Detection of Lane and Speed Breaker Warning System for Autonomous Vehicles using Machine Learning Algorithm

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Abstract-
With the rapid advancement of autonomous vehicle technologies, ensuring the safety of these vehicles on roads has become a paramount concern. One of the critical aspects of safe autonomous driving is the accurate detection of lanes and potential road hazards, such as speed breakers. In this study, we propose a Lane and Speed Breaker Warning System (LSBWS) that employs machine learning algorithms to enhance the perception capabilities of autonomous vehicles.The LSBWS utilizes a combination of computer vision and machine learning techniques to detect and analyze road lanes and speed breakers in real-time. The system utilizes a camera sensor to capture the road scene ahead and then employs image processing algorithms to identify lane markings and speed breakers. A convolutional neural network (CNN) is employed to accurately detect and classify these features within the captured images.

Keywords: Lane detection, Speed breaker detection, Autonomous vehicles, Machine learning algorithms, Convolutional neural network, Road safety.

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1. INTRODUCTION

The "Detection of Lane and Speed Breaker Warning System for Autonomous Vehicles using Machine Learning Algorithm" is a critical component of autonomous driving systems. This system is designed to enhance the safety and efficiency of autonomous vehicles by detecting and responding to lane markings and speed breakers on the road. In this introduction, we will provide an overview of the key components, goals, and benefits of such a system.By leveraging advanced machine learning techniques and sensor data, it enhances the vehicle's ability to navigate complex road conditions while prioritizing safety and passenger comfort.

2. MOTIVATION

The development of a lane and speed breaker warning system using machine learning algorithms is motivated by the need to enhance the safety, adaptability, and comfort of autonomous vehicles. It addresses critical challenges faced by self-driving cars in navigating diverse road conditions and contributes to the overall acceptance and success of autonomous driving technology.

3. OBJECTIVE

- To develop a machine learning algorithm capable of identifying and tracking lanes on the road.

- To create a system that can identify speed breakers (also known as speed bumps or humps) on the road.
- To implement a robust warning system that alerts the autonomous vehicle's control system when lanes or speed breakers are detected.
- To develop interfaces to seamlessly integrate the lane and speed breaker detection system with the vehicle's autonomous control system.

4. EXISTING SYSTEM

Existing systems for the detection of lanes and speed breakers in autonomous vehicles primarily leverage advanced computer vision and deep learning techniques. Lane detection often starts with traditional computer vision methods like Canny edge detection and the Hough Transform, which help identify lane boundaries by detecting edges and lines in images. Additionally, color filtering is used to isolate lane markings based on their color. More advanced systems employ convolutional neural networks (CNNs), such as SegNet or U-Net, for semantic segmentation to recognize lane markings with high accuracy. Specific architectures like LaneNet are designed to perform instance segmentation of lane lines. Some approaches adopt end-to-end learning models where the neural network directly predicts driving actions from raw images.

For speed breaker detection, existing systems frequently utilize a combination of sensor data and machine learning algorithms. Accelerometers and gyroscopes are common sensors used to detect the physical presence of speed breakers through sudden vertical accelerations. Additionally, camera-based systems use deep learning models to visually identify speed breakers. Convolutional neural networks are trained to recognize the unique visual features of speed breakers in road images. Sensor fusion techniques, combining data from cameras, LIDAR, and RADAR, are also employed to improve detection accuracy and reliability, particularly under varying environmental conditions.

5. LITERATURE SURVEY

1.Paper Name: Speed Breaker Detection and Mapping using IoT. Author: Rahul Ramakrishnan; Ayusha Pendse; Chetna Sharma; Priya Chimurkar. With increasing road accidents due to improper and non-standard speed breakers, it is the need of the hour to address this issue appropriately, and due to this although speed breakers are built for safety, they are posing to be more of a danger. This is mainly due to building illegal speed breakers and not maintaining existing ones. The existing solutions are largely dependent on the user or the surrounding, both of which do not provide immediate accuracy and dependability. This paper presents a self-improving system with minimal user involvement and aims to cover nearly all the drawbacks of the current solutions. It suggests speed breaker detection by measuring the difference in the height between the road level and the vehicle. In this approach, GPS coordinates are stored in an online database system that is available to the public through a portal. When the vehicle is at a predefined distance away from the speed breaker, the user is notified resulting in improved accuracy with every usage.

