Semi-Autonomous Floor Scrubber

Mechanical and Aerospace Engineering

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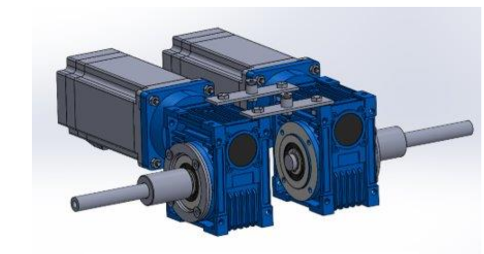
Abstract

The project consisted of the design and fabrication of a semi-autonomous floor cleaner for Asama Coldwater Manufacturing (ACM). ACM provided a floor cleaner to be modified to meet their cleaning needs. The team manufactured components, wired motors/sensors, wrote a path following algorithm, analyzed the cost, and implemented safety features.

Customer Needs and Requirements

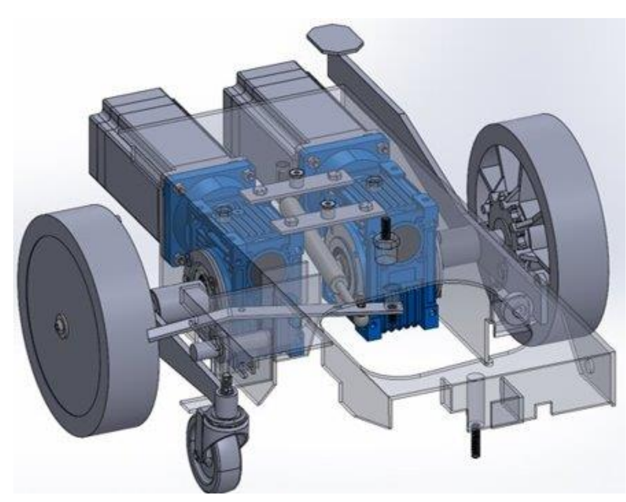
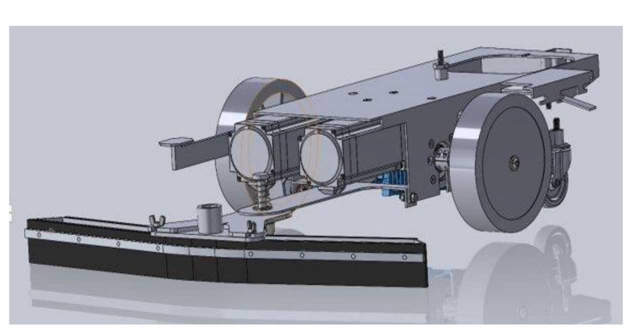
1	Have the floor scrubber clean up dry and wet material	Ability to clean both solids and liquids to Level 2-3 Custodial Standard
2	Clean the figure eight forklift path	Clean figure eight forklift path
3	Have the cleaner set to run one time each day	Cleaner shall be set to run once a day
4	The floor cleaner needs to not hinder traffic in the aisleways	Floor scrubber must stop within 5-7 feet of human or forklift
5	Floor cleaner should be battery powered	At least a three-hour battery life before needing to be recharged
6	Reduce the amount of man hours required to clean	Man-hours put into cleaning the floor will be less than three hours
7	Can stop when an obstacle is in its way (i.e., person/forklift)	Additional Safety Features: E-Stop button, flashing lights and sounds
8	Modify the Watchman 24 BETCO with a budget of $3000	The cost of the prototype is under budget and the given floor scrubber is modified.

