



2026 NASA Lunabotics – Propulsion, Navigation and Controls Team

Team ATHENA (Aztec Technology for Harvesting, Exploration, and Navigation in Astro-Mining)

Joint Electrical, Computer, and Mechanical Engineering Project

Sponsor: SDSU Department of Mechanical Engineering

Project Overview

Lunabotics is a multidisciplinary engineering project focused on designing and building a telerobotic rover capable of traversing, excavating, transporting, and depositing lunar regolith. The overall team is divided into two groups, Project 32 and Project 33. Project 32 is responsible for developing the rover's propulsion, navigation, and control systems and is composed of electrical and computer engineering (ECE) and mechanical engineering (ME) sub-teams.

The ECE team integrates both hardware and software to enable autonomous and remote operation. A roboRIO for reliable motor control, while a NVIDIA Jetson Nano serves as the main onboard computer, handling high-level processing and system coordination. For navigation, the team incorporates the Unitree 4D L2 LiDAR sensor and the ZED 2i Camera to provide depth sensing, environmental mapping, and visual feedback for automation. Additionally, the team developed a custom user interface for mission control, allowing operators to monitor the rover and issue commands in real time.

The ME team designs and manufactures the drivetrain subsystem using OnShape, including the chassis, wheel assemblies and gearboxes. The structure is built from aluminum box tubing and CNC waterjet-cut sheet metal and fastened together with rivets, bolts, and nuts. Finally, the driving chains and chain tensioner are applied to ensure reliable power transmission across all four wheels.

Together, the ECE and ME drivetrain subsystems are tested before integrating with Project 33's payload subsystem to form a fully functional rover. The goal of Lunabotics is to support NASA's research in lunar mining by creating efficient, lightweight robotic systems. These technologies are critical for enabling in-situ resource utilization, where materials such as regolith can be used for construction, fuel production, and long-term exploration.

Major Components

ECE Components

- Unitree 4D L2 LiDAR: sensor for obstacle detection and path finding
- NI roboRIO 2.0: robotics controller for motor controls
- ZED 2i Stereo Camera: mission controls visual and pathway finding
- TP-Link router and antenna: communication
- Enclosure Box: protects equipment
- Voltage Regulator Module: steps down voltage from 2A to 0.5A12V
- Battery: powers system

ME Components

- Kraken x60 Motors: for wheel movement
- Chassis: aluminum tube stock, triangle bracket, electronics housing
- Wheels: rim, drum, cleats, bearing block, hex bearings, mount bracket, dead axle mount block
- Gearbox: gears, sprocket, gear plate, spacers, gear cover, hex bearings, roller chain

