GROUP 17

LANE DETECTON FOR AUTONOMOUS VEHICLES

Presented by

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INTRODUCTION

Lane detection is a very important component for the safe and efficient operation of autonomous vehicles. It analyzes the boundaries of lanes on the road to ensure the vehicle stays within these boundaries.

Lane detection systems help keep autonomous vehicles properly aligned in their lanes and allow them to make correct driving decisions using computer vision techniques, edge detection, and deep learning.

This project leverages computer vision techniques, edge detection, and deep learning which helps autonomous vehicles stay within the correct lane and make informed driving decisions.

OBJECTIVES

✱ Objective - 1

This project aims to address the problems of real-time performance and imprecise lane line detection for automatic vehicles.

✱ Objective - 2

It can identify lane boundaries using opencv and image processing techniques like color filtering and edge detection, detects vehicles, pedestrians, and other objects on the road using the YOLOv3 deep learning model, displays visual lane instructions like “Traffic ahead!, go slow, ...”

✱ Objective - 3

The sole purpose of the project is to optimize autonomous vehicle navigation through lane detection, object detection, and smart driving assistance to enhance safety for both autonomous and human-driven vehicles.

LITERATURE REVIEW

Literary Review - 1

DETECT LANE LINES FOR SELF DRIVING CAR USING HUE-SATURATION LIGHTNESS AND HUE SATURATION VALUE COLOUR TRANSFORMATION, 2022

Method:

- The images are preprocessed by converting the image to grayscale, camera calibration and a masking filter.
- This study has proven that HSL(Hue Saturation Lightness) is better than HSV(Hue Saturation Value).
- Hough Transform technique is used for line detection.

Metrics:

- Accuracy of the model is 96.06%.

LITERATURE REVIEW

✱ Literary Review - 2

REAL TIME ROAD LANE DETECTION FOR SELF DRIVING CARS USING COMPUTER VISION, 2024

Method:

- two modes testing and training:
- the training mode allows data collection via three cameras (top, left, right) mounted on car capturing diverse perspectives.
- A data set of approximately 40,000 images annotated with steering angles and deviations was created by manually driving car on simulated track.
- includes greyscale conversion and gaussian blur to enchance image analysis by reducing noise and smoothening the image.
- the advantage of using canny edge detection and hough transformation is that method is highly effective for detecting road lane lines in various lightnings and environment conditions.

LITERATURE REVIEW

Literary Review - 3

OBJECT AND LANE DETECTION TECHNIQUE FOR AUTONOMOUS CAR USING MACHINE LEARNING APPROACH, 2021

Method:

This research employs a dual-method approach for lane detection:

Pre-processing: Uses color segmentation and HSL conversion to enhance lane visibility.
Edge Detection: Applies the Canny algorithm to identify lane edges.
Lane Line Extraction: Utilizes the Hough Transform to detect straight lane boundaries.
Filtering: Removes noise and outliers to improve accuracy.

LITERATURE REVIEW

Literary Review - 4

Lane detection technique based on perspective transformation and histogram analysis for self-driving cars, 2020

Methodology:

In this project, two approaches for lane detection are discussed: the Baseline approach and the Proposed (Advanced) approach.

- Baseline Approach:
  - Edge Detection: Identifies sharp changes in the image to locate lane boundaries.
  - Polynomial Regression: Fits a smooth line to the detected edges, but it only works well for straight lanes.
- Proposed Approach:
  - Perspective Transformation: Adjusts the image to make curves appear straighter, allowing better detection of curved lanes.
  - Histogram Analysis: Analyzes the brightness of vertical image columns to detect lane markings, improving detection for both straight and curved lanes.

GAP IN STUDY

Many existing methods work well in ideal weather conditions but fail in adverse environments.

Poor performance in curvy roads, merging lanes, and highways with multiple lanes.

Most existing models do not effectively predict if lanes are faded or blocked

Need for more diverse, real-world datasets with varying conditions and locations.

KEY SOLUTIONS FOR CHALLENGES

Adverse Environment Performance:

- HSV Color Filtering
- Canny Edge Detection

Hidden Lane Prediction:
Can Extrapolate missing lanes using deep learning techniques.

Dataset Diversity:
Create or utilize datasets with real-world conditions (varied weather, terrains, traffic).

