ROB 535 Final Project Proposal - Team 8

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I. PROJECT OBJECTIVES

End-to-end models have become a research hotspot in autonomous driving due to their ability to streamline these functions, reducing latency and minimizing error propagation between modules.This project is dedicated to exploring cutting-edge end-to-end models for autonomous driving, focusing on TCP, UniAD, and VAD. Our primary goal is to assess and enhance the capabilities of these models in processing image inputs and directly generating control signals, which is crucial for integrating perception, decision-making, planning, and control into a unified framework for safer and more efficient navigation.

II. TECHNICAL APPROACH

Our technical approach focuses on an comprehensive study and benchmark analysis of three advanced end-to-end models for autonomous driving: TCP, UniAD, and VAD. This approach consists of two primary stages: understanding each model's design, methodology, and theoretical foundation, followed by comparative testing through the Bench2Drive benchmark using the CARLA simulator.

A. Model Study and Comparison

In the first stage, we will conduct a theoretical analysis of each model to understand how they process image inputs and generate direct control signals, thereby integrating perception, decision-making, planning, and control into a unified pipeline. This involves examining their architectural designs, training methodologies, and unique strategies for handling dynamic and static elements within the environment.

B. Benchmark-Based Test

Following the theoretical analysis, we will perform benchmark-based tests using the Bench2Drive framework within the CARLA simulator, allowing for standardized, scenario-based comparisons.

These tests will evaluate each model's performance in several tradition scenarios, including dealing with overtaking, emergency brake, give way and traffic sign scenarios. Through this structured evaluation, we aim to determine optimal use cases, expose limitations, and identify potential areas for improvement for each model in the integrated perception-to-control task.

III. NOVELTY

The project provides a side-by-side comparative analysis of the end-to-end autonomous driving models TCP, UniAD, and VAD using the Bench2Drive benchmark in the CARLA simulator. By evaluating these models in standardized driving scenarios, we aim to uncover their distinct strengths and limitations, offering new insights into their practical applicability and areas for improvement.

IV. MILESTONE AND CONTRIBUTION

Initial Setup and Model Familiarization (1 Week)

- **All Members:** Read the papers on TCP, UniAD, and VAD to gain a foundational understanding of these three end-to-end models.

Individual Model Testing (1 Week)

- **All Members:** Each member will individually test one assigned model on the pre-determined dataset to familiarize themselves with the model's implementation and baseline performance.

Benchmark Test and Model Comparison (2 Weeks)

- **Tianyi, Jackson:** Learn to use the Bench2Drive framework and perform comparative testing of the three models, focusing on assessing and recording in different scenarios.
- **Conghao:** Explore the theoretical differences among the three models, focusing on their distinct methodologies, underlying architectures, and approaches to end-to-end autonomous driving.

Final System Evaluation and Documentation (1 Week)

- **All Members:** Compile results, perform comparative analysis with existing solutions, write the report, and prepare the poster for presentation.

V. OUTCOME

By examining the architectures, methodologies, and feature sets of TCP, UniAD, and VAD, each model's distinct strengths and potential limitations in managing diverse and complex driving environments will be pinpointed. Leveraging the Bench2Drive framework, benchmark-based testing and comparison of these models will be performed, offering insights into their real-world viability and adaptability to various driving conditions.

REFERENCES

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