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# Curve Path Prediction and Vehicle Detection in Lane Roads using Deep Learning for Autonomous Vehicles

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**Abstract:** *The development of autonomous vehicles has seen significant progress in recent years. One of the key challenges in this field is the ability of the vehicle to accurately predict the path of the road and detect other vehicles in real-time. In this research paper, we propose a deep learning-based approach for curve path prediction and vehicle detection in lane roads for autonomous vehicles. The proposed approach utilizes convolutional neural networks to detect vehicles and predict their trajectory, taking into account road geometry and traffic conditions. The model will be trained on a large dataset of road scenes and tested in realistic simulations. The findings of this study will contribute to the advancement of autonomous vehicle technology, particularly in terms of improving the accuracy and reliability of curve path prediction and vehicle detection in lane roads.*

**Keywords:** CNN Algorithm, Lane detection, Autonomous Vehicle, Curve Path Prediction, Deep Learning

## I. INTRODUCTION

With the increase in the number of vehicles and the enormous traffic in urban areas, traffic safety becomes the priority. According to a recent survey in Indian Business Standards, Road accidents lead to 3 deaths every 10 minutes in India. There founded to exist Road accidents every minute in the country and it counts to 16 accidents per hour and also discovered that a total of 4, 64,910 road accidents were reported by states. These accidents are avoidable if there is a proper lane departure warning system. Therefore, a such system that could provide an alert to the drivers about danger has a great impact to save more lives. The development of autonomous vehicles has been one of the most exciting and rapidly evolving fields in recent years. However, the challenge of ensuring safe and efficient navigation remains a critical aspect of this technology. One of the key components of autonomous vehicles is the ability to accurately detect and track other vehicles on the road and predict their future path.

## II. PROPOSED SYSTEM

A proposed system for lane detection and curved path prediction in autonomous vehicles can be based on the following steps:

- Image acquisition: The system takes input as a video dataset of roads.
- Pre-processing: The acquired images are pre-processed to remove any noise and improve the image quality for better processing.
- Lane detection: YOLOv3 algorithm is used to detect lane lines in the pre-processed images. This can be achieved by training YOLOv3 on a large dataset of lane images to detect lane lines accurately.
- Curve path prediction: After the lane lines are detected, the system uses computer vision techniques to fit a polynomial curve to the detected lane lines. This curve represents the path that the vehicle should follow.
- Output: The system outputs the predicted curve path to the vehicle's control systems, which can then use this information to control the vehicle's movements

## III. MOTIVATION

Increasing safety and reducing road accidents, thereby saving lives is of great interest in the context of Advanced Driver Assistance Systems. Lane detection and curve path prediction are to provide the driver with more accurate information about the road ahead, to improve the stability and safety of the vehicle, and to provide a more comfortable and convenient driving experience. The aim is to explore the capability of deep learning techniques in solving the problem of curve path prediction and vehicle detection in lane roads. By using a large dataset of road scenes and realistic simulations, this research aims to validate the effectiveness and efficiency of the proposed approach.

## IV. OBJECTIVE

For lane detection, the objective is to accurately identify the driving lanes on the road and determine the location of the vehicle relative to these lanes. For curve path prediction, the objective is to detect the curvature of the road ahead and predict the path of the vehicle. This information is used for adaptive cruise control, lane departure warning, and lane-keeping assistance systems.

## V. LITERATURE REVIEW

[1]"A review of lane detection methods based on deep learning," by Tang, Jigang, Songbin Li, and Peng Liu. The paper concludes with a comparison of representative methods and highlights current challenges, such as computation expenses and the lack of generalization. The authors also point out potential directions for future research, including semi-supervised learning, meta-learning, and neural architecture search.

[2]"Robust lane detection from continuous driving scenes using deep neural networks," by Zou, Qin, et al. The authors propose a hybrid deep learning architecture that combines the Convolutional Neural Network (CNN) and the Recurrent Neural Network (RNN). The CNN block is used to extract information from each frame, while the RNN block is used to learn features from the CNN features of multiple continuous frames. The experiments show that the proposed method outperforms existing methods in lane detection, especially in handling difficult situations.

[3]"A method to keep autonomous vehicles steadily drive based on lane detection," by Zhenyu, et al.

