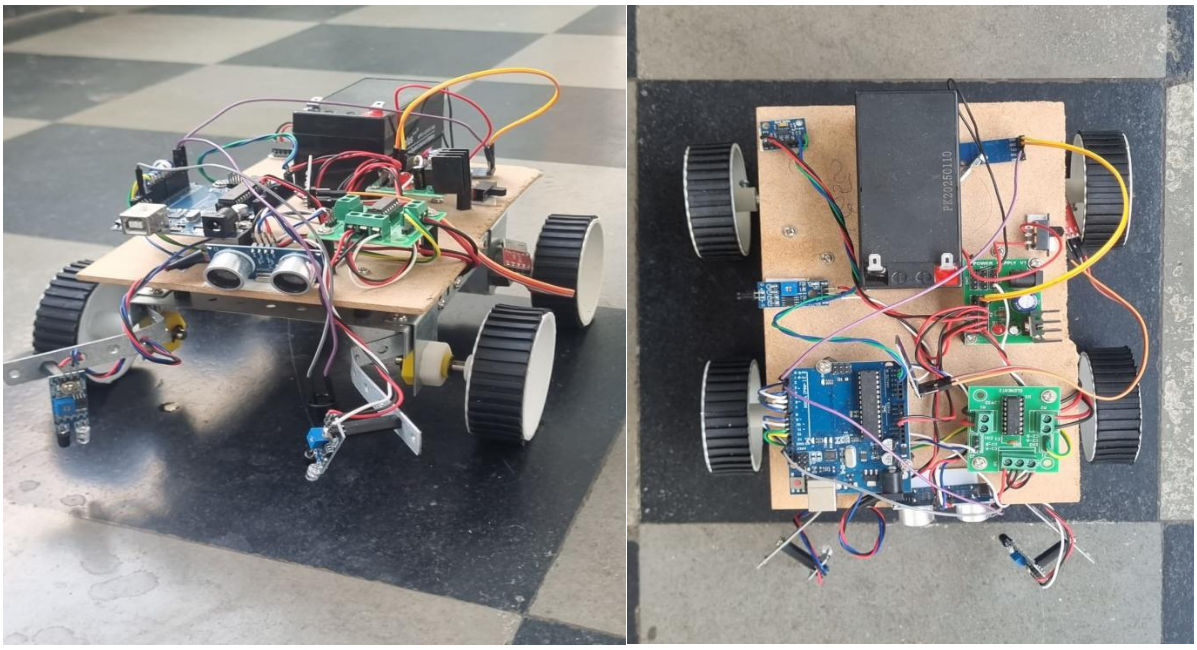


Fig 3. Working Model

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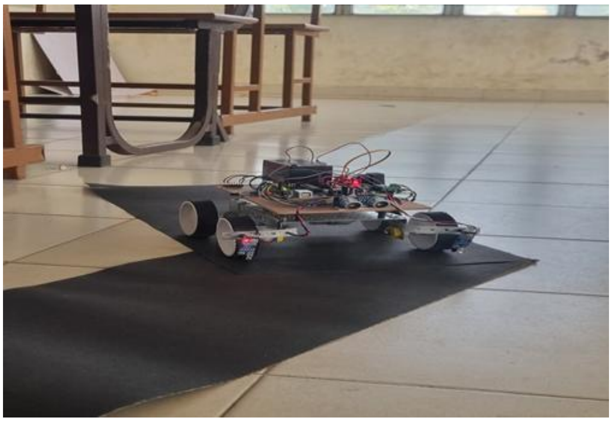

Fig 4. Lane detection by model.

