

Project Requirements

The Blaze Runner wagon is a ground vehicle that is designed to execute commands while carrying a payload of up to 200 lbs. This includes but is not limited to heavy supplies, chairs, cases of waters with minimal effort from the user.

Key Features

- Collision Avoidance System
Uses ultrasonic and lidar sensors for a 360-degree collision monitor
- 12-volt Battery
Main power source for our ground vehicle
- Mobile App
The mobile app allows wireless control and monitoring the status of wagon
- Physical Stop Button
This feature allows for a manual stop of the wagon at any time
- Autonomous and manual mode to the wagon

Background

- The need for this wagon would ease the manual carrying of heavy supplies. The wagon could be used at events, on campus and avoid injuries or strains when transporting heavy loads.
- The blaze runner can transport heavy loads through user interface eliminating pushing or pulling the heavy load.



Figure 1. Wagon moving Infront of the ERB

Architectural Design

Our wagon is organized into four functional layers

Sensor Layer- Using sensors mounted around the wagon (lidar, ultrasonic, camera, etc.), the wagon can detect obstacles and stop promptly.

IOT Layer- With the ESP32 microcontroller it bridges to the Raspberry pi with the use of the mobile application. This enables wireless communication and live user commands to the wagon.

Power and Safety Layer- Our 12-v battery is wired throughout the wagon with voltage regulators, and an emergency stop button on the wagon, that easy to find.

Mechanical Drive Layer- This includes our motors, motor drivers, and chain and sprocket. Controlled by a Sabertooth dual motor driver. Using front swivel wheels for steering, and drive MCU can change speed control for load.

System Control- The central decision-making unit performs localization, path planning and task management. It includes the Raspberry pi running ROS and a microcontroller responsible for low level motor control.

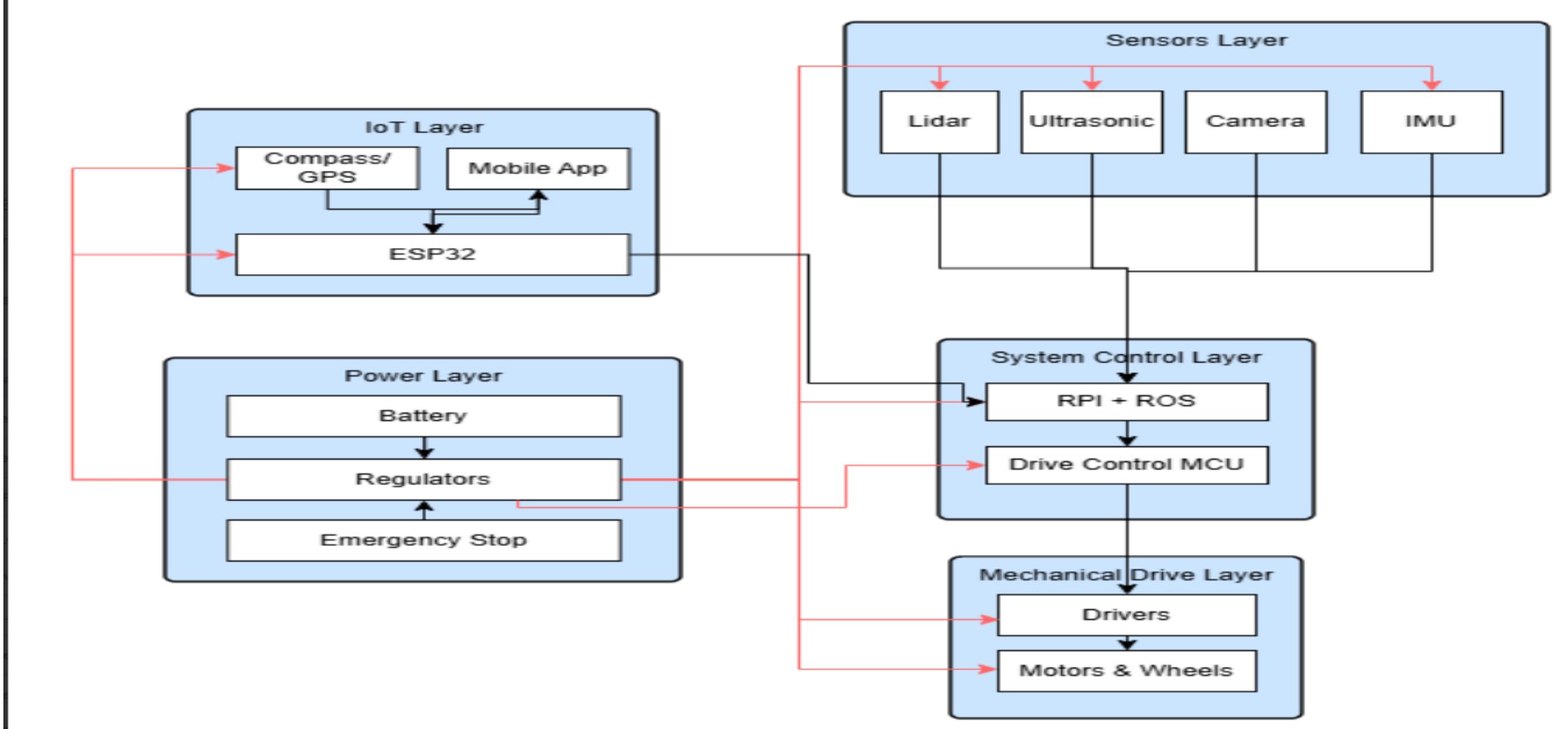


Figure 2 – Subsystem Diagram

Test Plan and Details of Implementation

- Mechanical Assembly- Our wagon was welded by cutting metal into specific dimensions and creating mounts for our DC motors and a stand for our lidar and camera. A battery compartment was also welded to prevent the battery from moving out of place.

Here we can see the bottom of the wagon and how the front swivel wheels and back wheels are attached. We can clearly see the chain and sprocket mechanism which is responsible for the propulsion aspect of the wagon. Most of the work on the wagon was built by some heavy metal welding.



Conclusions and Future Works

- In this project we were all able to work together and learn different aspects varying from mechanical to software, or to just working as a team.
- For our future works we hope that the camera would be done using ArUco markers so that the wagon can follow the user (a black and white code used in computer vision). This would involve figuring out how far away the user is and the direction of the marker to follow adequately.
- We also plan in the future to add some headlights and LED lights for aesthetic purposes.

References

1. Morgan Quigley et al. Ros: an open-source robot operating system, 2009. Accessed: 2025-10-17.
2. Dimension Engineering. Sabertooth 2X32 User's Guide, 2024.
3. Jin-Woo Kwon, Hyunwoo Lee, Jaeho Lee, Nam-Ho Lee, Jae C. Kim, Taehwan Uhm, and Young-
4. Ho Choi. Uwb-based human-following system with obstacle and crevasse avoidance for polar-exploration robots. Applied Sciences, 14(16):6918, 2024.

