
ADVANCE ROAD LANE
DETECTION

Team Member details

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PROBLEM STATEMENT AND OBJECTIVES

Develop a robust, real-time lane detection system capable of accurately identifying lane boundaries under various road and environmental conditions. The solution should be able to:

- Handle different lane types (solid, dashed, double lanes).
- Operate effectively in challenging conditions (e.g., rain, fog, nighttime driving).
- Adapt to varying road shapes, curves, and intersections.

Objectives:

- Accurately Detect Lane Markings
- Handle Challenging Conditions
- Real-time Performance

Literature Survey

Sr No	Name of paper	Methodology	Datasets	Result achieved
1	Lane detection networks based on deep neural networks.	ResNet50 (LeakyReLu)	TuSimple, Custom dataset	Accuracy of 91.34% by incorporating LeakyReLU activation functions
2	PolyLaneNet: Lane Estimation via Deep Polynomial Regression	PolyLaneNet	TuSimple and other public Datasets	Accuracy of 93.36% with high efficiency, operating at 115FPS.
3	End-to-End Deep Learning of Lane Detection and Path Prediction for Real-Time Autonomous Driving	DSUNet	TORCS,LLAMAS, TuSimple	Accuracy of 97.1%
4	Vision-Based Robust Lane Detection and Tracking in Challenging Conditions	Canny Edge Detection, Hough Transform, AGC, LGC, Lane Tracking (RHLP)	DSDLDE, SLD	97.55% detection rate, 22.33 ms/frame processing time