ECE Sub-Team



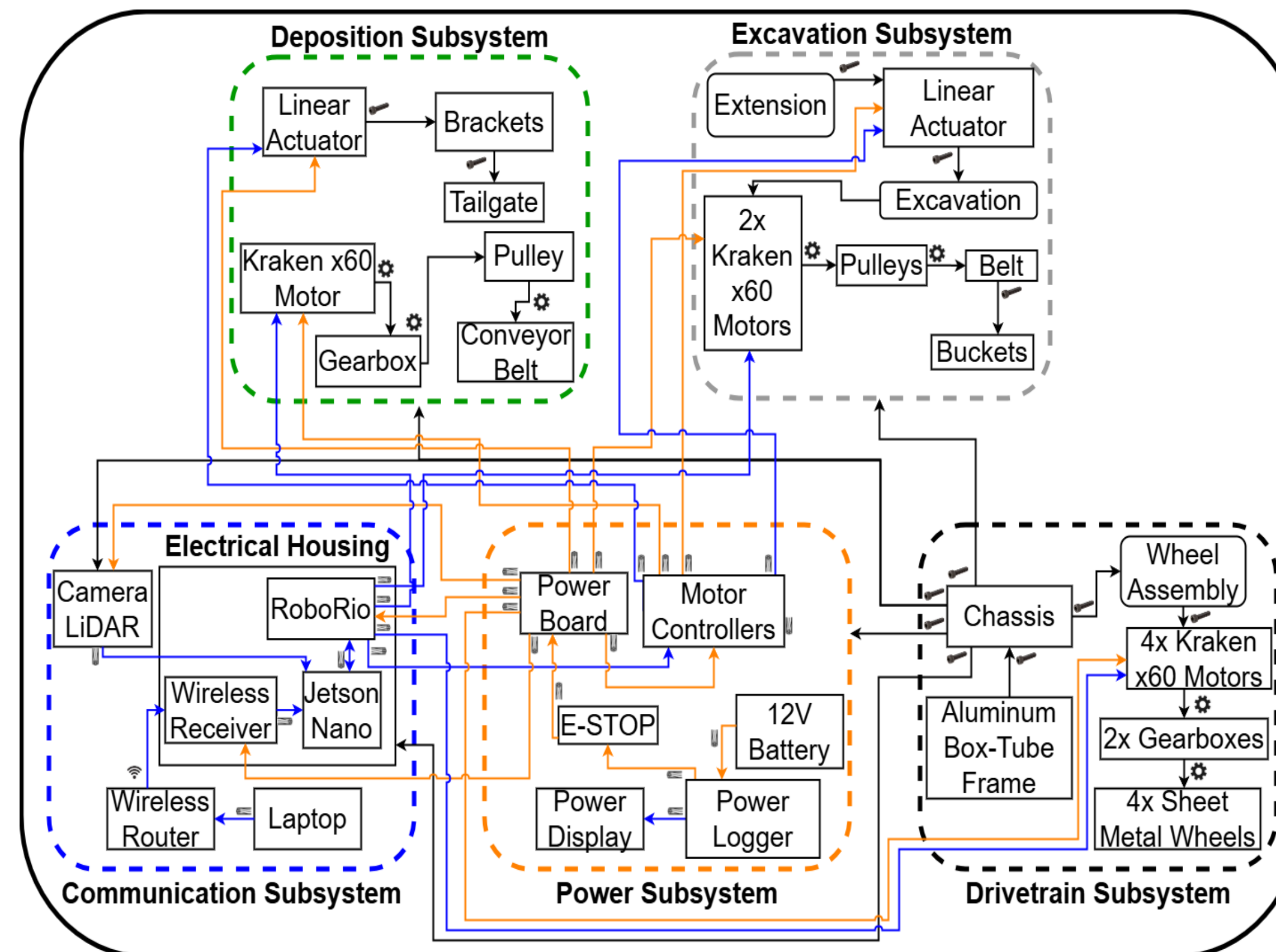
Front Row: Geccsan Reyes (COMPE), Charmay Hoang (EE), Gio De Guzman (EE)
Back Row: Sai Nampalli (COMPE), Ava Aiken (COMPE)

