Vehicle Intersection Control

McMaster University

Hazard Analysis

SE 4G06

Group 6

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1 Revisions

Table 1: VIC Table of Revisions

Date	Revision Number	Authors	Comments
January 9, 2017	Revision 0	Alex Jackson Jean Lucas Ferreira Justin Kapinski Mathew Hobers Radhika Sharma Zachary Bazen	N/A

2 Introduction

When multiple autonomous cars arrive at an intersection simultaneously, due to the lack of a decision making protocol, the cars have no way of determining in which order to proceed. The purpose of this project will be create a system that allows autonomous cars to navigate through intersections. This will be accomplished by providing an appropriate order for the vehicles to proceed through the intersection.

Vehicle Intersection Control (also known as VIC) will allow autonomous vehicles to make navigation decisions at intersections. In addition, VIC will be able to dynamically handle changing scenarios at an intersection without running into deadlock or stalemate situations. To ensure safety, VIC will allow cars to navigate through the intersection only after the scheduling algorithm determines the order in which they should proceed.

The following document will outline the hazards that VIC poses to humans, as well hazards to the system. Causes and effect of failures, as well as detection, control and recommended action for failures will also be discussed.

3 Component Descriptions

3.1 Image Processing

This component allows the vehicle to follow lanes and detect obstacles. It makes use of a WebCam, Raspberry Pi, and algorithms to allow the vehicle to interpret the track environment.

3.2 Steering Controller

The steering controller works with the image processing component to steer the vehicle. Further more, the steering controller must make adjustments to ensure the vehicle stays within the track lanes.

3.3 Speed Controller

The speed controller uses a hall effect sensor to determine the speed of the car. This controller will make adjustments to the vehicle's speed according to the track environment.

3.4 Communication

The communication component will consist of the blue-tooth signals between the vehicles and intersection controller. The blue-tooth communication will be utilized by the system to make scheduling decisions.

3.5 Intersection Sensors

The intersection sensors will be used to provide additional feedback to the intersection controller. The sensors will be placed at each lane of the intersection and will signal the intersection controller when a vehicle has arrived or departed from the intersection.

4 FMEA Worksheet

4.1.1.2 Component 2 Verification

Design Component	Failure Modes	Causes of Failure	Effects of Failure	Detection	Controls	Recommended Action
Image Processing	Incorrect Lane Following	- Damaged webcam - Slow feedback - Dead battery	- Collision with humans or cars - Vehicle exits track - Image proccesing fails to operate	- Visual check - Signal for dead battery	- Image processing algorithm must respond within a required time - Ensure track is clear and no undesired objects are present	- If too many consecutive deadlines are missed, controller will adjust speed - EIf RasberryPi battery dies alert the car controller to go in emergency shutdown mode
	Incorrect Obstacle Detection	- Damaged webcam - Software error - Slow feedback - Loss of power	- Collision with humans or vehicles	- Visual check - Signal for dead battery	- Image processing algorithm must respond within a required time - Ensure track is clear and no undesired objects are present	- If too many consecutive deadlines are missed, controller will adjust speed - EIf RasberryPi battery dies alert the car controller to go in emergency shutdown mode
Steering Controller	Incorrect Steering	- Software Malfunction - Damaged Servo - Disconnected Wires - Loose steering assembly - Loss of power	- Collision with humans or vehicles - Vehicle Exits Track - Vehicle fails to make turn	- Visual check	- Image processing	- Direction corrected with software - Vehicle shutdown - Recalibrate/Repair/ Replace Servo
Speed Controller	Incorrect Speed	- Overheated speed controller - Incorrect speed calculation - Hall Effect sensor not working - Motor failure - Disconnect wires - Loss of power	- Failure to stop at intersection - Overshooting lanes when turning - Damaged hardware - Vehicle instability - Collision with vehicle or cars	- Hall Effect sensor - Visual check	- Feedback loop between speed sensor and speed controller	- Speed corrected with software - Vehicle shutdown - Recalibrate/Repair/ Replace Speed sensors and/or speed controller

Communication	Failure to maintain signal	- Low signal - Car distance out of range - Loss of power	- Vehicle waits too long at intersection - Vehicle goes through intersection at the wrong time	- Intersection Sensors will detect car at intersection		- Refresh/Reconnect - Vehicle Shut down and repair/replace device
	Failure to transmit signal	- Software Failure - Damaged transmitter or receiver - Loss of power	- Vehicle waits too long at intersection - Vehicle goes through intersection at the wrong time	- Intersection Sensors will detect car at intersection		- Refresh/Reconnect - Vehicle Shut down and repair/replace device
Intersection Sensors	Failure to detect vehicles	- Damaged/disconnected sensors - Software Failure	- Vehicle stalled at intersection - System deadlock if intersection controller does not detect vehicle leaving - Vehicle collision	- Lack of feeback - Check for correct signal when vehicle is at the intersection	- Bluetooth communication between vehicle and IC	- Reconfigure/Replace Sensor