Lane Detection and Tracking using Hough Transform

Abhishek Sriram
Bhanu Prasad Arjun Jyothieswar
Xiatao Wu
Yinkai Liu

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Abstract

The project will aim to develop a system that can accurately **detect and track lane markings** on a road **using computer vision techniques**, specifically the **Hough Transform**, without relying on machine learning algorithms. This system will be designed to enhance the capabilities of autonomous vehicles, aiding in navigation and ensuring safe driving.

1 Goal

We will reproduce the result in **Table 1** from the IEEE paper D. Qiu, et al., *"Research on Lane Line Detection Method Based on Improved Hough Transform,"* 2019 Chinese Control And Decision Conference (CCDC), Nanchang, China, 2019, pp. 5686-5690, doi: 10.1109/CCDC.2019.8833139 [1]. We shall also try improvising the algorithm presented in the paper.

2 Approach

The key deliveries in this project will be on:

- Develop a robust lane detection algorithm using the Hough Transform to identify lane markings in road.
- Implement a lane tracking mechanism to maintain continuity in lane detection across consecutive frames.
- Design the system to be computationally efficient, allowing real-time processing of the road.
- Validate the system's performance under various environmental conditions, including changes in lighting, road surfaces, and weather from the data set.

Table1. Algorithm contrast

Types of algorithms	Average time / ms	Accuracy rate /%
The classical Hough transform	86.6	91.32
Algorithm in this paper	25.6	94.6

Figure 1: From doi: 10.1109/CCDC.2019.8833139

3 Quantifying Result

3.1 Processing Speed

- Measure the time taken to process each frame (FPS) and detect lanes.

3.2 Lane Detection Accuracy

- Measure the percentage of correctly identified lane markings compared to ground truth data.
- This can be quantified by calculating the intersection over union (IoU) or the Jaccard index between the detected and annotated lanes.

$$IoU = (Area\ of\ Intersection)/(Area\ of\ Union)$$

3.3 Lane Tracking Consistency

- Measure the stability of lane tracking over time.
- This can be quantified by calculating the standard deviation of lane position or slope across consecutive frames.

3.4 False Positive Rate

- Measure the percentage of false positive detections, i.e., non-lane markings incorrectly identified as lanes.
- This can be quantified by counting the number of false positive detections per frame or unit distance traveled.

References

[1] Dong Qiu, Meng Weng, Hongtao Yang, Weibo Yu, and Keping Liu. Research on lane line detection method based on improved hough transform. In *2019 Chinese Control And Decision Conference (CCDC)*, pages 5686–5690, 2019.