ME Sub-Team

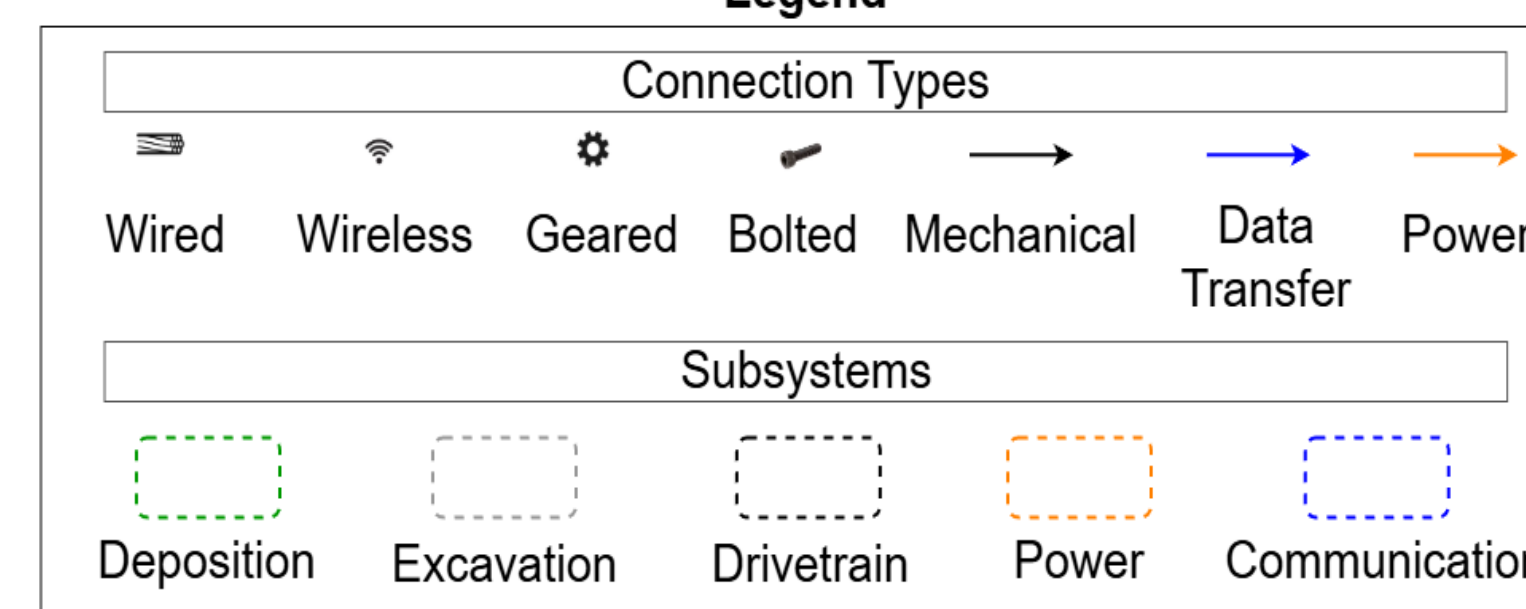


Front Row: Bailey Morgan (ME), Giovanni Diaz-Lopez (ME), Oscar Sou (ME)
Back Row: Jacob Ibay (ME), Kai Pichay (ME)

