

Lane Detection System Using OpenCV

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Motivation

- Road Safety: The increasing number of vehicles on the road leads to a higher risk of accidents. Lane detection systems can help in developing advanced driver-assistance systems (ADAS) aimed at preventing accidents.
- Autonomous Vehicles: Lane detection is critical for the functionality of autonomous vehicles. Accurate lane detection improves navigation and safety in self-driving technology.
- Traffic Management: Enhancing traffic flow by providing data on lane occupancy can improve urban mobility solutions.

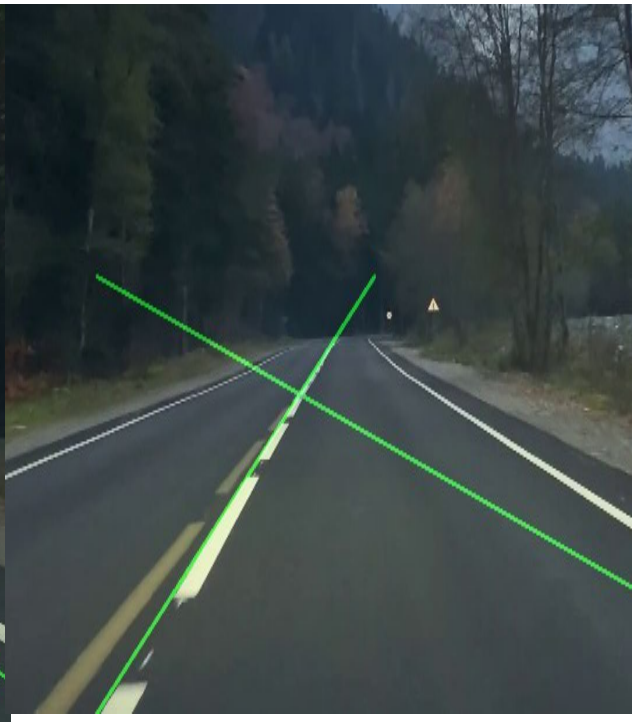
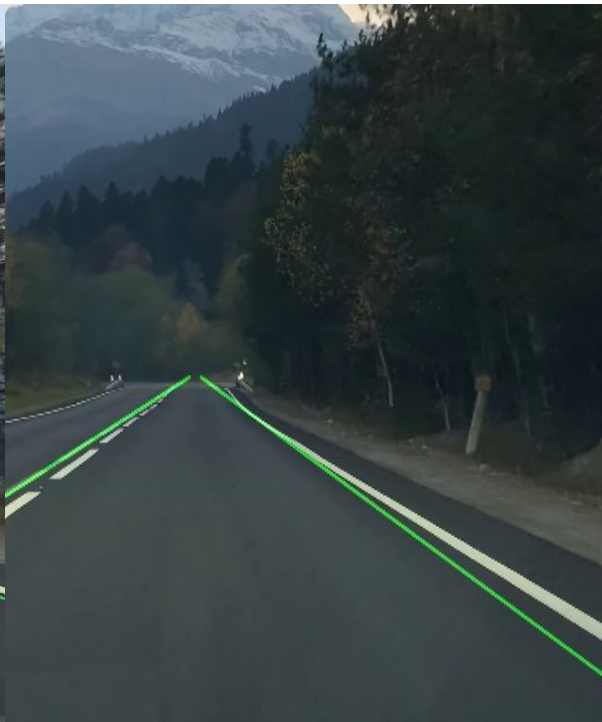
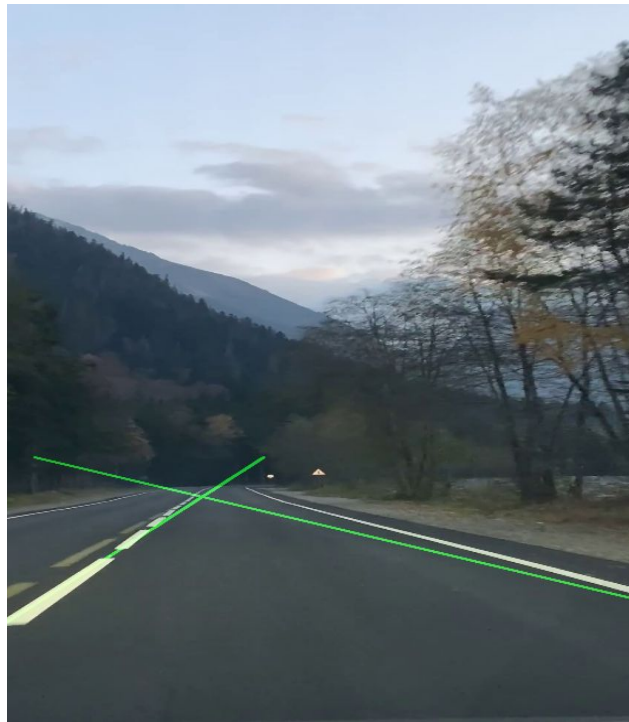
Introduction

- Objective: To implement a lane detection system that accurately identifies lane markings on the road using computer vision techniques.
- Technologies Used:
 - OpenCV: A powerful library for computer vision tasks.
 - Python: A versatile programming language well-suited for rapid development and prototyping.
- Methodologies:
 - Edge detection techniques (Canny).
 - Hough Transform for line detection.
 - Color detection techniques to identify lane colors.
 - Line Segment Detector (LSD) for detecting lane lines.

Description

- System Overview:
 - Input: Video feed from a camera or a pre-recorded video file.
 - Processing Pipeline:
 1. Preprocessing the image (grayscale conversion, Gaussian blur).
 2. Region of Interest (ROI) selection to focus on the area of interest.
 3. Lane Detection Algorithms:
 - Hough Transform
 - Color Detection in HSV
 - Line Segment Detection (LSD)
 4. Lane Visualization: Drawing lane lines on the video output.
- Implementation: The code is structured using the Object-Oriented Programming (OOP) paradigm for better modularity and maintainability.

Demo



Results

- Performance Evaluation:
 - Discuss the accuracy and reliability of the lane detection under different conditions (day, night, varied weather).
 - Evaluate the performance differences between Hough Transform, Color Detection, and LSD methods.
 - Present results visually with side-by-side comparisons of extracted lane lines for various techniques.
- Limitations: Highlight scenarios where the system may struggle, such as:
 - Poorly marked roads
 - Overlays from shadows or obstacles
 - Changes in lane colors under different environmental conditions.

Conclusions

- Summary: Recap the motivation and key findings from the lane detection project.
- Future Work:
 - Explore integration with real-time systems for ADAS.
 - Implement machine learning techniques for improved adaptability and robustness.
 - Expand functionality to include detection of other road elements (e.g., pedestrians, traffic signs).
- Final Thoughts: Lane detection plays a vital role in enhancing road safety and paving the way for future autonomous driving systems.