2. Paper Name: Detection of Potholes and Speed Breaker on Road Author: Gurpreet Singh; Rajeev Kumar; Poonam Kashtriya. In this paper, earlier potholes detection systems that have been developed and introduces a worthwhile solution to recognize humps, potholes and speed breakers on road surface and give up-to-date signals to drivers to avoid vehicle damages or accidents, by giving him earlier warnings. To identify of humps, speed breaker and potholes, ultrasonic sensors are used and also to estimate their height and depth, respectively. In our proposed system, we are using global positioning system receiver (GPS receiver) for identification of geographical location coordinates of the detected potholes and speed breaker. The data which are sensed by the ultrasonic sensors includes geographical location, the height of speed breakers and depth of potholes, which is saved in the local and cloud database. This paper also considers updating the database on the regular basis so that potholes can be repaired regularly by concerned authorities.

3.Paper Name: Pothole and Speed Breaker Detection Using Smartphone Cameras and Convolutional Neural Networks.Author: Zahid Hasan; Samsoon Nahar Shampa; Tasmia Rahman Shahidi; Shahnewaz Siddique. Poor road conditions are one of the major causes for road accidents. Developing countries in particular are witnessing increased accident rates due to these poor road conditions. Potholes, deep ridges, missing pitches, improper speed breakers, poorly constructed manhole covers and slabs all combine to greatly

increase the probability of serious accidents thus transforming roads into obstacle courses. In this study we have developed a model to detect unwanted potholes, deep ridges and speed breakers using computer vision and machine learning tools. We have developed a customized dataset (called Bumpy) that we use to train our machine learning algorithms. In this paper we propose a method where we use the Tensorflow pre-trained model to detect the potholes, deep ridges and speed breakers. Our experimental results demonstrate high accuracy although there are many obstacles on the road.

4.Paper Name: Real time detection of speed breakers and warning system for on-road drivers. Author: Mahbuba Afrin; Md. Redowan Mahmud; Md. Abdur Razzaque. The excessive use of speed breakers on national highways distracts vehicle drivers. In addition to that, drivers often can't recognize the appearance of unmarked speed breakers and loose control of the vehicle, causing serious accidents and loss of lives. In the literature, there exist a few methods to warn on-road drivers about the upcoming speed breakers which are highly error-prone and time consuming. Moreover, none of them pay any heed to track the information of infringing speed breakers. In this paper, we come forward with a system that facilitates autonomous speed breaker data collection, dynamic speed breaker detection and warning generation for the onroad drivers. Our system also incorporates real-time tracking of driver, vehicle and timing information for speed breaker rule violations. The proposed system outperforms the state-of-the-art works with which it is compared to in terms of response time and accuracy.

5.Paper Name: Speed detection using image processing Author: Pranith Kumar Thadagoppula; Vikas Upadhyaya. With the increase in automobile use, the highway traffic have only surged. At the current rate of increasing automobiles, speed determination has become a major concern in avoiding fatal accidents. Radar technology is the current productive way used for speed detection. In this paper we have come up with an alternative method of using image and video processing which can overcome the drawbacks of radar guns. It uses the live video stream from the surveillance cameras for calculating the speed of the vehicle. The speed of vehicle is updated every half a second, hence keeping a track on acceleration and deceleration of vehicle in the field of view of the camera. Any violation in the speed laws can be observed and notified to the officer of law. This helps in keeping track of the speed violators and saves the effort of an officer holding a radar gun on the highways. The video can also be saved for future use.

6.Paper Name: Intelligent speed breaker system design for vehicles using Internet of Things. Author: Sarah Biswal, Ishika Chandra, S.K. Sinha, Kamlesh Pandey. Bad visibility conditions which occur due to fog in winters or night time driving are the major causes of road accidents in India. The principal cause for such accidents is the unintentional ignorance of speed breakers which may be due to the driver not being able to detect them or may be due to over speeding of vehicles. This paper brings an idea of an intelligent speed breaker system that helps in detecting speed breakers well in time so that such accidents can be avoided. This system makes use of a RF module that warns the person who is driving about the existence of a speed breaker in proximity, with this it assists in automatically reducing the vehicle's speed if no action is taken by the driver in time. Through Internet of Things (IoT), GPS Location (latitude and longitude) of speed breaker can be sent to cloud using GPS and stored on cloud to use it for future to avoid mishaps.