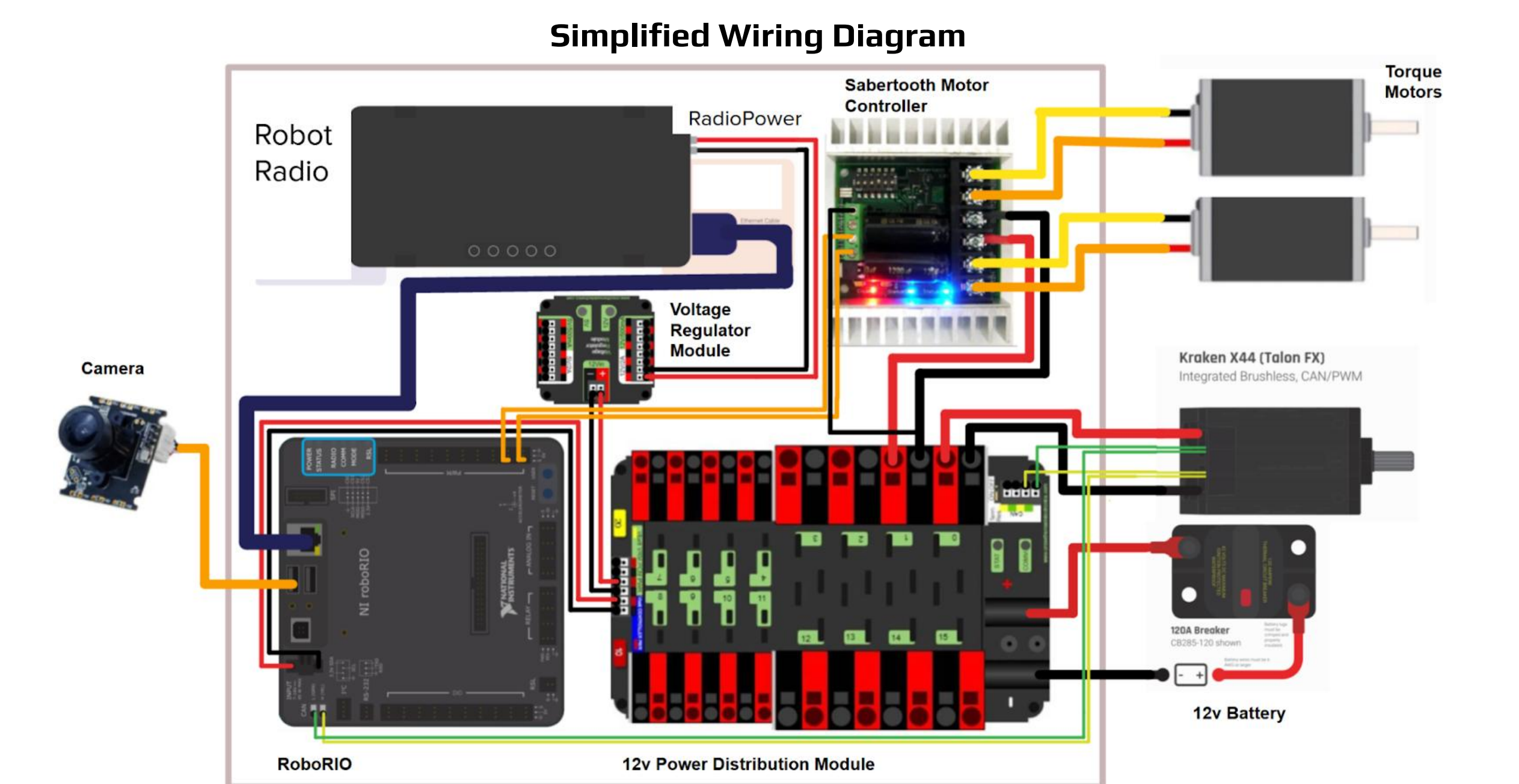
System Level Diagram



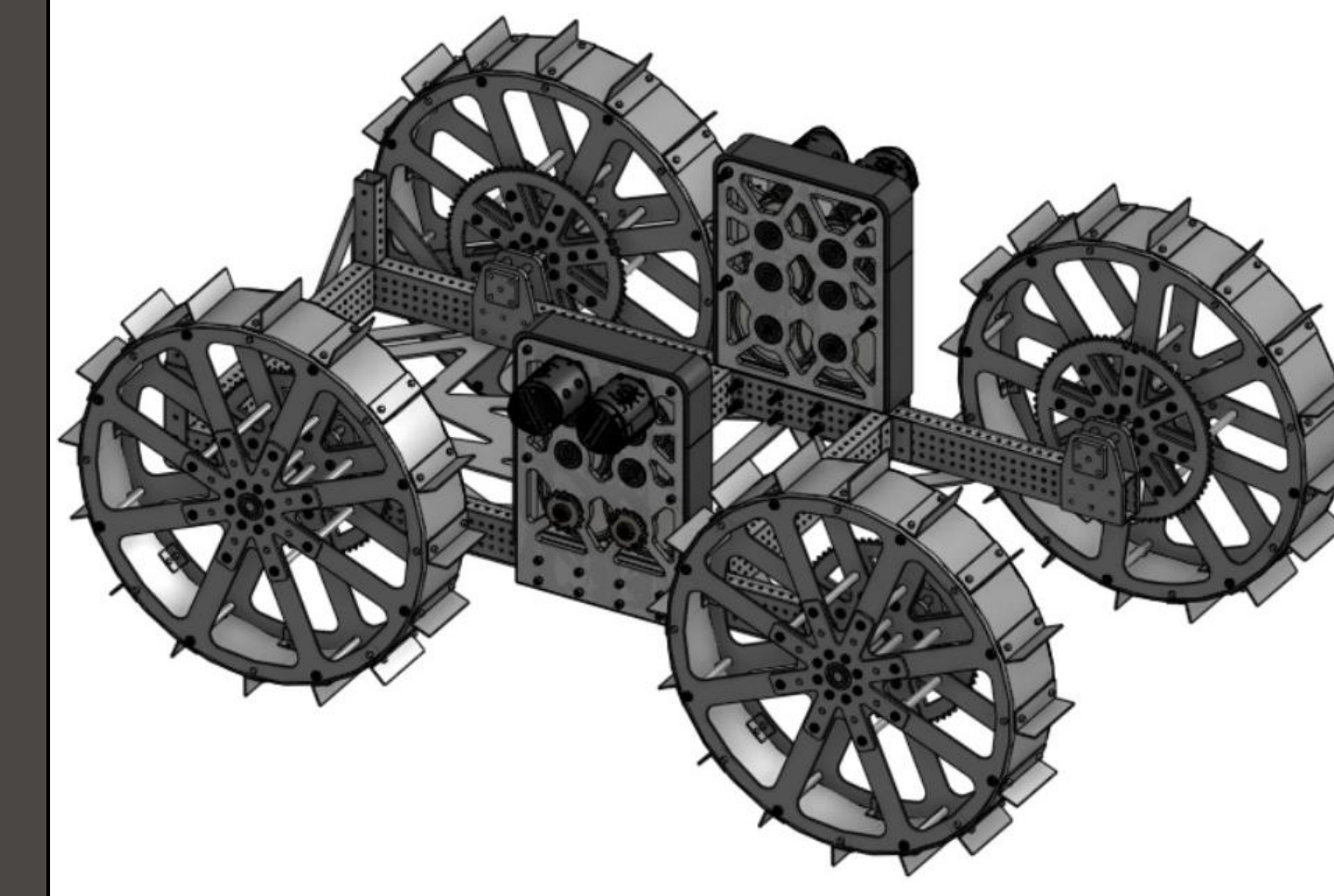
Legend



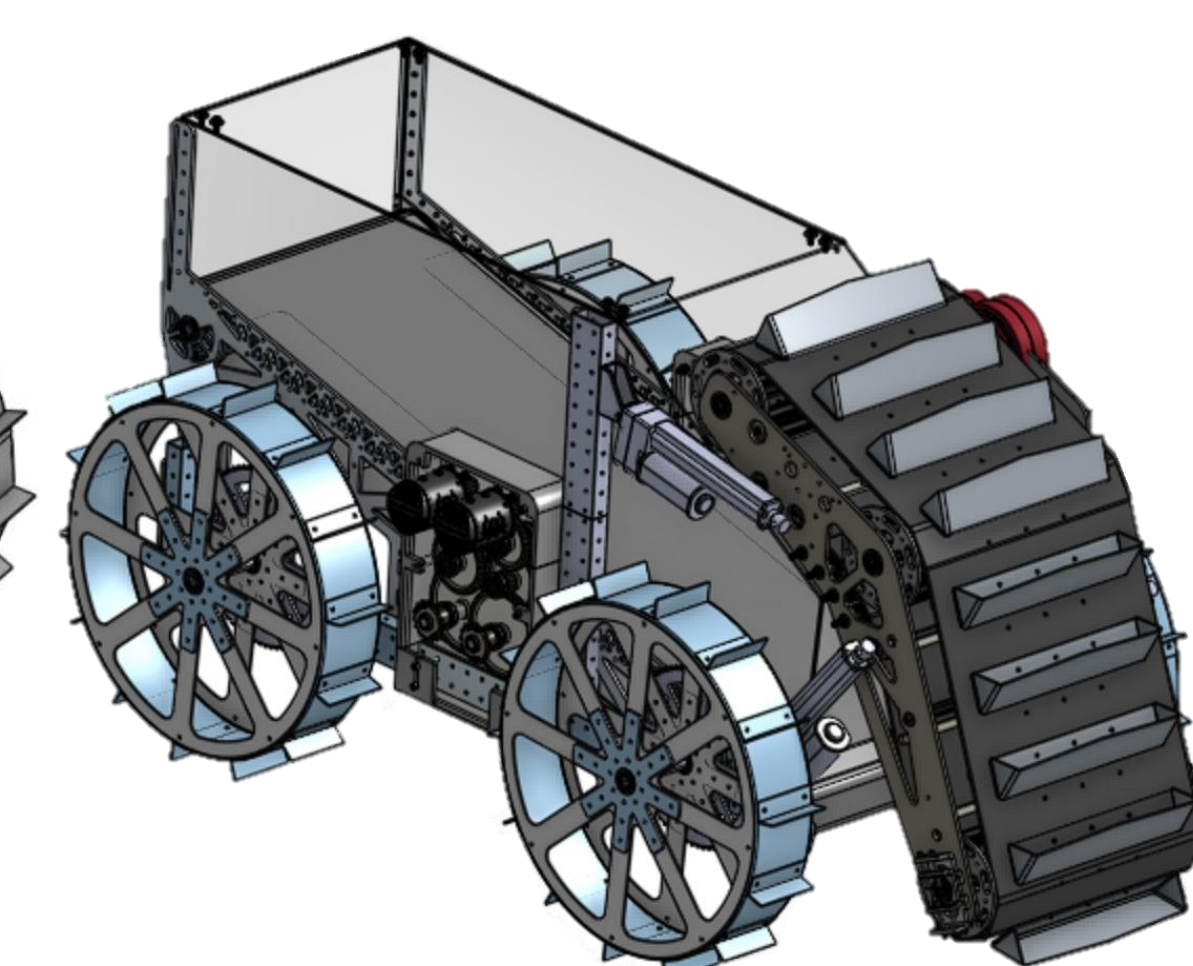
Design Illustrations



Drivetrain Subsystem CAD Model



Full ATHENA Rover CAD Model



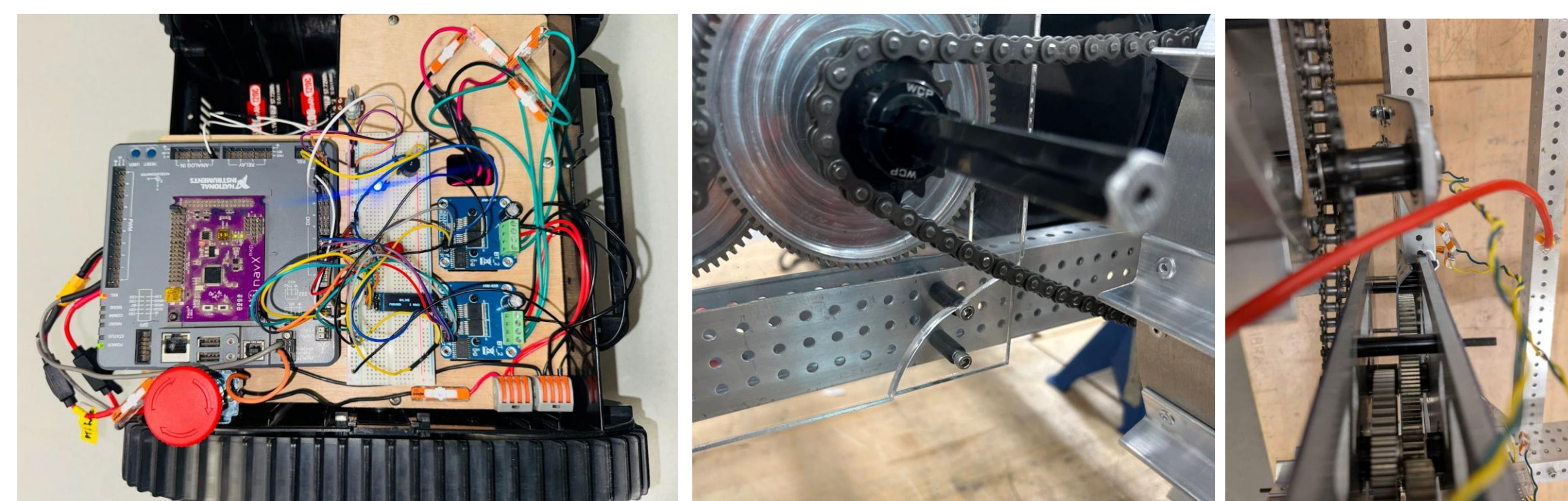
Testing and Verification

Power Supply

- Verified all devices are powered on