The method first uses a CNN model to detect lanes in driving video images. Then, an "expectation line" is introduced to model the driving behavior of the autonomous vehicle, and an LSTM model is applied to predict the future trajectory of the expectation line. By combining these two methods, the autonomous vehicle can drive smoothly, taking into account prior information. The proposed method was evaluated using driving video data and showed improved performance compared to methods without trajectory prediction.

[4]"A review of lane detection methods based on deep learning," by Tang, Jigang, Songbin Li, and Peng Liu. The existing methods are then grouped into two categories: two-step and one-step methods. The methods are analyzed and discussed from two perspectives: network architectures and related loss functions. The contributions and weaknesses of each method are introduced, and a brief comparison of representative methods is presented. The paper concludes by highlighting the current challenges of lane detection, such as expensive computation and lack of generalization, and pointing out potential future directions, such as semi-supervised learning, meta-learning, and neural architecture search.

[5]"End-to-end deep learning of lane detection and path prediction for real-time autonomous driving." by Lee, Der-Hau, and Jinn-Liang Liu.The approach is based on the UNet architecture for semantic image segmentation, but uses a lightweight version called DSUNet with depthwise separable convolutions. A path prediction algorithm is also integrated with the CNN to form a simulation model (CNN-PP) that can be used to assess the performance of the CNN in real-time autonomous driving scenarios. The results of the study show that DSUNet-PP outperforms traditional UNet-based approaches in terms of model size, inference speed, and prediction accuracy, both in dynamic simulation and real-world testing. The study concludes that DSUNet is an efficient and effective approach for lane detection and path prediction in autonomous driving.

## VI. SYSTEM ANALYSIS

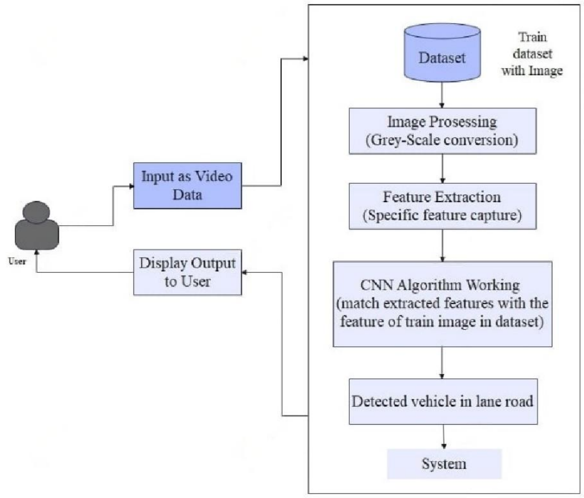


**Figure:** System Architecture

## VII. ALGORITHM

**CNN (Convolutional Neural Network)**

Convolutional Neural Networks (CNNs) is a type of deep learning algorithm widely used in computer vision tasks such as image classification, object detection, and semantic segmentation. In the context of lane detection, a CNN can be trained to identify lane markings in road images and perform lane segmentation to extract the lane boundaries.

**YOLO v3**

YOLOv3 uses a single convolutional neural network (CNN) to perform object detection in real-time, making it well-suited for applications in autonomous vehicles where fast and accurate lane information is critical. The algorithm is designed to be highly efficient, running at over 150 frames per second on standard hardware, making it suitable for use in real-time autonomous vehicle systems. Overall, YOLOv3 is a promising technology for lane detection in autonomous vehicle systems, offering high accuracy, real-time performance, and efficiency for safe and efficient autonomous vehicle navigation.

## VIII. MATHEMATICAL MODEL

- Let S be the Whole system S = {I, P, O}
- I-input
- P-procedure
- O-output
- Input(I)
- I = {Lane Detection Video dataset}
- Where
- Dataset->
- Video
- Procedure (P),
- P = {I, Using I System perform operations and calculate the prediction}
- Output(O)-O = {System detects vehicle and curve path in road lane}

## IX. CONCLUSION

Lane detection and curve path prediction are crucial components in Advanced Driver Assistance Systems (ADAS) and Autonomous Vehicles. Lane detection involves identifying the boundaries of the lanes in a given image or video frame, and curve path prediction involves predicting the future path of the vehicle based on its current trajectory. Both tasks require the use of computer vision algorithms, such as edge detection, feature extraction, and machine learning techniques, to accurately detect and predict road lanes and paths. The success of lane detection and curve path prediction is crucial for the safe operation of vehicles and has received significant attention from the research community in recent years.

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