COMP ENG 4DS4

Project 2 - Autonomous Vehicle: Putting it All Together

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Declaration of Contributions:

All students contributed to the lab report and did the write-up.

Student	Contributions
Aidan Mathew	Worked on Part 2
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Introduction

The goal of Lab 3 / Project 2 was to integrate PX4 applications, uORB messaging, and MAVLink protocol to build an autonomous vehicle platform. This project was implemented on a car equipped with an FMU, Raspberry Pi, camera, ultrasonic sensor, and RC controller. The project was broken into three main components: Part 0, Part 1, and Part 2, each building upon the previous to achieve a fully autonomous driving system eventually.

Project 2 – Part 0: RC Channel Reader

In Part 0, we developed a PX4 application that subscribes to the rc_channels topic using uORB. The application continuously copies the channel values and prints them to the NuttX terminal in real-time. This allowed us to validate the communication between the RC controller and the FMU. It served as a foundation for later control logic by verifying that input signals from the controller were being received accurately.

Project 2 – Part 1: RC-Controlled Motor and Servo

Building on Part 0, Part 1 involved normalizing the rc_channels input values, which range from -1 to 1, to a usable range of 0 to 1. These normalized values were then published to the test_motor topic using uORB. One publication controlled the DC motor, and another controlled the servo motor for steering. This allowed us to control the speed and direction of the car directly from the RC controller, enabling manual operation.

Project 2 – Part 2: Fully Autonomous Navigation

In Part 2, we transitioned to autonomous operation by flashing a PX4 application onto the FMU that subscribes to the debug_data topic. The values for this topic are sent from the Raspberry Pi using MAVLink. A Python script integrates data from an ultrasonic sensor and a camera-based direction detection algorithm on the Raspberry Pi. The Pi determines whether the car should stop, go forward, or turn, and sends a corresponding integer over MAVLink. The FMU receives this value and adjusts the DC motor speed and servo direction accordingly. This decouples the decision-making logic from the low-level control, allowing the FMU to act solely as an actuator while the Raspberry Pi handles sensor processing and behavior decisions.

Conclusion

This project successfully integrated PX4 development, uORB messaging, MAVLink communication, and sensor-based decision-making to create a fully autonomous vehicle. Each part of the project demonstrated a specific skill set, from basic RC input handling to complex inter-device communication and control.