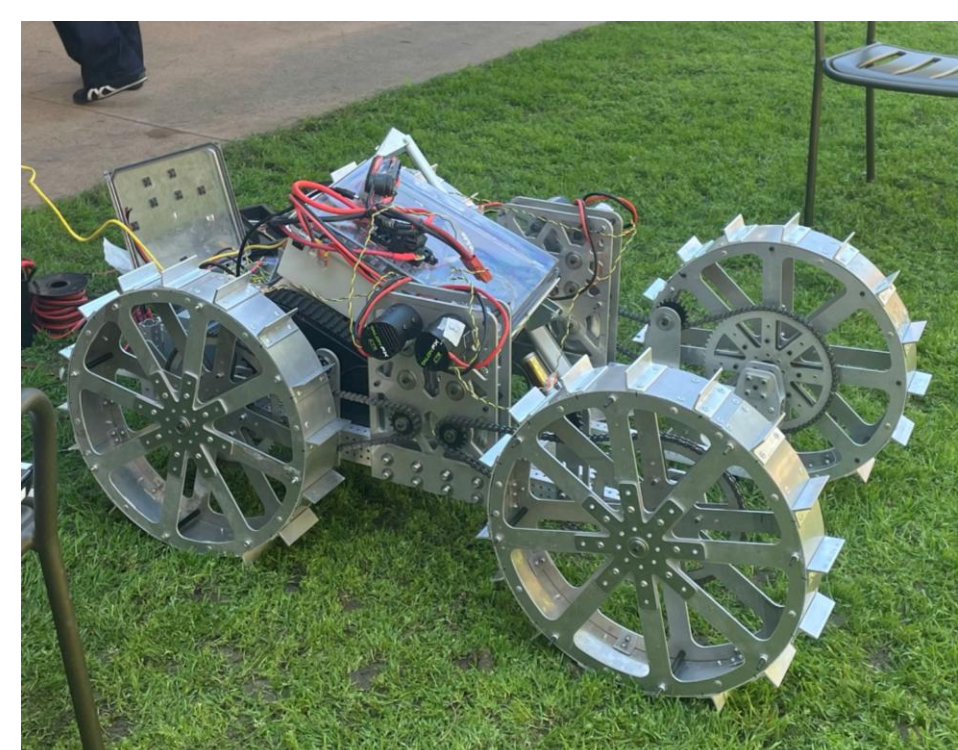
Standard Drivetrain

- Verified motor synchronization and wheel movement



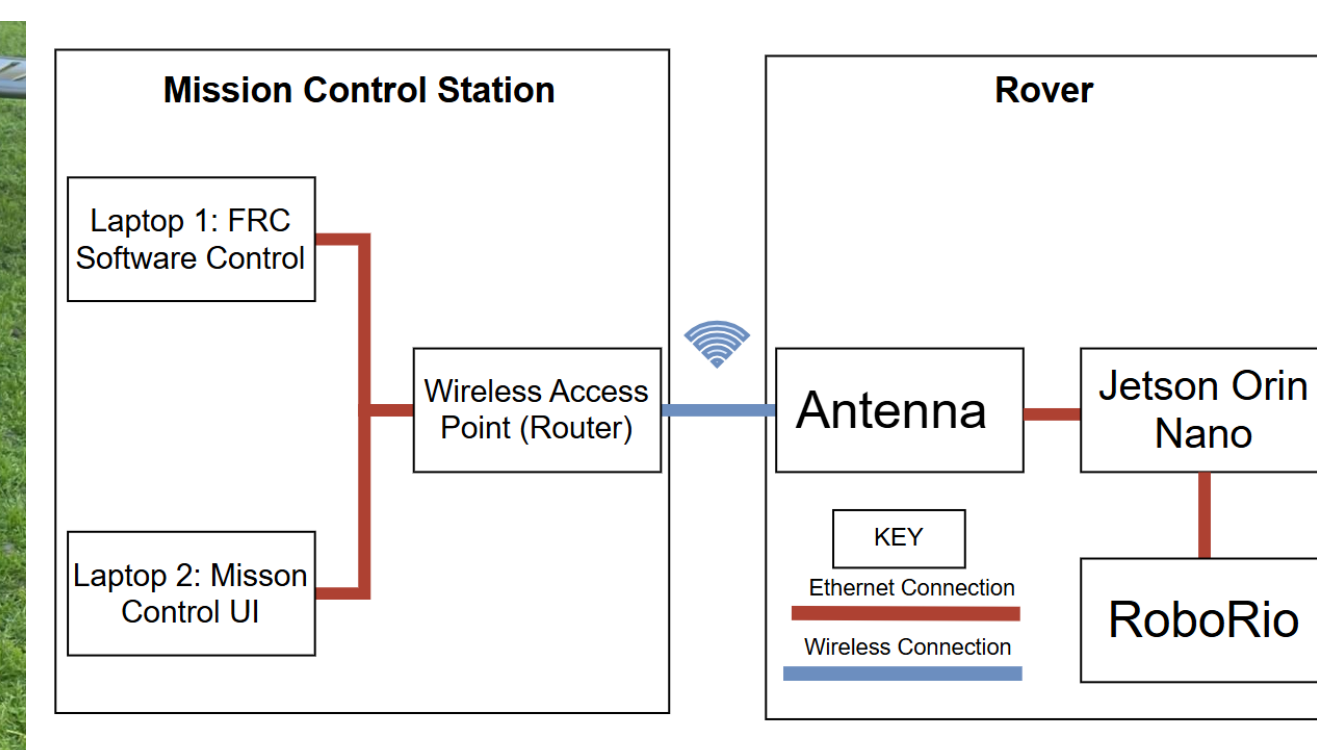
Full Drivetrain

- Verified rover movement outside



Communication

- Verified all devices connected and communicating



Conclusion

This project demonstrates the importance of developing robotic systems for future lunar exploration. By designing and integrating a telerobotic rover capable of excavating, transporting, and depositing regolith, the team explored key challenges in autonomy, control systems, and mechanical design. The project highlights the role of in-situ resource utilization in advancing propulsion, controls and navigation strategies for robotic mobility. Overall, it provided valuable experiences in interdisciplinary engineering, system integration, and iterative design, while establishing a strong foundation for future improvements in efficiency, autonomy, and robustness.

Acknowledgements

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