APPLICATIONS

This project enhances autonomous driving and ADAS(Advanced Driver Assistance Systems) **by enabling real-time lane detection and object recognition for improved road safety. It supports traffic monitoring, smart city applications, and highway surveillance for efficient navigation. Additionally, it benefits military, robotics, and assistive technologies, advancing intelligent transportation systems. Future advancements can integrate sensor fusion and deep learning for enhanced accuracy, making it suitable for real-time deployment in autonomous vehicles.**

NOVELTY

Advanced Object Detection

- YOLOv3 Integration – Enables fast & accurate detection of vehicles, pedestrians, and obstacles.
- Performance in Occlusions & Low-Light – Detects partially visible objects and enhances night-time visibility.

ADAS (Advanced Driver Assistance Systems)

- Live Visual Driving Instructions – Displays alerts like "Traffic Ahead! Slow Down" or "Pedestrian Detected."

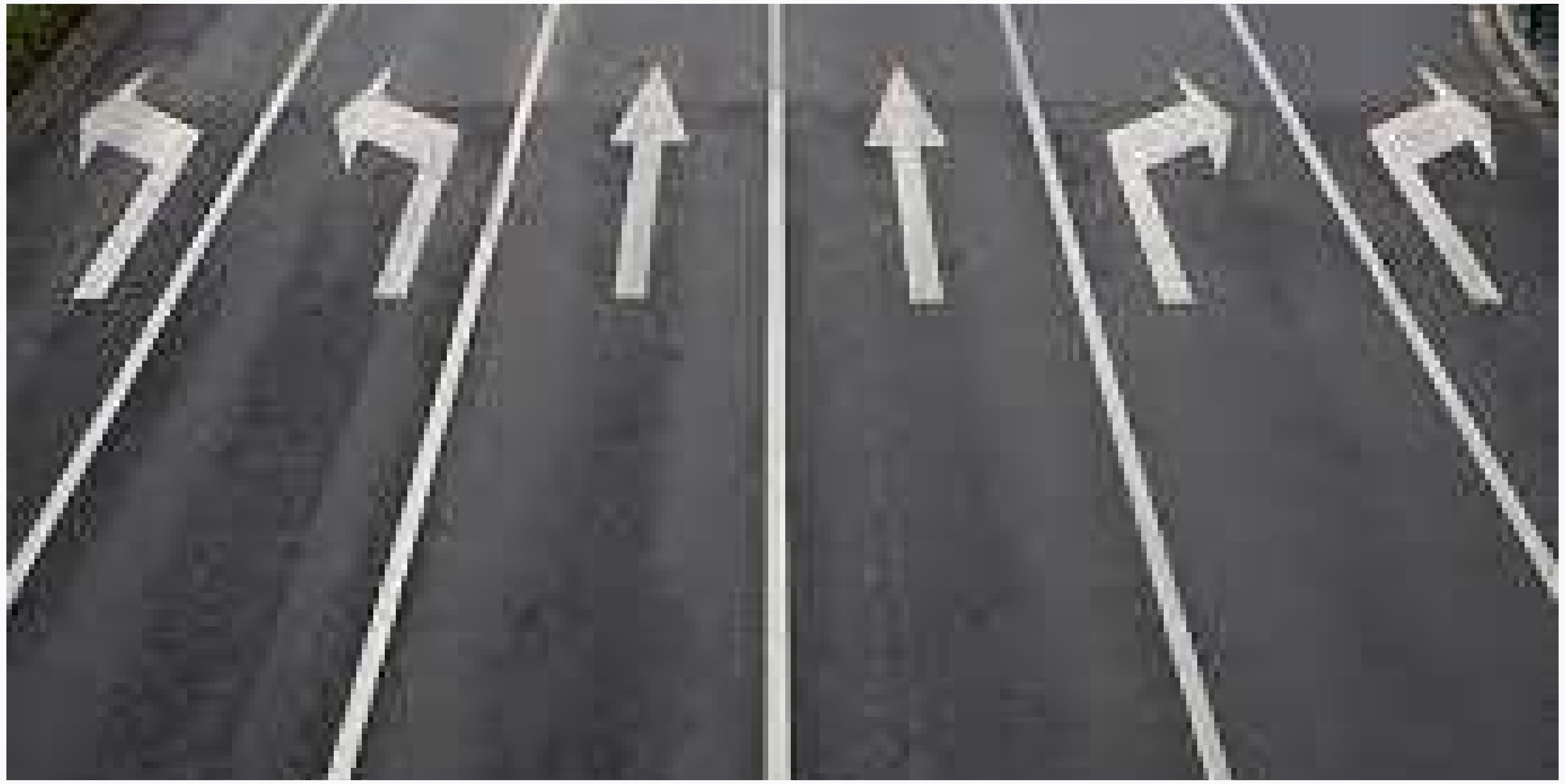
PROBLEMS STATEMENT

Autonomous vehicles rely on lane detection and object recognition to navigate roads safely.

