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SSLA Based Traffic Sign and Lane Detection for Autonomous Cars

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Abstract: *Autonomous vehicles are rapidly evolving to improve road safety and reduce human errors, which account for a majority of traffic accidents. This project proposes an intelligent system for traffic sign detection and lane detection using a Shape Supervised Learning Algorithm (SSLA). The system integrates machine learning techniques with computer vision methods such as Hough Line Transformation and edge detection using OpenCV and NumPy. The model is trained using supervised learning to accurately detect traffic signs and lane boundaries. The proposed system improves detection accuracy while reducing processing time, contributing to safer and more reliable autonomous driving..*

Keywords: Autonomous Vehicles, Lane Detection, Traffic Sign Detection, SSLA, Machine Learning, OpenCV, Hough Transform, Computer Vision

I. INTRODUCTION

In modern transportation systems, road safety is a critical concern due to the high number of accidents caused primarily by human errors. Autonomous vehicles, also known as self-driving cars, are being developed to address these issues by eliminating the need for human intervention.

Autonomous cars rely on a combination of sensors, actuators, and intelligent software systems to perceive their environment and make driving decisions. A key component of these systems is the software architecture, which acts as a bridge between hardware and application layers. AUTOSAR (Automotive Open System Architecture) provides a standardized framework for developing such software.

Two essential functionalities in autonomous driving are lane detection and traffic sign detection, as they directly impact vehicle navigation and safety. This project introduces a Shape Supervised Learning Algorithm (SSLA) that enhances detection accuracy using machine learning and image processing techniques such as Hough Line Transformation and edge detection.

II. LITERATURE SURVEY

Several research works have contributed to the development of autonomous vehicle technologies, particularly in the areas of lane detection and traffic sign recognition. A comprehensive study on the evolution of autonomous cars highlights the transition from early radio-controlled vehicles to modern AI-driven systems, emphasizing the role of vision-based and sensor-based technologies in current implementations. Research on traceability maintenance in software engineering underscores the importance of maintaining high-quality links between system components, which is crucial for developing reliable automotive software architectures. Studies focusing on software design and testing for automotive applications discuss the significance of methodologies such as Automotive SPICE and the V-model in ensuring safety and efficiency in system development.

In addition, road safety analysis studies reveal that a significant number of accidents are caused by human errors, thereby reinforcing the need for intelligent transportation systems. Recent advancements in deep reinforcement learning demonstrate its capability in enabling autonomous navigation and obstacle avoidance using sensor data such as cameras and LiDAR. Research on 3D object detection further explores the use of multiple sensors for accurate environment

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perception. Moreover, traffic sign detection systems based on convolutional neural networks (CNNs) have shown promising results in recognizing and classifying traffic signs using image data. These studies collectively highlight the importance of integrating machine learning, computer vision, and robust software architectures to build effective autonomous driving systems.

III. PROPOSED METHODOLOGY

A. Proposed System

The proposed system introduces an intelligent approach for traffic sign and lane detection using a Shape Supervised Learning Algorithm (SSLA) combined with computer vision techniques. The system is designed to improve detection accuracy and reduce computational time compared to existing methods. It utilizes Hough Line Transformation to detect geometric shapes, particularly circles, which are commonly found in traffic signs. Additionally, edge detection techniques are applied to identify lane boundaries based on color and intensity variations in road images. The implementation is carried out using Python, leveraging libraries such as OpenCV and NumPy for efficient image processing.

The machine learning component of the system involves training shape models using supervised learning, where a large dataset of images is used to improve the model's ability to recognize patterns. The detected shapes are further processed and converted into mathematical representations for accurate classification. The system is specifically optimized to detect circular traffic signals, even when they are partially visible or placed at elevated positions. Overall, the proposed system enhances the performance of autonomous driving by providing reliable and efficient detection of critical road features.

B. Modules Information

The system is divided into multiple modules to ensure efficient implementation and functionality. The model training module is responsible for training the machine learning algorithm using labeled datasets and storing the trained model for future use. The video input module allows users to provide input data in the form of video streams, which are then processed by the system. The lane detection module uses edge detection and Hough Transform techniques to accurately identify road lanes, ensuring proper vehicle alignment.

The traffic sign detection module focuses on identifying and classifying traffic signs based on their shapes, particularly circular signs, using the trained machine learning model. The processing module integrates all detection techniques and ensures smooth execution of the algorithms. Finally, the output module displays the detected lanes and traffic signs in a user-friendly format, providing visual feedback for analysis. These modules work together to create a robust system capable of handling real-time detection tasks in autonomous vehicles.

IV. RESULTS

The proposed system demonstrates effective performance in detecting both lane boundaries and traffic signs using a combination of machine learning and image processing techniques. The implementation of the Shape Supervised Learning Algorithm significantly improves the accuracy of shape detection, especially for circular traffic signals. The system is capable of identifying lanes and signs even under challenging conditions, such as partial visibility or variations in lighting.

Compared to existing approaches, the proposed system achieves better accuracy while reducing the time required for processing. The use of Hough Line Transformation and edge detection techniques enhances the reliability of detection, making the system suitable for real-time applications. Experimental results using video datasets indicate that the system performs consistently and provides accurate outputs, thereby contributing to safer and more efficient autonomous driving systems.