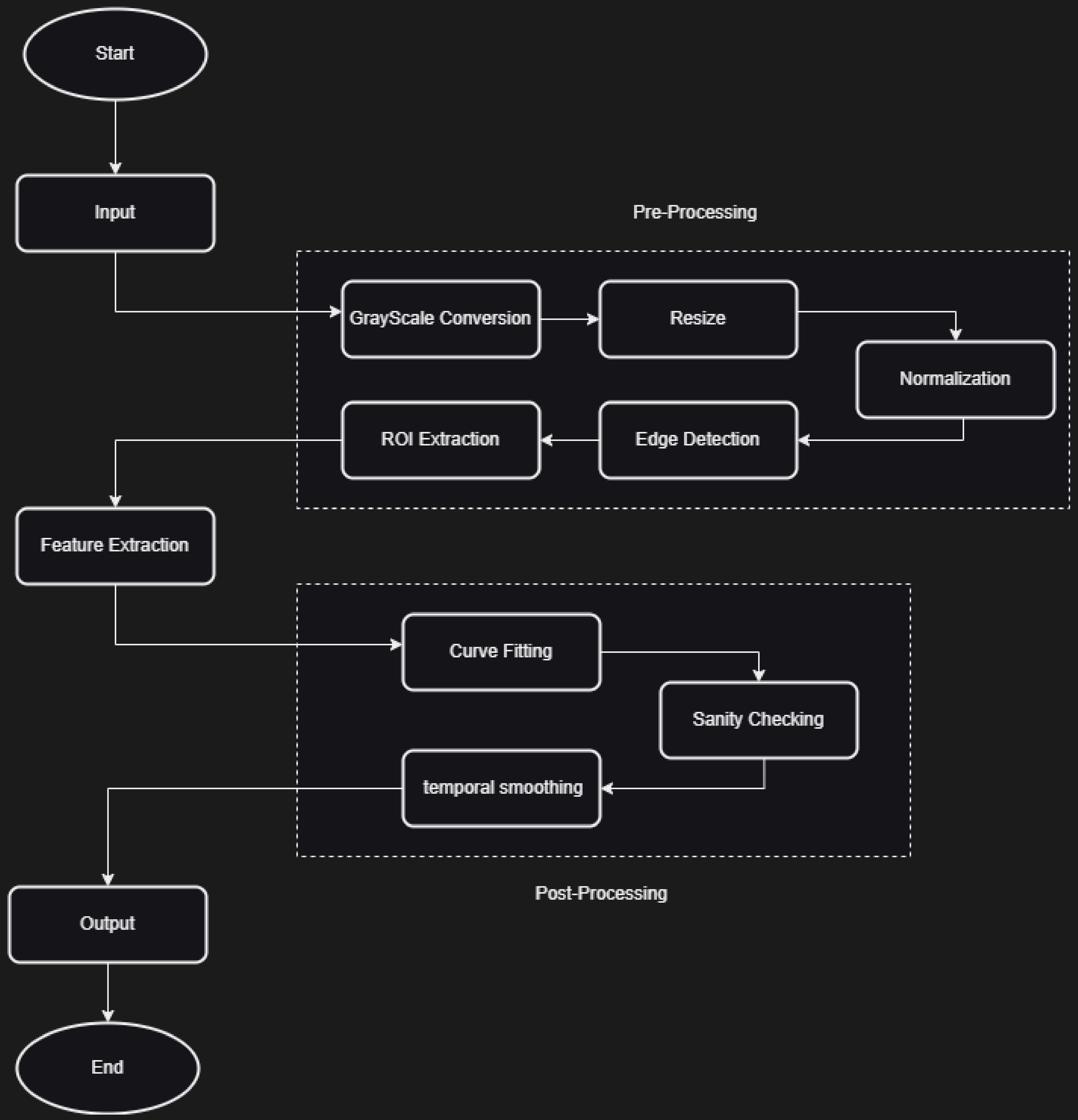
Technical approach

1. Image Preprocessing

- Purpose: Enhance lane features and normalize input.
- Techniques: Distortion correction, perspective transform, color space conversion.

2. Feature Extraction

- Purpose: Isolate lane-relevant information
- Methods: Color thresholding, gradient analysis (Sobel operator)



