

Project Overview

Analyze, design, and build an automated utility robot to completely eliminate the need for human interaction when cleaning/general pickup of product is needed.

Background:

- Symbotic is a robotics and warehouse automation company
- Current cleaning and maintenance is done by humans, requiring shutdown of the system due to safety reasons

Requirements:

- Capable of cleaning liquid, granular, powder, sauce from transfer deck and rails
- Fit within the size envelope of current bots
- Use the same autonomous control system and physical infrastructure currently used for Symbotic bots



University of
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Symbotic Utility Bot

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Cost, Benefit, Project Future

Cost:

- Project budget: \$10,000
- Bot cost: ~ \$6,000

Benefit:

- Bot will perform maintenance currently done by humans
- Maintenance can be performed while system is still live, eliminating shutdown time and costs that are associated with it

Project Future:

- Finished bot will serve as a “proof of concept,” and invention disclosure will be provided to Symbotic for possible patent application

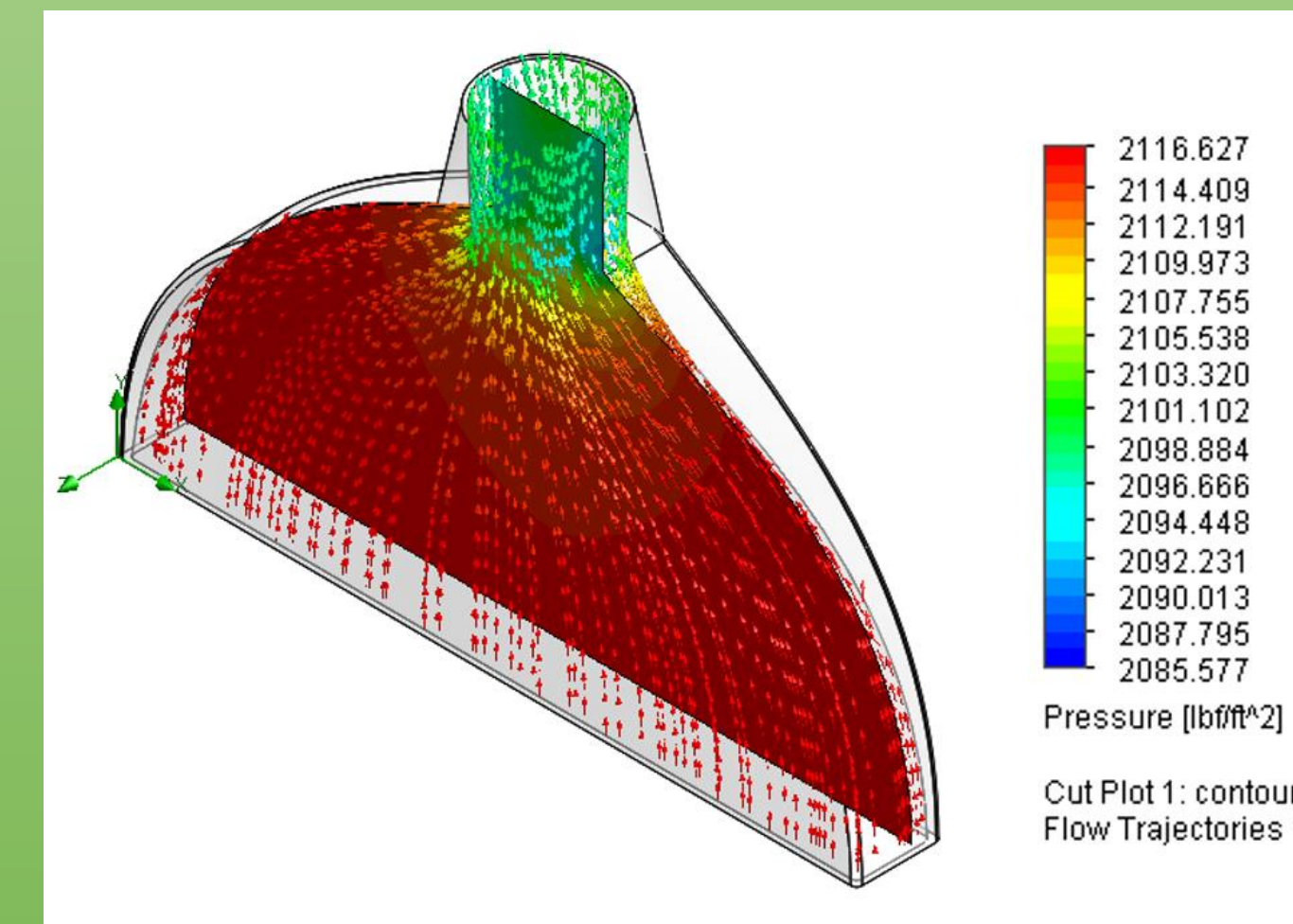


U-Bot Chassis

- Compatible with Symbotic autonomous driving system
- Cleaning apparatus attached to the chassis
- Design goal was to maximize functional space by allowing apparatus to exceed bot envelope during cleaning process, but fit within the envelope during travel