6. HARDWARE AND SOFTWARE REQUIREMENT

SR.NO	Hardware	Description
1	Processor	Intel i3 or AMD
2	Speed	1.1GHz
3	Hard Disk Space	40 GB
4	RAM	8 GB

Table 1. Hardware Requirements

SR.NO	Software	Description
1	Operating System	Windows
2	IDE	Spyder

3	Processor	Intel i3
4	Coding Language	Python 3.5

Table 2. Software Requirements

7. ARCHITECTURE

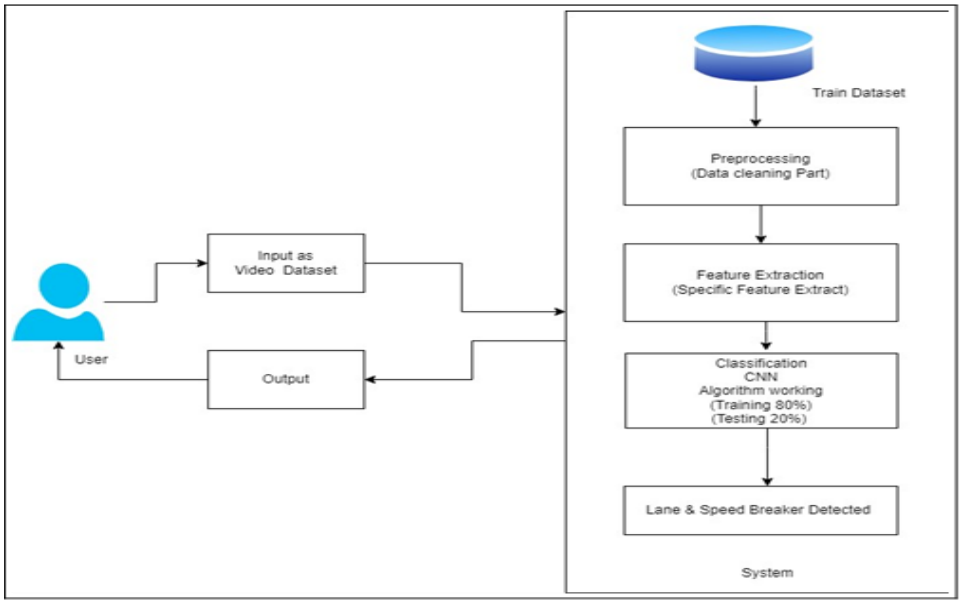


Fig. System Architecture

8. ADVANTAGES

Improved Safety:

- High accuracy in detecting lane markings reduces the risk of lane departure accidents.
- Early detection of speed breakers allows for timely speed adjustments, preventing sudden jolts and potential vehicle damage.

Enhanced Reliability:

- Machine learning models trained on diverse datasets are robust against varying road conditions, lighting, and weather.
- Real-time data processing ensures timely and reliable lane and speed breaker detection.

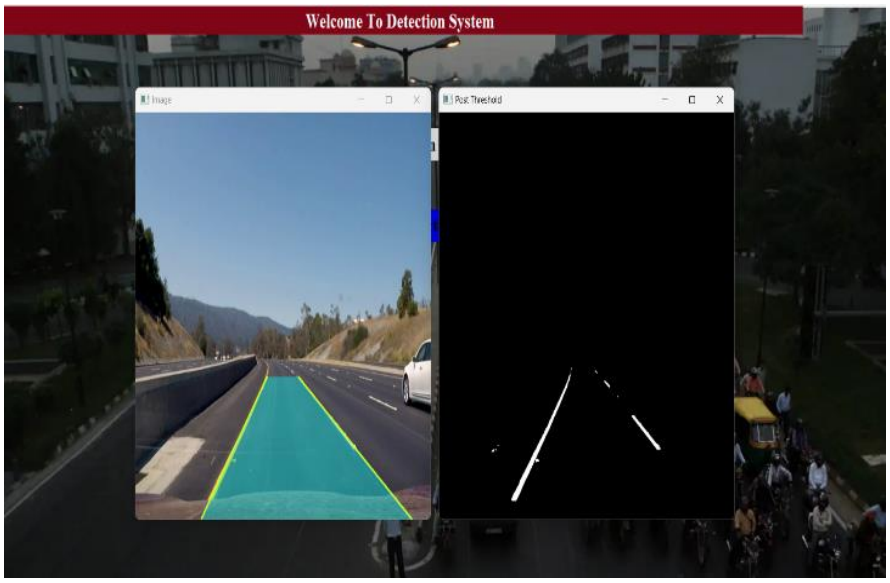
Cost-Effectiveness:

- Minimizes the need for expensive sensors by enhancing the capabilities of standard cameras and accelerometers through sophisticated algorithms.
- Reduces vehicle maintenance costs by avoiding unnecessary jolts and ensuring smoother rides.