The existing lane detection systems face challenges in real-world conditions, such as poorly marked lanes, adverse weather, occlusions, and complex road environments.

Real-time object recognition is important for collision avoidance and safe driving, it needs high computation efficiency to run smoothly in real time.

METHODOLOGY



1. Input Video Processing

2. Lane Detection Using Image Processing

Color-Based Lane Filtering
Edge Detection
Hough Line Transform
Lane Tracking and Instruction Overlay

3. Object Detection Using YOLOv3

4. Display the processed video feed with lane lines and detected objects.

1. **INPUT VIDEO PROCESSING**

Load the video using OpenCV and verify successful loading. Sequentially process each frame.

2. **PREPROCESSING WITH GAUSSIAN BLUR**

Apply gaussian Blur to reduce noise and smooth the image.

3. **COLOR FILTERING USING HSV**

Convert the frame into HSV color space, isolate the lanes using defined HSV ranges.

4. **EDGE DETECTION WITH CANNY**

Highlight significant edges using canny Edge Setection with appropriate thresholds.

5. **LINE DETECTION USING HOUGH TRANSFORM**

Detect straight lines in the edge-detected image and overlay them on the original frame.

6. **VISUALIZATION**

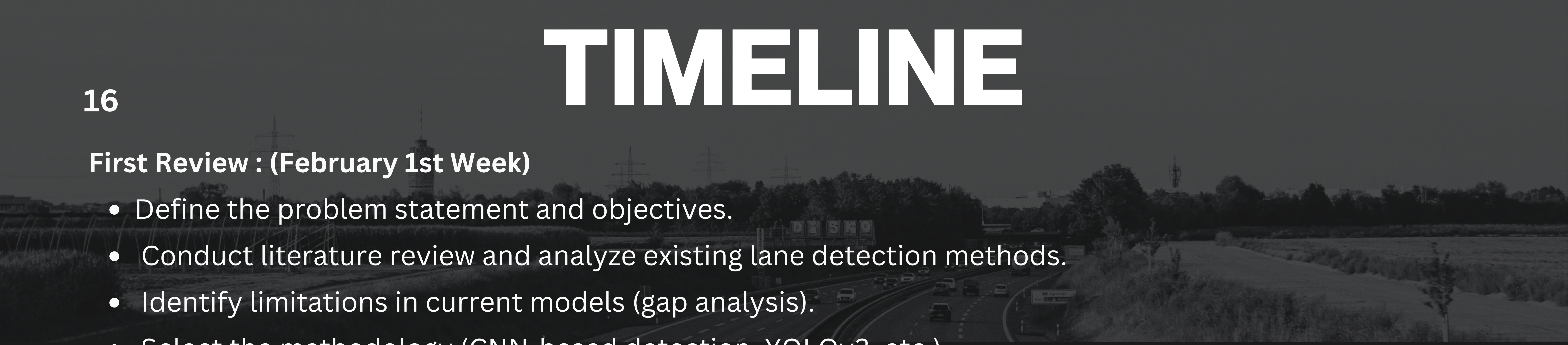
Display the original frame with detcetd lines and the edge-detected frame.

RESULT

The project can successfully detect lanes and objects in real-time and also provide driving assistance with instructional overlays. It has accurate lane detection in clear conditions and reliable object recognition using YOLOv3.

FUTURE SCOPE

Implementation to live video, enabling real-time lane and object detection in dynamic road environments.



TIMELINE

First Review : (February 1st Week)

- Define the problem statement and objectives.
- Conduct literature review and analyze existing lane detection methods.
- Identify limitations in current models (gap analysis).
- Select the methodology (CNN-based detection, YOLOv3, etc.).

Second Review: (March)

- Implement lane detection pipeline (image processing, edge detection, filtering).
- Develop object detection model (YOLOv3 integration).
- Test algorithm performance on sample datasets.

Third Review: (April 2nd Week)

- Fine-tune the model for better accuracy in real-world conditions.
- Implement real-time video processing with instructional overlays (ADAS alerts).
- Evaluate performance on diverse datasets (curved roads, night conditions, etc.).

THANK YOU SO MUCH!

Presented by Group 17