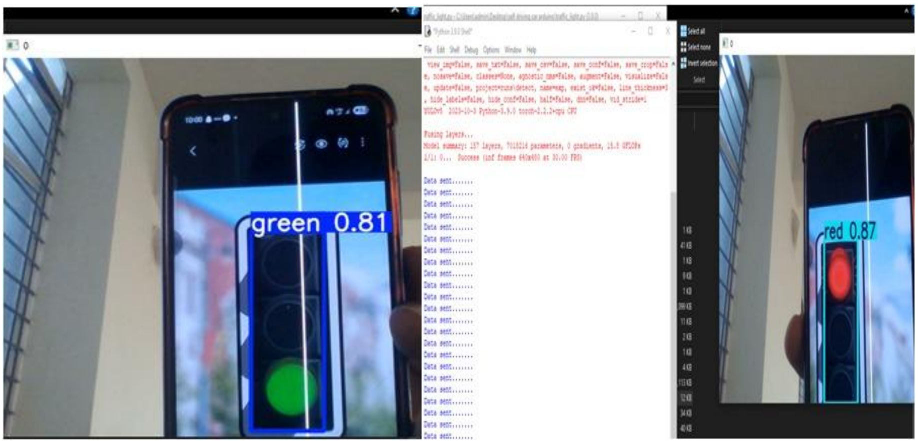

Fig 5. Traffic Signal detection by camera

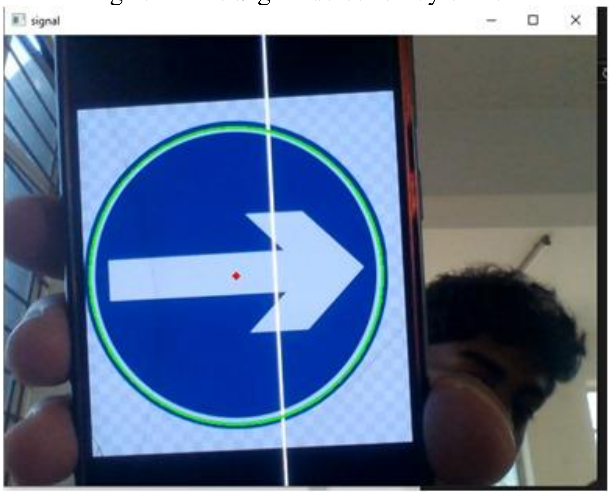

Fig 6. Traffic sign detection

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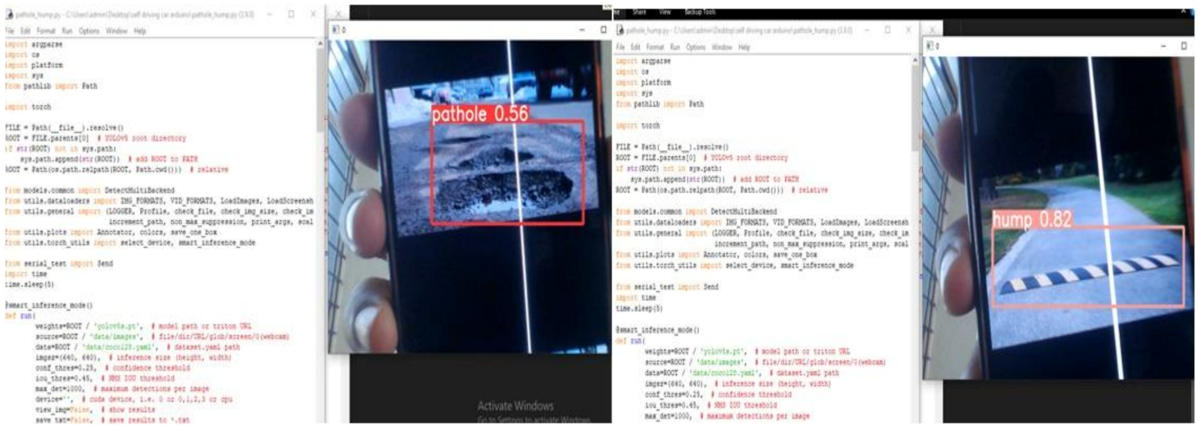

Fig 7. Pathole and Hump detection by camera

V. CONCLUSION

The implementation of real-time object detection using the Haar Cascade Classifier shows that classical machine learning techniques can still provide fast and lightweight solutions for autonomous driving tasks. The system successfully detects basic objects such as pedestrians, cars, and signs using simple pattern-based features, making it suitable for low-power hardware.

However, the project also highlights the limitations of Haar Cascades in dynamic and complex environments. The accuracy decreases in poor lighting, crowded roads, or when objects vary greatly in size or shape. These issues affect the reliability needed for fully autonomous navigation.

Overall, the project demonstrates that Haar Cascade–based detection can serve as an introductory or supportive module for object recognition in self-driving systems. While it offers good speed and simplicity, it cannot replace more advanced techniques for real-world autonomous driving tasks.

VI. FUTURE SCOPE

Future development can focus on integrating deep learning–based detectors such as YOLO, SSD, or Faster R-CNN, which provide higher accuracy and better adaptability to complex environments. These models can detect multiple objects with greater precision and handle variations in lighting and movement more effectively.
The system can also be improved by combining object detection with additional modules like tracking, lane detection, and sensor fusion (LiDAR, RADAR). Using multiple sensors will make the detection system more robust and reliable in challenging conditions such as night driving or fog.