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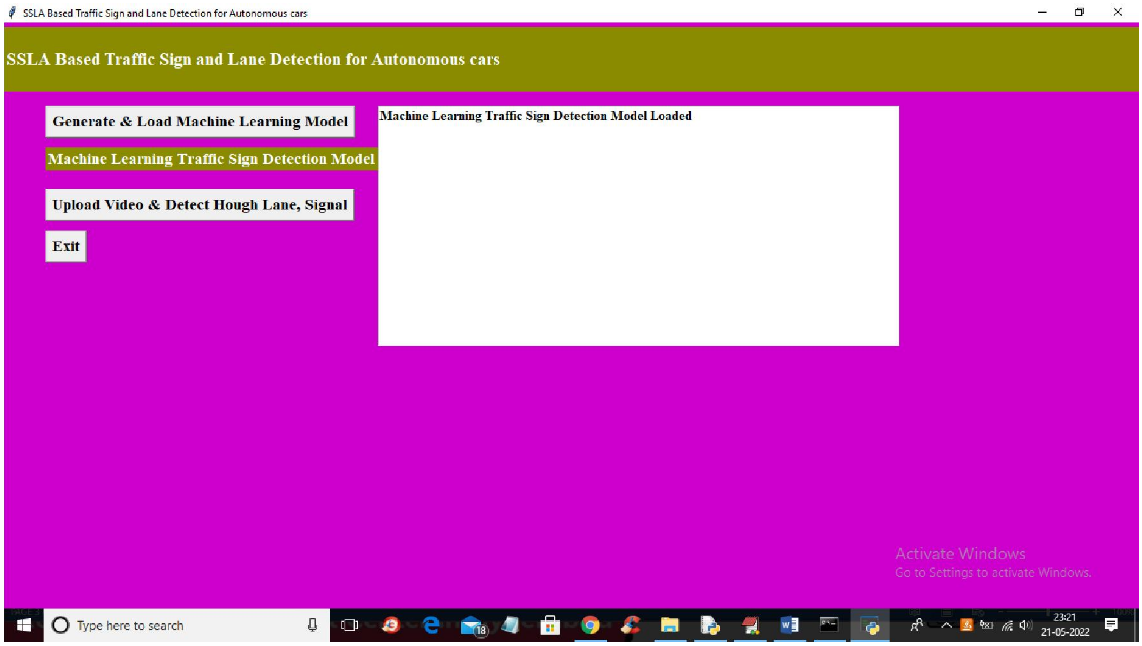

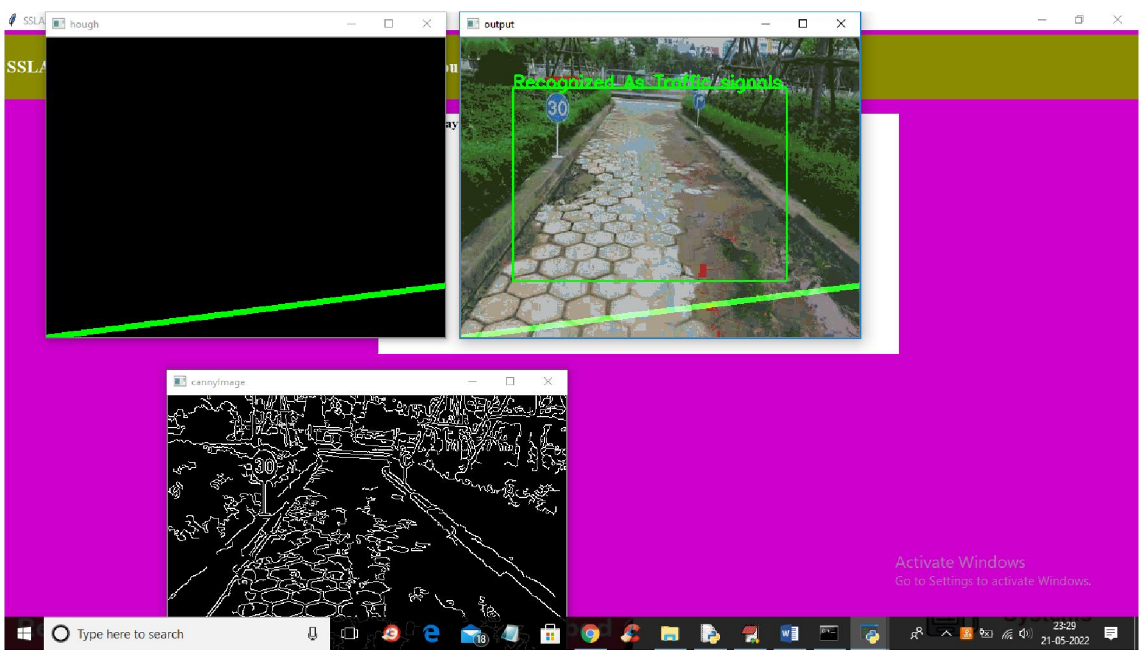

V. CONCLUSION

Autonomous vehicle technology plays a crucial role in improving road safety and reducing accidents caused by human errors. This project presents an efficient approach for lane and traffic sign detection using SSLA and computer vision techniques.

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By integrating machine learning with image processing, the system achieves accurate and fast detection, making it suitable for real-time applications. The proposed approach enhances the reliability of autonomous driving systems and contributes to the advancement of intelligent transportation.

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