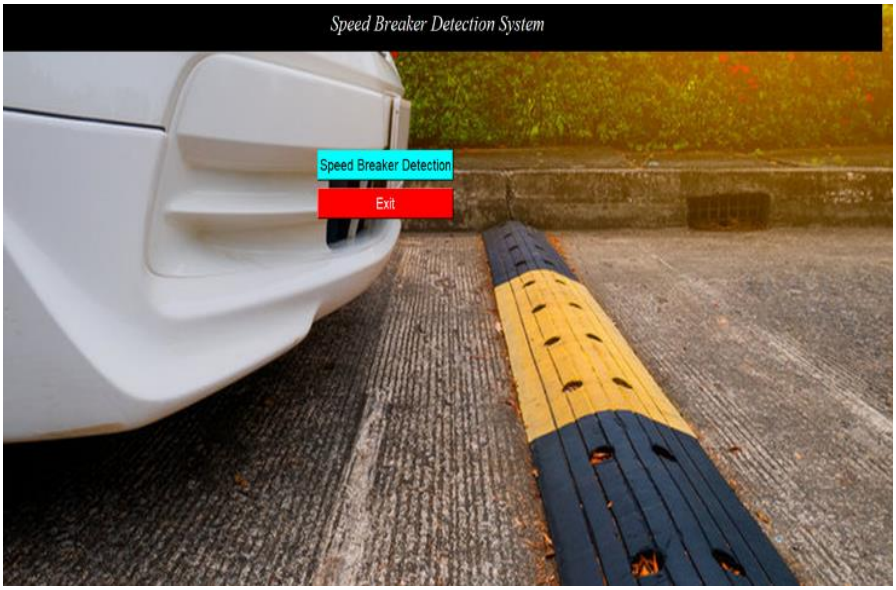
9. RESULT

1.Speed and Lane Detection:

2. Lane Detection Module:

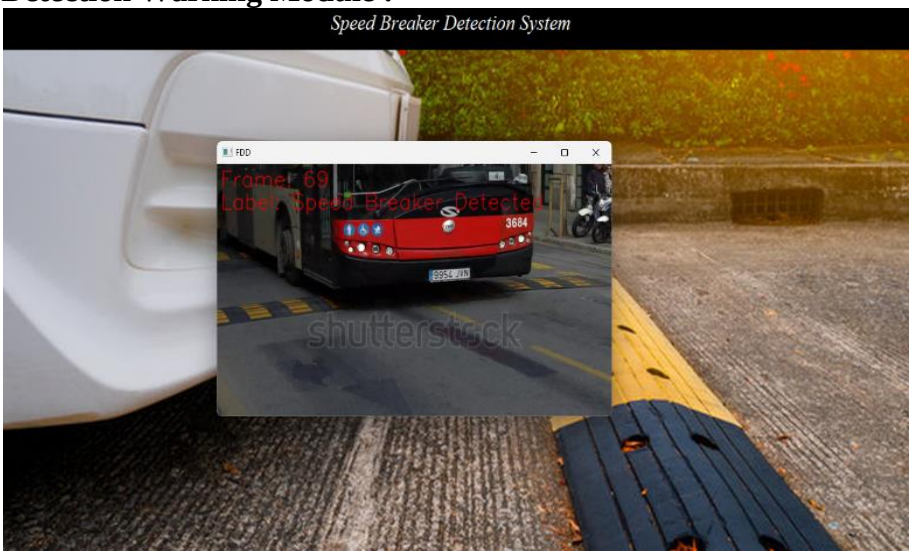


3. Speed Breaker Detection Module I :



4. Speed Breaker Detection Module II :

5. Speed Breaker Detection Warning Module :



10. CONCLUSION

The ”Detection of Lane and Speed Breaker Warning System for Autonomous Vehicles using Machine Learning Algorithm” research presents a comprehensive approach to enhancing the safety and reliability of autonomous vehicles through accurate lane and speed breaker detection. By leveraging machine learning algorithms, the proposed system addresses critical challenges in autonomous driving, contributing to the realization of safer and more efficient transportation systems. By effectively combining machine learning algorithms with real-world road scenarios, the system contributes to the broader goal of reshaping transportation, enhancing road safety, and establishing autonomous vehicles as a safer and more viable mode of transportation. As the field of autonomous vehicles progresses, the research’s insights will undoubtedly serve as a foundation for further advancements in perception systems and autonomous vehicle technology as a whole.

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