

Shop cleaning vacuum, Navigation: Executive Summary

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May 2021

Project Overview

The purpose of this project was to design and create an autonomous vacuum robot to clean the floors of a shop environment. Other robots currently exist on the market such as the well-known Roomba, as well as more shop-oriented competitors from traditional tool companies. However these competitors are either too large and expensive, or not large and rugged enough to fit the needs of a robot capable of traversing a shop environment while having enough capacity and battery life to clean the entire space.

This robot was to be being built for Mr. Don Heer, since all other vacuum robots he has purchased have been insufficiently powerful to deal with his working environment. He is a woodworking enthusiast who has been dealing with the issue of excess sawdust building up in the shop. He has had other off the shelf models previously, but they did not fit his needs so he has commissioned the creation of a robot which can fit better within the shop.

Design

This project was developed in less than nine months, or one academic year at Oregon State. It served as a design project for a group of ten students, a required project in order to graduate. The robot was split into smaller groups that worked individually to design and create each section of the robot. The three groups were Navigation, Embedded, and Power.

The development phases of this project were separated into three main phases, design, assembly and testing. During the design process, we worked closely with our project partner, Don, to meet his requirements for the project and set ourselves up for the next phase, assembly. During this phase, we bought and implemented our system both in separate subsystems.

The final result for the stakeholders was going to be a working robot which met the requirements of the original sponsor and hopefully would last for many years to come. This finished robot would help keep his shop clean and more easy to work in, and potentially even make it a more healthy space by removing dust which could create breathing issues. Each subsystem was able to create a finished product, but because of the Covid restrictions and delays, a fully operational robot was never assembled.

Each sub team worked to create a product that could be completed and assembled by another group of ECE students in the future. This system would be able to achieve more of the multi team accomplishments that would lead to a fully operational system such as cooperation of motos and navigation, as well as updates to the sensor to improve navigational operation.

What we learned

The navigation system was implemented by a group of three Computer Science students here at Oregon state University. Although we did not have experience with operating a robot or interfacing with live sensors in a control system environment, we learned a series of skills that helped us overcome the challenges that we face. The tutorials for ROS (the Robotic Operating System) gave us the skills to create a control system that takes in and reacts to sensor and other live data. We learned how to interface with our camera to track and path to QR codes, and we learned how to interpret raw distance data from lidar sensors to track and map our path through a (simulated) environment.

As students working to complete a system as a team of ten students, we learned how difficult it can be to collaborate without breaking social distancing protocols. By meeting virtually, we did find that we could agree on documentation to standardize our protocols. Moving forward, we will value the simple ability to sit down and discuss engineering solutions in person or in front of a whiteboard. But, we will also be able to draw upon our practice this past year when we need to work with a team that is divided by distance.