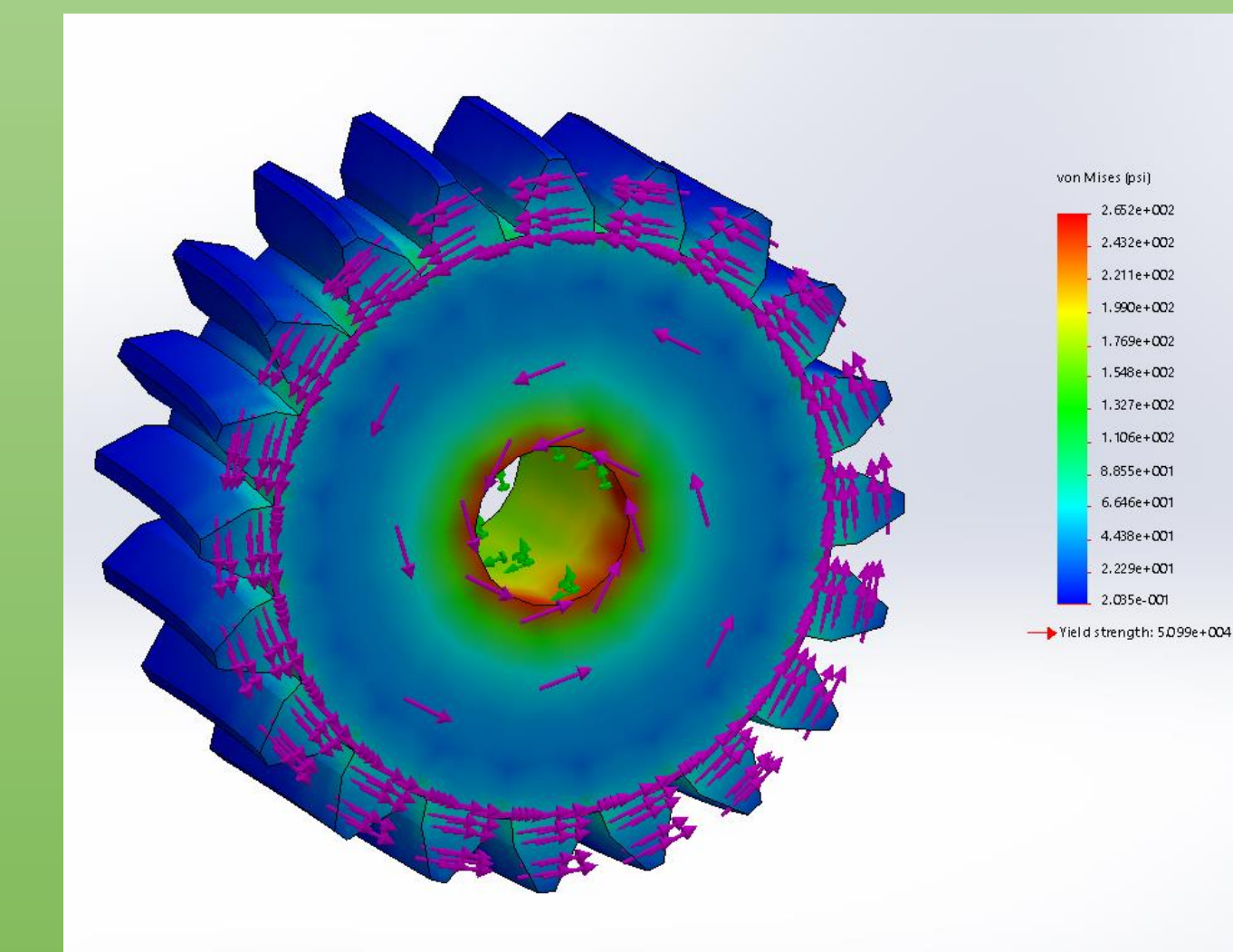


Design & Analysis



Fluid System Analysis

- CFD utilized to analyze vacuum and water pump systems
- Pressure drop and fluid velocity used to compare design options and choose the best one



Mechanical System Analysis

- FEA performed to verify parts will be able to handle stress with a suitable factor of safety
- Deformation and cycle-life considered when choosing materials
- Static and dynamic analysis

Main Cleaning Components

- Wet/Dry Vacuum unit
 - High Volume flow rate for suction strength
 - Low voltage to remain compatible with control system and reduce risk of electric shock
- Brushes
 - Rotating to create agitation within the spill: circular and cylindrical
 - High strength bristles for better control of debris
 - Rotational velocity optimized to clean spill without damaging cleaning surface
- Pressure Washer
 - De-greasing cleaning solution to break down spills
 - Low pressure to reduce risk of cleaning surface damage



Build Considerations & Constraints

- Built to allow for independent testing of components before attaching apparatus to bot chassis
- Assembled one system at a time, incorporated into control system piece by piece
- Materials
 - Chosen based on strength, weight, machinability, availability and cost
- Processes
 - Lathe, milling, bending brake used to manipulate metal parts as needed
 - UNH machine shop used for all metal work



Deliverables & Criteria

Deliverables:

- Preliminary design report and design review
- Monthly Updates to Symbotic
- Final design report
- Utility Bot
 - Full-scale functioning prototype
 - Designed and built with U-bot chassis as basis

Competition Criteria:

- Cleaning efficiency
 - Spill types: syrup, oil, powder, granular, hardware
 - Evaluated on multiple test surfaces
- Design Innovation
 - Symbotic interpretation of design uniqueness
- Final Presentation
 - Presentation quality
 - Design process
 - Robot overview
 - Q+A