Concept Selection

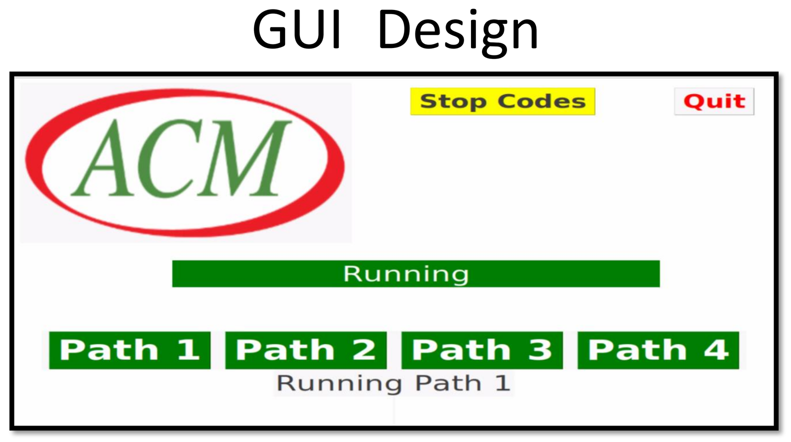



- Path Following:
  - Two 12Nm stepper motors coupled with right angle gear boxes
  - IMU used for tracking and targeting orientation
- Safety Features:
  - LiDAR and Sonar sensors
  - E-stop, blue light, & light bar
- Cleaning System:
  - Modified squeegee mount
  - Default configuration

Design Solution

GUI Design



Control Method:

- 90° turn utilized IMU
- Hardcoded a zigzag motion for the straights
- Control algorithm was made simpler as deadline approached

Manufacturing

Machining:

- ACM machined parts using created drawings

Component Integration:

- Components necessary for movement were installed under the frame

Software and Electrical Mounting:

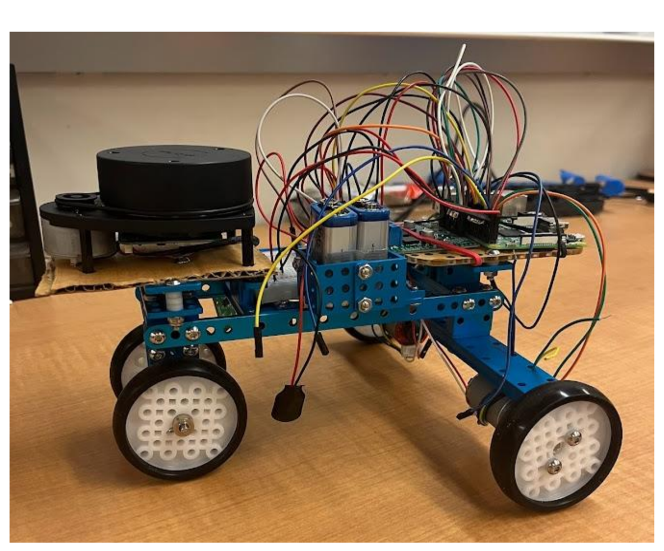
- Made use of 3D Printing
- Final "Saddle Mount" was made of ABS; Test pieces were PLA

Final Assembly

Testing and Validation

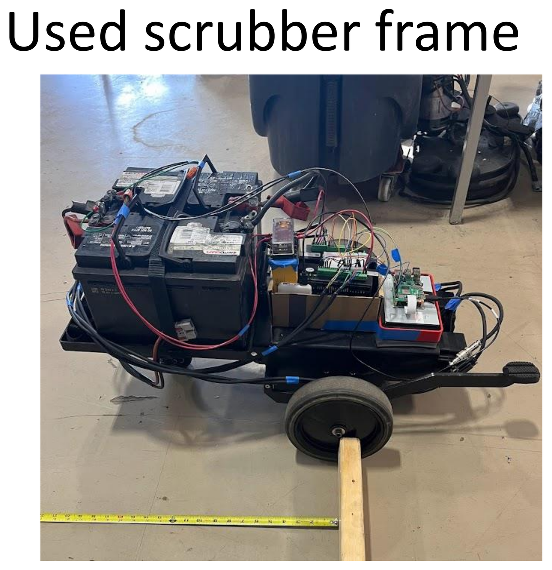
Prototype 1:

- DC Motors Robot Kit
- Tested LiDAR and IMU to determine how accurate the robot can follow a figure 8



Prototype 2:

- Stepper Motors and Drivers with 24V supply
- Tested to see distance and turning with stepper motors.
- Used scrubber frame



Prototype 3:

- Fully assembled scrubber with all sensors attached
- Testing including straight line and 90° turns.
- Focus was using IMU and PID control to optimize path following
- Tested LiDAR and sonar functionality
- Configured scrubber to run from the GUI

Acknowledgments

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