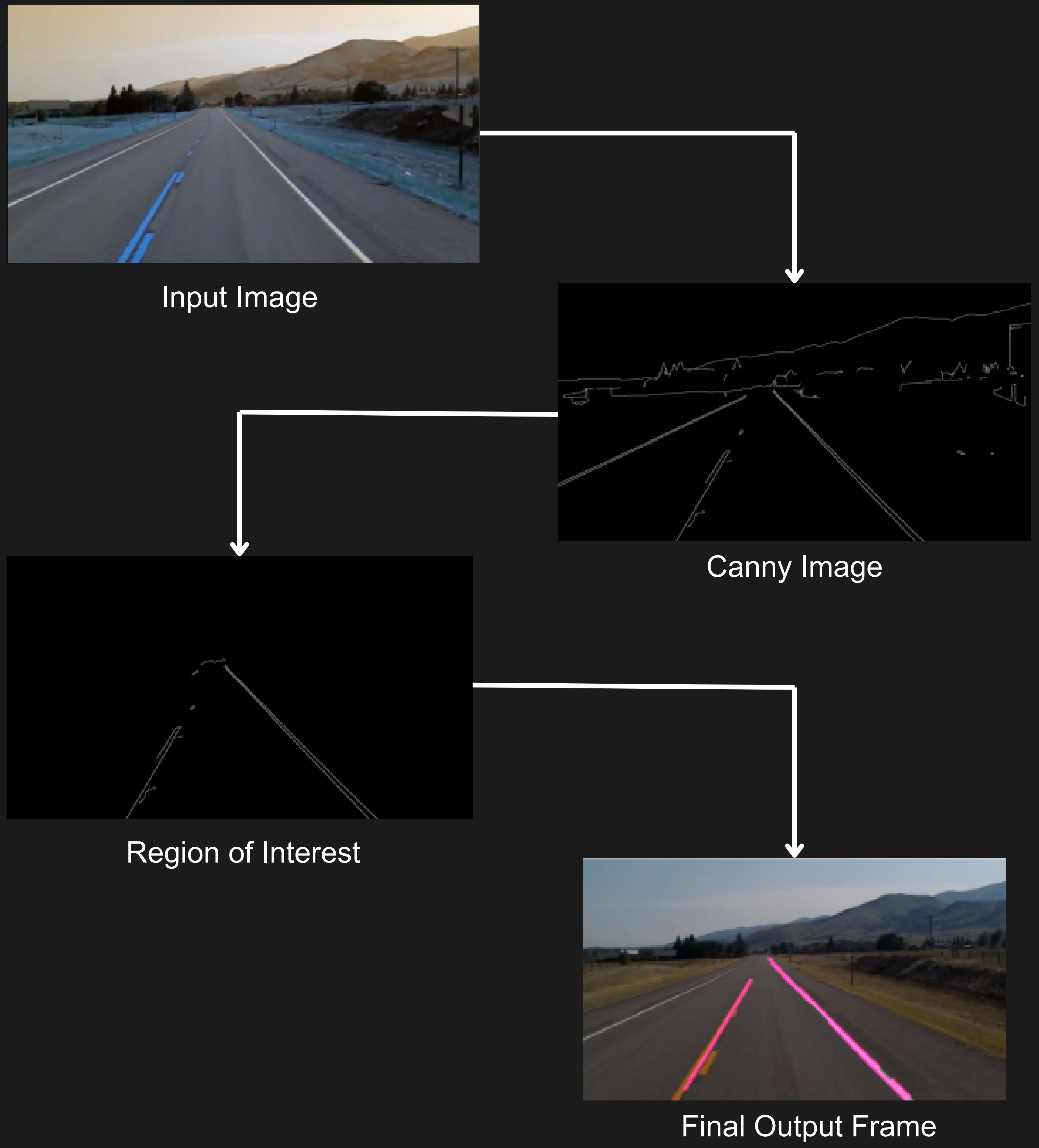
3. Lane Detection Algorithm

- Dual approach:
  a) Traditional: Hough Transform + Sliding Window
  b) Deep Learning: CNN-based semantic segmentation (ResNet-UNet)

4. Post-processing and Lane Tracking

- Purpose: Refine detections and ensure temporal consistency
- Techniques: Polynomial fitting, sanity checks, temporal smoothing

Datasets to be used:
TuSimple, CuLane, LLAMAS, etc.



Applications

Advanced Driver Assistance Systems (ADAS): Lane detection is a core feature for lane departure warning and lane-keeping assistance in autonomous and semi-autonomous vehicles.

Autonomous Vehicles: Crucial for self-driving cars to maintain lane discipline, navigate roads, and adapt to dynamic driving environments.

Traffic Monitoring Systems: Lane detection can be integrated into surveillance systems to monitor traffic flow, identify lane violations, and improve traffic management.

Highway Safety: Assists in detecting dangerous lane changes or drifting, reducing accident rates on highways.

Smart Cities: Lane detection integrated with smart infrastructure can provide real-time data for traffic control and automated tolling.

Driver Education: Used in simulators or training systems to provide real-time feedback on lane-keeping and lane discipline for new drivers.

LIMITATIONS

Challenging Weather Conditions: Extreme weather such as heavy snow, fog, or heavy rain can obscure lane markings and reduce detection accuracy.

Occlusions: Lane markings may be partially or fully occluded by vehicles, objects, or road debris, impacting real-time tracking.

Faded or Eroded Markings: Worn-out or poorly maintained lane markings, common in many regions, can lead to misdetections or failure to detect lanes.

Similar Patterns: Objects like guardrails, road cracks, and shadows can create false lane-like patterns, confusing the detection system.

Camera Dependency: The system heavily relies on camera sensors, which can suffer from lens flares, glare, or poor lighting conditions.

Real-Time Constraints: Ensuring low-latency, high-performance operation in real-time under all conditions can be computationally demanding and requires optimized hardware.

References

[1] Huei-Yung Lin, Chun-Ke Chang, Van Luan Tran,Lane detection networks based on deep neural networks and temporal information.

[2] L. Tabelini, R. Berriel, T. M. Paixão, C. Badue, A. F. De Souza and T. Oliveira-Santos, "PolyLaneNet: Lane Estimation via Deep Polynomial Regression," 2020 25th International Conference on Pattern Recognition (ICPR), Milan, Italy, 2021, pp. 6150-6156, doi: 10.1109/ICPR48806.2021.9412265. keywords: {Measurement;Deep learning;Lane detection;Estimation;Cameras;Real-time systems;Pattern recognition},

[3] [2102.04738] End-to-End Deep Learning of Lane Detection and Path Prediction for Real-Time Autonomous Driving (arxiv.org)

[4] Sultana, S., Ahmed, B., Paul, M., Islam, M. R., & Ahmad, S. (2023). Vision-Based Robust Lane Detection and Tracking in Challenging Conditions. IEEE Access. Digital Object Identifier(DOI): 10.1109/ACCESS.2023.3292128

Thank You