Using Sensors to Detect and Maintain Distances in the Real World

New Mexico

Supercomputing Challenge

Final Report

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Team #22

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Executive Summary

The most common auto accident is the rear-end collision and the leading cause being distracted driving. Originally, this project planned to create a front and rear license plate frame that contained technology to detect and prevent these types of collisions. Although, due to time constraints and level of difficulty, we decided to narrow the scope of our project. This paper now focuses on the use of distance sensors and how they may be used to detect and avoid objects. We were able to relate this project to a real world situation found in another competition we had competed in. We modeled this situation in netlogo and showed the differences in driving behaviors with and without distance sensors. The successful results of our project now allow us to now pursue our original project with far more preparation and knowledge of netlogo and the Supercomputing Challenge as a whole.

Introduction

We were shocked to hear that a member of our community had almost been in an auto accident. While driving his car at night, he encountered a truck and trailer with its rear lights unilluminated. He barely managed to swerve out of harm's way after seeing the rear of the truck in his headlights. A large number of modern vehicles are equipped with forward collision safety equipment. However, many older vehicles do not have these safety features. If the driver had not acted so quickly, the situation would have gone far worse. A total of nearly 2 million accidents involving rear-end collisions occur in the United States annually, with about 1,700 fatalities and 500,000 injuries. Additionally, distracted driving accounts for more than 80% of these rear-end collisions.

Originally, our project was going to follow the creation of an aftermarket collision detection system that was to be implemented via license plate frames. This system would have been designed to detect quickly approaching vehicles from the rear and detect when your vehicle is about to collide with a vehicle in front of you. When sensors on the rear license plate frame detected an impending rear-end collision, lights would flash on the license plate frame to alert the following driver to slow down. When sensors on the front license plate frame detected an impending rear-end collision, a device with lights mounted within the equipped car would flash to alert the driver to slow down.

Due to time constraints and level of difficulty, we decided to narrow our project to one aspect of this system, the detection of objects. The ability to detect incoming vehicles is vital to our project. Our code shows an example of how objects can be detected by sensors, which can later be implemented into the full collision detection system.

Problem Statement

Rear-end crashes are the most frequently occurring type of collision. Distracted driving is the leading cause of these accidents. Many modern vehicles are equipped with collision detection systems, but older vehicles have no technology to prevent these accidents. This project plans to take a step forward in creating an aftermarket collision detection system that can be retrofitted onto unequipped vehicles via license plate frames.

Description

To model this project, we used our knowledge from another competition, Botball. Botball is a robotics competition where teams of students build and program autonomous robots to complete tasks and earn points on a predetermined gameboard. The goal is to earn more points than your opponent, who competes on an identical gameboard opposite yours, in two minutes.

PVC tubing around the gameboard is used to designate the edges of the play area. Sometimes, it is beneficial to follow the edge of the board to complete certain tasks, such as picking up a block that is placed in the corner of the gameboard. Although, this may be difficult because mechanical parts in the real world have imperfections and inconsistencies. For example, one wheel on the robot may turn faster than the other, which would veer you off course unless you correct for it. Fortunately, an IR (infrared) (Top Hat) sensor is included in the robot building kit and can be used to detect the distance between your robot and other objects, such as the PVC tubing. The desired distance value can be implemented in your code to have your robot drive along the edge of the board while correcting its path by turning slightly left or right to maintain a consistent distance away from the edge. Our team used this prior knowledge and experience to build a computer model that will drive along the edge of the simulation and correct itself if it veers to one side.

The Model

After getting familiar with netlogo, we started by scaling our Botball gameboard down to an appropriate size for a netlogo simulation. We then set the background to white and marked the edges of the board with gray to signify the PVC border in real life. Next, we added a turtle in the bottom left of the board where the starting point would be. After that we made it move along the bottom edge of the simulation and added some randomness that would be present in real life. By using the in-cone function, we were able to simulate the field of vision of a real IR sensor. The cone of vision was turned towards the bottom gray edge and programmed to detect a difference in color. The turtle was then programmed to go straight if it saw the right amount of gray. If it veered off to the left and saw less gray it would turn right to correct itself, and if it veered off to the right and saw too much gray it would turn left to correct itself. Buttons on the model show the turtle's ability to follow the edge with the sensor and without it.

Results

The results of our study were very positive as we had accomplished the goals that we had set out after narrowing our scope. The model was effectively able to use sensors to follow the edge of the simulation and . The model was effectively able to convey the differences between using and not using an IR sensor. We were able to display how this model may look in the real world. Our team was also able to gain a better knowledge of netlogo and the coding involved.

Conclusions

The results of this project show how sensors can detect objects in their environments and react appropriately. In the future, we would love to expand on this project and eventually make a working model of the license plate frame collision detection system. We believe that this project can one day prevent accidents and save lives.

Significant Achievement

This being our first year competing in the Supercomputing Challenge, we are very proud to have been able to create a successful model in netlogo.

Acknowledgements

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