Finally, optimizing the system for real-time performance on embedded platforms like NVIDIA Jetson or Raspberry Pi can enhance practical use in small-scale autonomous vehicles. With hardware acceleration and advanced algorithms, the project can evolve into a more complete and dependable perception system for future self-driving applications.

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REFERENCES

[1]. P. Gowsikraja, T. Thevakumaresh, M. Raveena, J. Santhiya, and A. Vaishali, "Object detection using haar cascade machine learn- ing algorithm," in 2022 International Journal of Creative Research Thoughts (IJCRT), IJCRT22A6329, 2022, pp. 555–559.

[2]. Thadeshwar, Hiral, Vinit Shah, Mahek Jain, Rujata Chaudhari and Vishal Sahebrao Badgujar. "Artificial Intelligence based Self-Driving Car." 2020 4th International Conference on Computer, Communication and Signal Processing (ICCCSP) (2020): 1-5.

[3]. Sharma, Paawan & Gupta, Mukul & Mondal, Amit Kumar &Kaundal, Vivek. (2017). HAAR like Feature-Based Car Key Detection Using Cascade Classifier. 10.1007/978-981-10-1708-7_79.

[4]. Noor, Kazy, E Alam Siddiquee, Dhiman Sarma, Avijit Nandi, Sharmin Akhter, Sohrab Hossain, Karl Andersson, and Mohammad Shahadat Hossain. "Performance Analysis of a Surveillance System to Detect and Track Vehicles Using Haar Cascaded Classifiers and Optical Flow Method." 2017 12th IEEE Conference on Industrial Electronics and Applications (ICIEA), 2017. doi:10.1109/ICIEA.2017.8282853.

[5]. Bratu, Dragoș & Moraru, Sorin-Aurel &Gușeilă, Ligia. (2019). A Performance Comparison between Deep Learning Network and Haar Cascade on an IoT Device. 1-6. 10.1109/ISSI47111.2019.9043714.

[6]. Sanil, Nischal, Pasumarthy Ankith Naga Venkat, Rakesh V, Rishab Mallapur and Mohammed Riyaz Ahmed. "Deep Learning Techniques for Obstacle Detection and Avoidance in Driverless Cars." 2020 International Conference on Artificial Intelligence and Signal Processing (AISP) (2020): 1-4.

[7]. Masmoudi, Mehdi, Hakim Ghazzai, Mounir Frikha and Yehia Massoud. "Object Detection Learning Techniques for Autonomous Vehicle Applications." 2019 IEEE International Conference of Vehicular Electronics and Safety (ICVES) (2019): 1-5.

[8]. Lo, Rong-Chin, Chin-Yi He, Chun-Ju Chiu and Ya-Hui Tsai. "Obstacle detection using combination of disparity and optical flow under around "Comparison of Haar-like, HOG and LBP approaches for face detection in video sequences." 2019 16th International Multi Conference on Systems, Signals & Devices (SSD) (2019): 266-271.

[9]. view for driver assistance system." 2013 International Conference on Connected Vehicles and Expo (ICCVE) (2013): 451-458.

[10]. Prabhakar, Gowdham, Binsu J. Kailath, Sudha Natarajan and Rajesh Kumar. "Obstacle detection and classification using deep learning for tracking in high-speed autonomous driving." 2017 IEEE Region 10 Symposium (TENSYMP) (2017): 1-6.

[11]. Fayjie, Abdur Razzaq, Sabir Hossain, Doukhi Oualid and Deok Jin Lee. "Driverless Car: Autonomous Driving Using Deep Reinforcement Learning in Urban Environment." 2018 15th International Conference on Ubiquitous Robots (UR) (2018): 896-901.

[12]. Arunmozhi, Ashwin and Jungme Park. "Comparison of HOG, LBP and Haar-Like Features for On-Road Vehicle Detection." 2018 IEEE International Conference on Electro/Information Technology (EIT) (2018): 0362-0367.

[13]. Tyas PurwaHapsari, Diajeng, Cindykia Gusti Berliana, Putri Handayani Winda and M. Arief Soeleman. "Face Detection Using Haar Cascade in Difference Illumination." 2018 International Seminar on Application for Technology of Information and Communication (2018): 555-559.

[14]. Adouani, Amal, Wiem Mimoun Ben Henia and ZiedLachiri. [15] Cruz, Juliano E. C., ElcioHideitiShiguemori and Lamartine Nogueira Frutuoso Guimarães. "A comparison of Haar-like, LBP and HOG approaches to concrete and asphalt runway detection in high resolution imagery." (2016).

