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College of Engineering

Mission/SOW

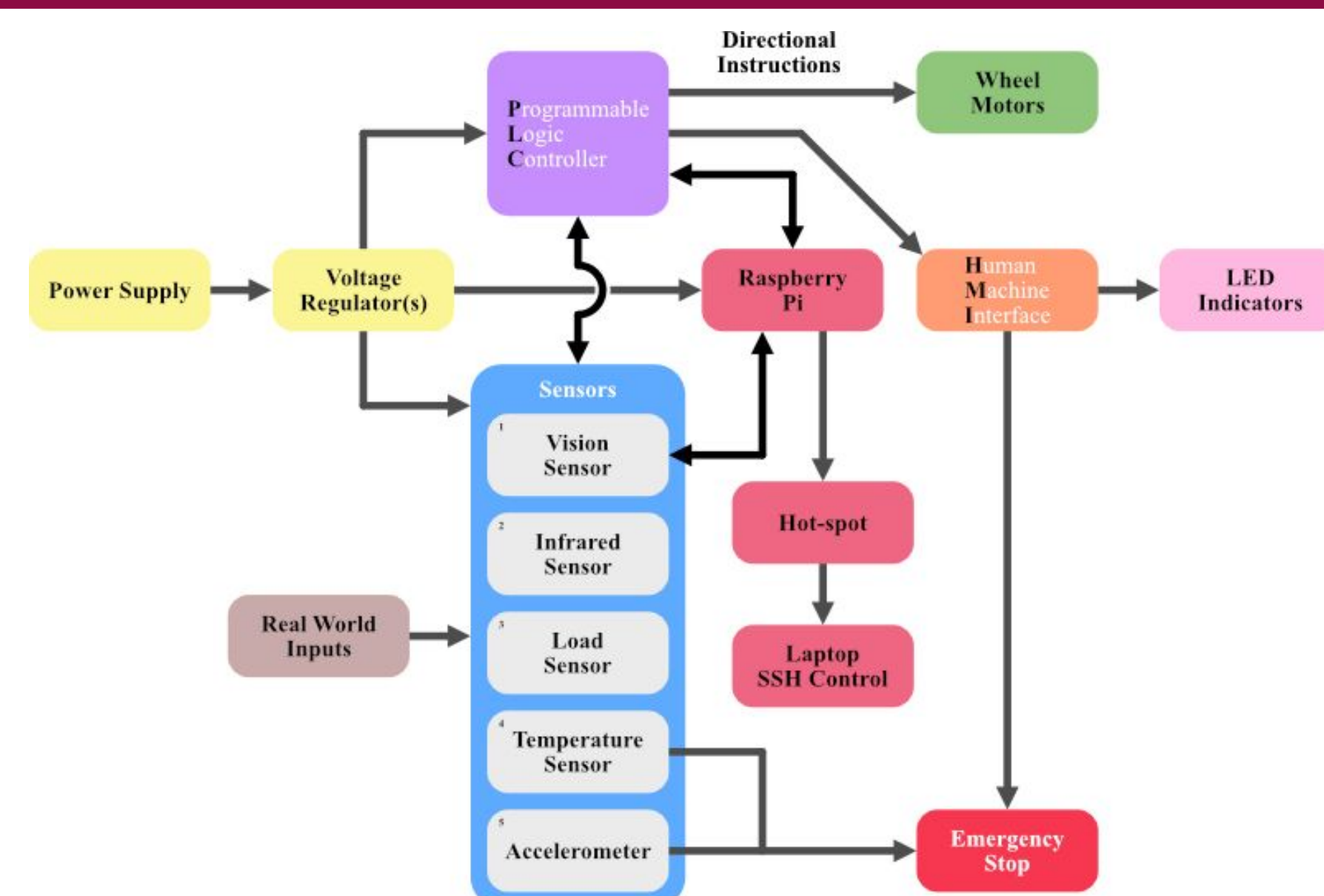
Our mission is to empower individuals with limited mobility, helping them achieve their goals comfortably and without the risk of further injury.

- Haul-E is designed to assist in transporting objects.
- Haul-E navigates using Computer Vision.
- This project tackles the challenge of using a PLC for robotic Computer Vision.

Research

- A Programmable Logic Controller, or PLC, is a ruggedized computer used for industrial automation. These controllers can automate a specific process, machine function, or even an entire production line.
- Computer vision is a field of artificial intelligence (AI) that enables computers to "see" and interpret images and videos, in a way similar to humans, by using machine learning and neural networks to identify objects, analyze scenes, and understand visual information.
- Based on surveys conducted with our target audience, physically impaired individuals and students, we found that users prioritize:
 - Accessibility and usability to support different ranges of motion.
 - An easy-to-use interface with minimal setup.
 - Hands-free operation.
 - Notifications about battery life.
 - Safety features, including obstacle detection and emergency stops.

