

A Lane Detection and Following System for Autonomous Vehicles

Carleton University Engineering Capstone Group #74

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Abstract

Autonomous driving technology has garnered significant attention lately due to its potential to improve road safety and help remove the need for manual adjustments from drivers on the road. This project focuses on the development of a lane detection and following system for self-driving cars, aimed at improving a vehicle's ability to maintain its position within a lane as it drives along a stretch of road.

The system uses a refinement-based neural network to detect and interpolate the positions of lane markings on the road from a real-time video feed captured by an onboard dashcam in the vehicle. This positional data is fed into a feedback control mechanism to generate a path for the vehicle to follow. By continuously adjusting steering commands based on the detected lane position, the system ensures that the vehicle remains centered within the lane.

Key features of the lane detection and following system include real-time processing capabilities, robustness to environmental variations and driving conditions, and adaptability to different shapes of curves in the road.

The effectiveness of the proposed system is evaluated through simulation experiments. Since the system is designed with modularity in mind, it can be deployed on either real hardware or a virtual vehicle in a simulator, allowing for detailed measuring of lane detection accuracy, lane-keeping precision and computational efficiency.

1 Introduction

As discussed in the above document, Chapter 1 is expected to be the standard introduction to the problem, concluding with an overview of the rest of the report.

1.1 Identification of the Need

1.2 Definition of the Problem

1.2.1 Functional Requirements

1.2.2 Non-Functional Requirements

1.2.3 Constraints

1.3 Conceptual Solutions

1.3.1 Literary Review

1.3.2 Concepts

1.4 System Architecture

1.4.1 Software Architecture

1.4.2 Physical Architecture

1.5 Overview of Remainder of Report

2 The Engineering Project

2.1 Health and Safety

Using the Health and Safety Guide posted on the course webpage, students will use this section to explain how they addressed the issues of safety and health in the system that they built for their project.

2.2 Engineering Professionalism

Using their course experience of ECOR 4995 Professional Practice, students should demonstrate how their professional responsibilities were met by the goals of their project and/or during the performance of their project.

2.3 Project Management

One of the goals of the engineering project is real experience in working on a long-term team project. Students should explain what project management techniques or processes were used to coordinate, manage and perform their project.

2.4 Justification of Suitability for Degree Program

In this section, students should explain how the project relates to the degree program of each group member.

2.5 Individual Contributions

This section should carefully itemize the individual contributions of each team member. Project contributions should identify which components of work were done by each individual. Report contributions should list the author of each major section of this report.

2.5.1 Project Contributions

2.5.2 Report Contributions

3 Work Plan

3.1 Work Breakdown Structure

3.2 Responsibility Matrix

3.3 Project Network

3.4 Gantt Chart

3.5 Costs, Special Components and Facilities

3.6 Risk Analysis

4 Software Subsystems

4.1 Lane Detection

4.1.1 Requirements

4.1.2 Technologies and Methods

4.1.3 Conceptualization

4.1.4 Software Architecture

4.1.5 Implementation

4.1.6 Evaluation

4.2 Lane Keeping & Control

4.2.1 Requirements

4.2.2 Technologies and Methods

4.2.3 Conceptualization

4.2.4 Software Architecture

4.2.5 Implementation

4.2.6 Evaluation

5 System Integration and Evaluation

5.1 Integration

5.1.1 Docker

5.1.2 ROS2 Orchestration

5.2 Evaluation

5.2.1 CARLA Simulator

5.2.2 HiWonder JetAcker

6 Reflections

The final report needs to contain your original project proposal (for example, as an Appendix or a separate chapter in your main document). It is not uncommon that changes in your project goals and objectives, methods used to achieve them, etc., may have occurred over the course of the project. Therefore, in a final chapter in the report, entitled “Reflections”, discuss how well the original project objectives were met. Identify and discuss any changes that occurred as the project progressed. Finally, as part of this chapter, reflect, as a group, on

the past two terms. Did the project unfold as expected? Did the team work result in unexpected challenges or benefits? With hindsight, if you had to undertake the project again, would you make the same initial decisions about tools/methods/timelines?

6.1 Success of Project Objectives

6.2 Changes from Proposal

6.3 Group Reflection

References

Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first . . .”

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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