Version 1.0

The Luminary Collective

Stevens Institute of Technology: The Charles V. Schaefer, Jr. School of Engineering and Sciences

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ALSET IoT Hug the Lanes

Software Development Documentation

A project dissertation by:

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I pledge my honor that I have abided by the Stevens Honor System - Zeynep Alta, Isabella Ganguzza, Kayli Gregory, and Matthew Werner

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1 Introduction

1.1 Outline of Automated Vehicles

As expressed in *Software System of Autonomous Vehicles: Architecture, Network and OS,* Autonomous vehicles (AVs) are designed to operate without human intervention, categorized into five levels of autonomy. Lower levels (0-3) include Advanced Driver Assistance Systems (ADAS) that aid with emergency braking and parallel parking, while higher levels (4-5) strive for full automation through advanced machine intelligence and data integration.

Unlike traditional computing systems, AVs rely on multiple Electronic Computing Units (ECUs) that manage different vehicle functions such as vision, radar, steering, and braking. Future designs aim to consolidate these components into a more streamlined architecture, reducing complexity and improving performance.

The AV industry is rapidly evolving, with major automotive and technology companies investing in research and development. In the coming years, fully automated vehicles will be more readily available to day-to-day consumers. However, the industry is still in its early stages and therefore lacks the regulations and standards that are present in more established fields such as automation within the aerospace industry.

1.2 Project Scope

The current scope of the project refers to the creation and running of onboard software used to allow an AV to maintain its position within the lanes of a road. The project will consist of a simulation of the sensors and not be implemented into a test vehicle, but rather be the first release of many to incrementally build a complete mission critical real-time embedded system. An Internet of Things (IoT) network will be used to allow an interconnection between all the embedded systems within the AV. The devices will be connected via an internal bus to ensure fast and accurate cross-communication with each device. An IoT Engine will be used to process information and make decisions which will be passed to the Car Control System (CCS) for automated real-time lane correction. The driver will receive status updates on the current state of the system and will be able to input commands via the steering wheel to supplement the self-driving capabilities. The IoT Engine will support full Cloud uploading and downloading of both software updates and car data for further analysis by the manufacturer.

1.3 Project Management

The project management was conducted in an agile manner using an iterative process to achieve all of our goals, specifically Scrum. Scrum is an agile management framework designed for projects to be done collaboratively amongst a team while still prioritizing efficiency. Biweekly, we elected a new Scrum leader to “coordinate project activities, align these with business objectives, and break down projects into smaller pieces” (Indeed Editorial Team). This process allowed us to break the project into manageable tasks, delivering incremental results.

Weekly meetings outside of instruction were conducted to track progress, align efforts, and identify where key focuses were needed. These meetings encourage constant communication between team members, ensuring each member is aware of their responsibilities. The Scrum leader took the initiative to generate sprint retrospectives where the team reflected on the previous sprint to identify ways of improving and ensuring accountability among team members.

The agile approach fits best for the needs of the project because, with software, we want to work closely with the customer and create a project they want before sinking too much time into the deliverables. This iterative approach allows the team to ensure what features should be prioritized. Likewise, with a small team such as The Luminary Collective, creating time to verify which task each member is completing and the progress of those tasks was effective in achieving the scope of the project.

1.4 The Luminary Collective Qualifications

The following are the current qualifications for The Luminary Collective. The team is comprised of Stevens Institute of Technology Undergraduates who are enrolled in course code CS-347 Software Development Process.

1.4.1 Zeynep Alta Qualifications

Zeynep Alta is a three-out-of-four Computer Science major. She has hands-on data analytics experience in the healthcare sector and conducts research at Stevens facilitating HCI user studies. This work has helped her develop strong teamwork, listening, and problem-solving skills, and with her academic experience, Zeynep has gained proficiency in Python, Java, R, and SQL.

1.4.2 Isabella Ganguzza Qualifications

Isabella Ganguzza is a three out of four Computer Science major. She has completed multiple courses enhancing problem-solving and analytical skills. Isabella has gained proficient programming skills in languages such as Python, Java, OCaml, R, and SQL.

1.4.3 Kayli Gregory Qualifications

Kayli Gregory is a four out of five computer science major with a minor in finance. She has completed the CO-OP program at Stevens with industry experience in both business and tech. She has classroom experience with programming languages such as Python, Java, and SQL.

1.4.4 Matthew Werner Qualifications

Matthew Werner is a current four out-of-five electrical engineering major with a minor in computer science. He has completed the Co-Op program at Stevens with industry experience in both the aerospace and factory line machine industry. Additionally, Matthew has working experience in control systems and sensor calibration.

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