System Diagram

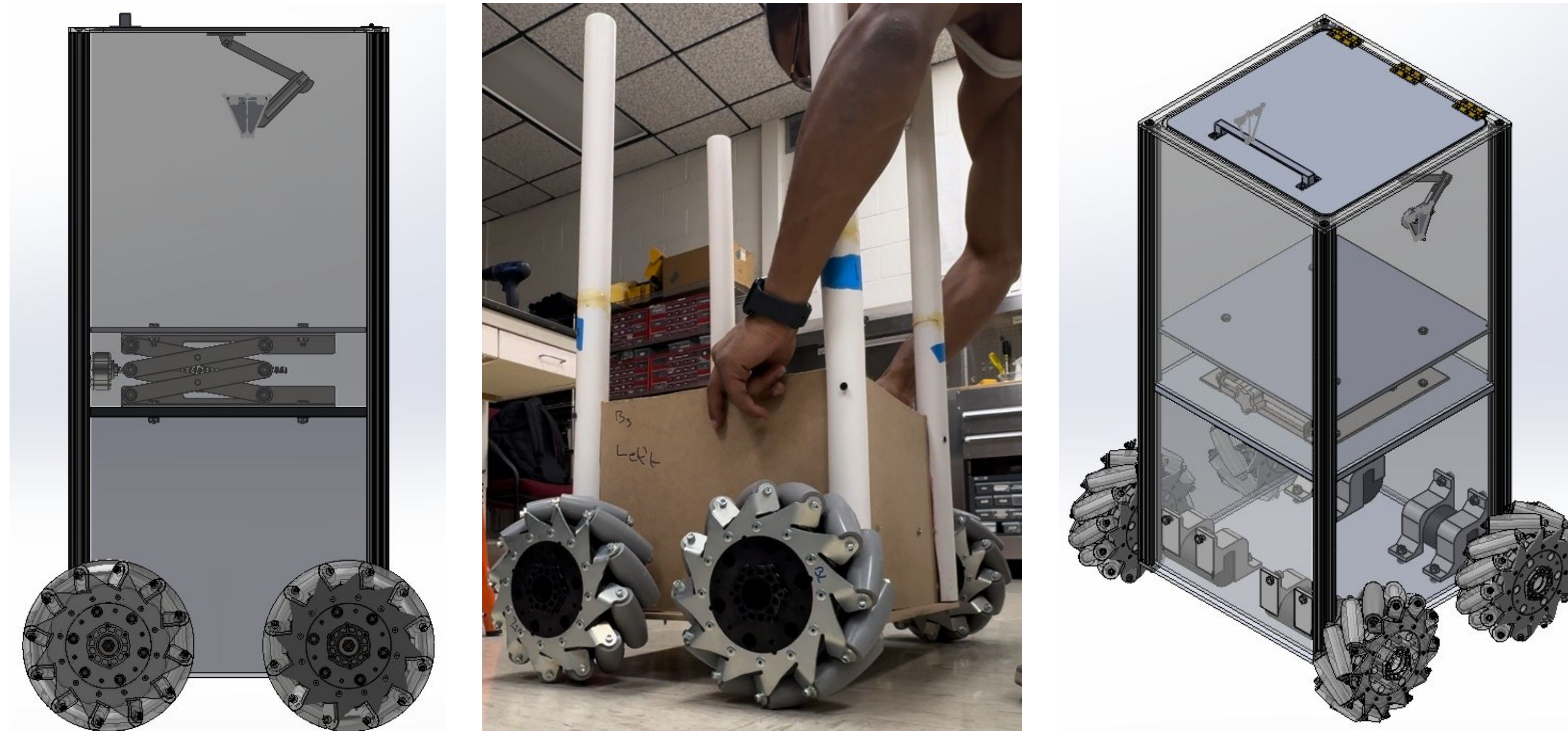


Haul-E /CV

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For Reliable Controls Corporation and Entrepreneurial Lead Linda Martin

Final Design



Materials & Structural Design

- Aluminum plates—Provide durable and secure key connection points, ensuring the robot can carry heavy loads without warping or bending.
- High-impact acrylic—In select panels to lower overall weight and maintain impact resistance, striking a balance between strength and agility.

Omnidirectional Wheels

- Mecanum wheels enables full directional control—forward, backward, sideways, and diagonal movement.
- Supports high-weight loads while still allowing effortless maneuvering, enhancing overall user experience and accessibility.

Scissor Lift for Ergonomic Payload Access

- A scissor lift raises the storage floor to a comfortable height, easing the strain of bending or lifting items into or out of the storage compartment.
- A key element is its compact design; the lift supports substantial weight loads, and due to its efficient design will not add that much to the overall weight of the construction, ensuring it meets the needs of users with varying mobility levels.

Vision Sensor/PLC System Overview

- PLC Opta serves as the central decision-making component. It receives input signals from the vision, IR, and temperature sensors via dedicated input terminals (e.g., Input I5), processes these signals, activates indicator LEDs (e.g., Warning LED L4) for immediate visual status updates, and controls external actuators or devices through specific output channels (e.g., Output O4).

Human Machine Interface (HMI)

- In development is an HMI app that would allow the user to conveniently control the Haul-E for functions such as start, stop, lock-in-place and to provide alerts on the status of the robot.



Sensor Functionality

- **Vision Sensor:** Tracks an AprilTag to follow the user. If the tag moves left or right, the motors adjust to re-center Haul-E on the tag.
- **Load Sensor:** Monitors weight placed in the Haul-E cargo compartment.
 - Red LED – Overload detected
- **Infrared Sensor:** Measures distance from the user.
 - Green LED – Within optimal range (2–3 feet)
 - Red LED – Too far/Too close → Haul-E will catch up or slow down, accordingly.
- **Temperature Sensor:** Checks the temperature in the electronics housing unit.
 - Green LED – Normal
 - Blue LED – Getting warm
 - Red LED – Overheating → Triggers emergency stop with notification
- **Accelerometer:** Detects if Haul-E has tipped over.
 - Green LED – Stable
 - Blue LED – Warning: Risk of tipping (20°– 45°)
 - Red LED – Fallen over (angle > 90°) → Triggers emergency stop with notification

References

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