FrostAV: System Requirements Specification

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1 Introduction

1.1 Identification

This document is the System Requirements Specification (SyRS) for FrostAV, an autonomous vehicle project, under the supervision of Clarkson University's Computer Engineering department.

1.2 Problem Overview

The system to be specified requires the design and construction of an autonomous car that has the ability to navigate within a lane. The system should satisfy the tasks specified in section 2.1. Furthermore, the car must have wireless communication abilities. And, the sensor systems implemented on the car must be minimally invasive (see section 3.1).

1.3 Intended Standards

- ISO/IEC 29110: Systems and Software Life Cycle Profiles and Guidelines for Very Small Entities (VSEs)

2 System Requirements

2.1 Problem-Domain Requirements

1. Given a <u>lane</u>, the car must travel approximately parallel to it, such that the car stays within its <u>boundaries</u> consistently, and, if the car is to accidentally leave it, it promptly returns.

2. Given a <u>corner</u>, the car must turn, continuing from the car's current <u>lane</u> to the next, such that the car stays within its <u>boundaries</u> consistently, and, if the car is to accidentally leave it, it promptly returns.

3. Given an <u>obstacle</u>, the car must stop until it is moved further from the car, or it is removed from <u>circuit boundaries</u>.

4. Given a <u>sign</u>, the car must respond to the event provided by it.

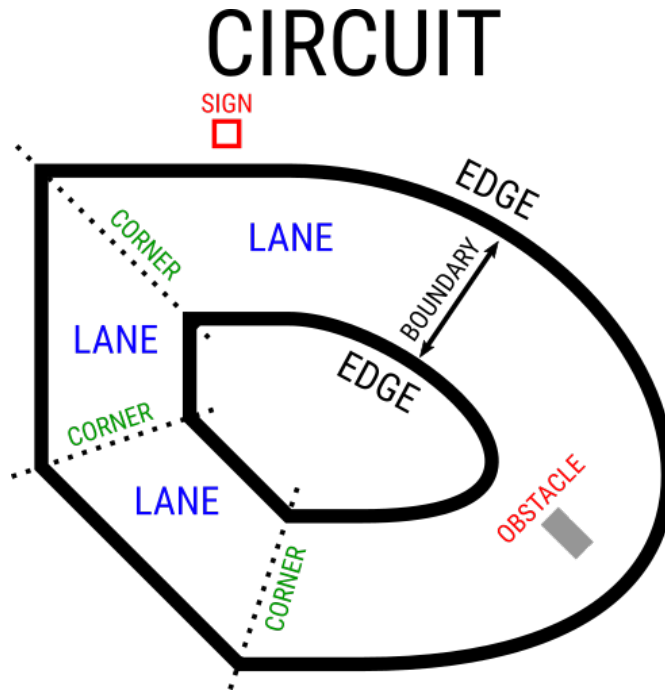5. Given a <u>circuit</u>, the car must complete a full loop.

Figure 1: An example <u>circuit</u> which the car must navigate through. Provides visuals for the definitions in section 2.1.1.

2.1.1 Problem-Domain Definitions

Term	Definition
Corner	A sharp change in path direction that connects two lanes
Lane	A path that has a <u>boundary</u>
Boundary	The area between two parallel <u>edges</u>
Edge	A line or a curve
Circuit Boundary	All connected <u>boundaries</u> which define the total area of the <u>circuit</u>
Circuit	A closed path defined by connected <u>lanes</u> and <u>corners</u>
Obstacle	Any object that lies within <u>circuit boundaries</u>
Sign	A flat image mounted to a post outside of <u>circuit boundaries</u>

2.2 Control Requirements

2.2.1 Control System:

The Control System shall:

1. Interface with vehicle peripherals, such as, motors, servos, batteries, etc.

2. Be the only system coupled to the vehicle.

3. Have a subset of Control Modules for each peripheral in need of control.

2.2.2 Control Modules:

Each Control Module shall:

1. Encapsulate a single purpose, such that, one controller controls a single peripheral.

2. Couple to a peripheral electronically, not mechanically.

3. Be able to communicate with other controllers via a wired bus.

4. Be able to communicate with non-controllers that depend on it, via a wired bus.

5. Communicate with other controllers and non-controllers via a single shared wired bus.

2.3 Autonomy Requirements

The Autonomy System shall:

1. Not be directly coupled to the Vehicle Interface (section 2.4.1).

2. Be able to fit on the vehicle.

3. Allow the vehicle to navigate, as per section 2.1, without user interaction.

4. Be able to communicate with the Control System (section 2.2).

2.4 Interface Requirements

2.4.1 Vehicle Interface Requirements

The Vehicle Interface shall:

1. Include a way for the vehicle to be turned on and off, such that, the vehicle receives no power to the drive system or logic when off.

2. Include a way for the vehicle to have its logic turned on, while the drive system is off.

3. Provide a battery peripheral that powers the logic.

4. Provide a battery peripheral that powers the drive system.

5. The total power consumption of the logic and drive system cannot exceed the maximum capacity of the battery peripheral(s).

6. Provide a peripheral that moves the vehicle.

7. Provide a peripheral that steers the vehicle.

8. Provide an electronic interface from each peripheral.

Term	Definition
Logic	Eletronic Systems including the Control and Autonomy Systems
Drive System	The electromechanical parts on the car, such as, the motor(s)

2.4.2 Wireless Interface Requirements

The Wireless Interface shall:

1. Allow for wireless tunneling (e.g. via SSH)

2. Be able to access a server.

3. Provide bi-directional communication.

3 System Constraints

3.1 Sensor Constraints

1. The sensors to go on the vehicle must be minimally invasive such that any sensor attached to the chassis is not coupled to an existing mechanism on the chassis. For example, an encoder cannot be used since it is coupled to the vehicle drive system. Sensors such as accelerometers and cameras can be used since they can be attached to the chassis, but are independent of existing vehicle mechanisms.

3.2 Financial Constraints

1. The FrostAV team shall not exceed $300 towards parts under the superivision of Clarkson University's Department of Computer Engineering.