Robust System Development for Mobile Terrestrial Rovers

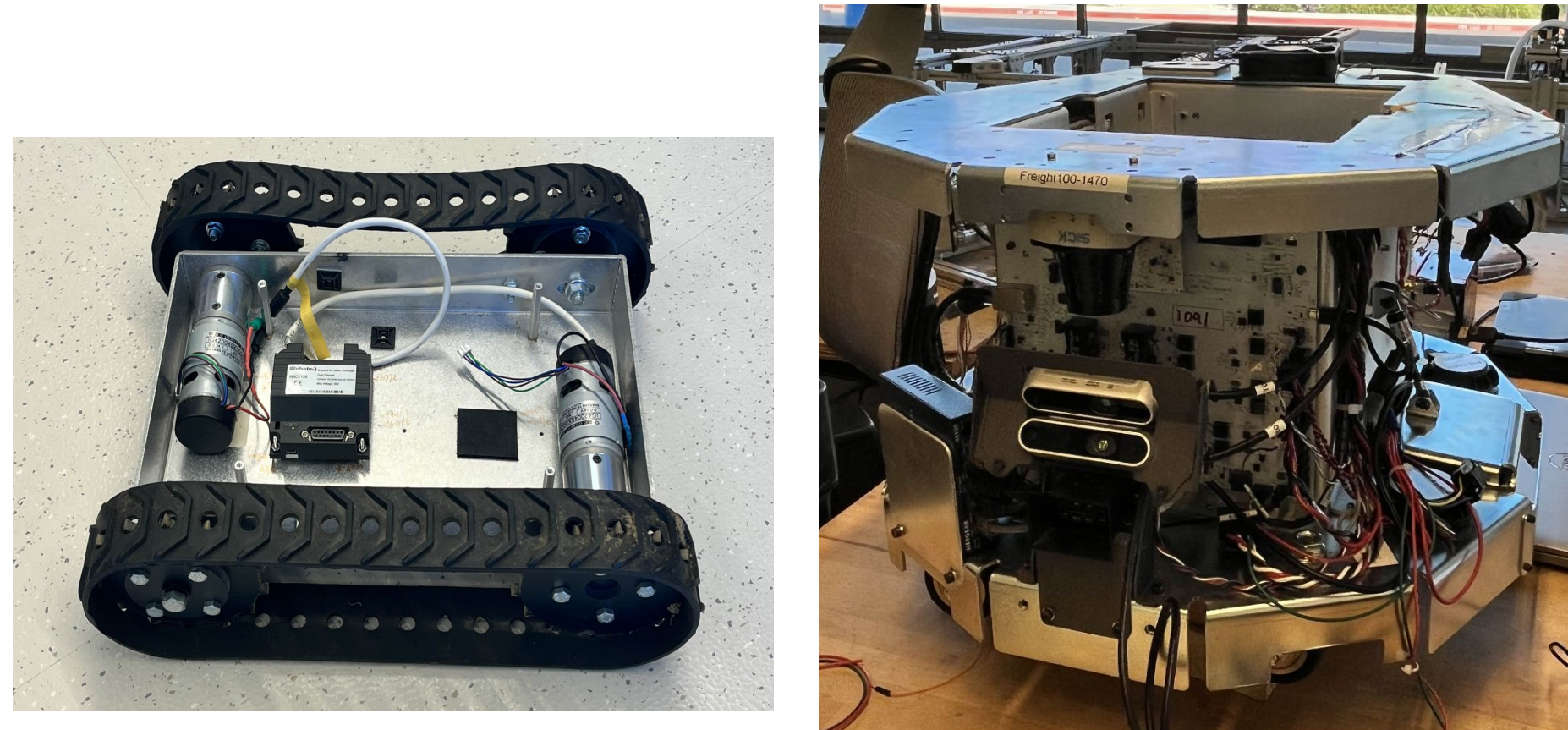Rucha Damle

Advisor: Dr. Manoj Sharma

Problem Statements

- Roo began as an empty chassis with no control system.
- Kanga's larger design could not be directly scaled, resulting in unreliable locomotion.
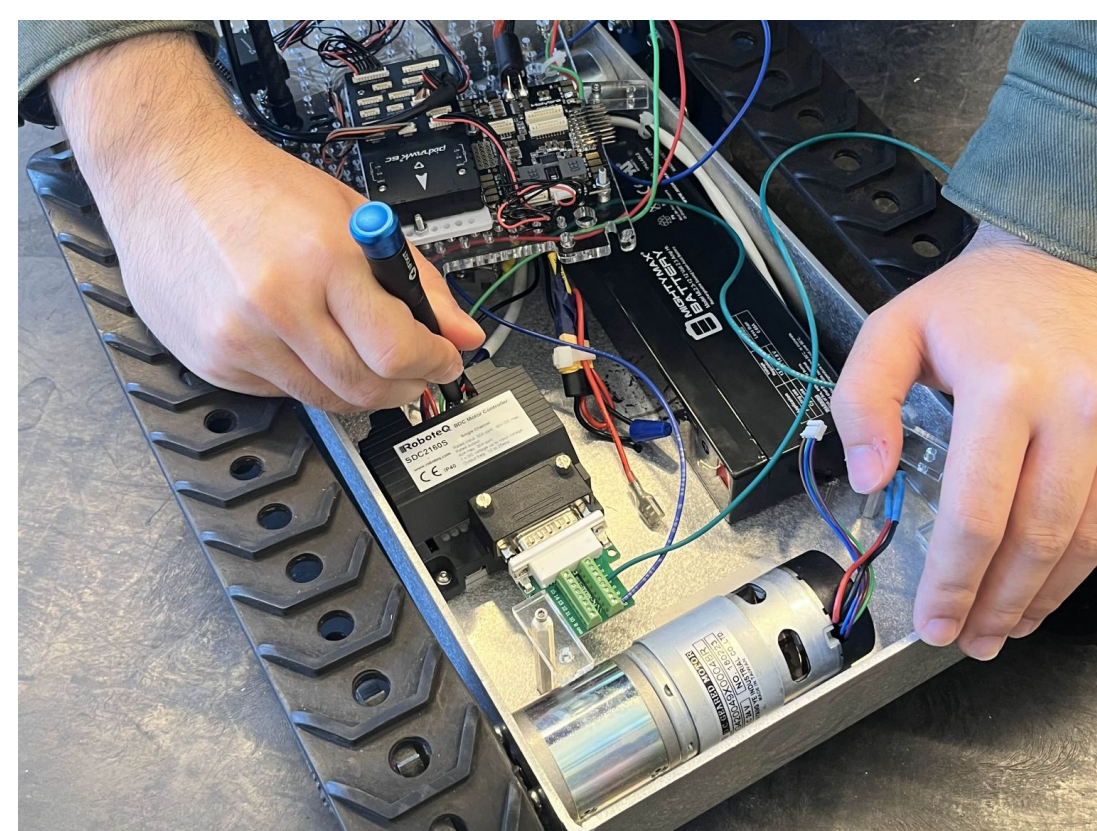- Fetch robot was inactive and was not able to be controlled.

Goals:

- Improve Roo's control system for greater reliability and robustness.
- Establish functional control of the Fetch robot.

Applications

Education:
- Teaches students fundamentals of terrestrial rover design and control.
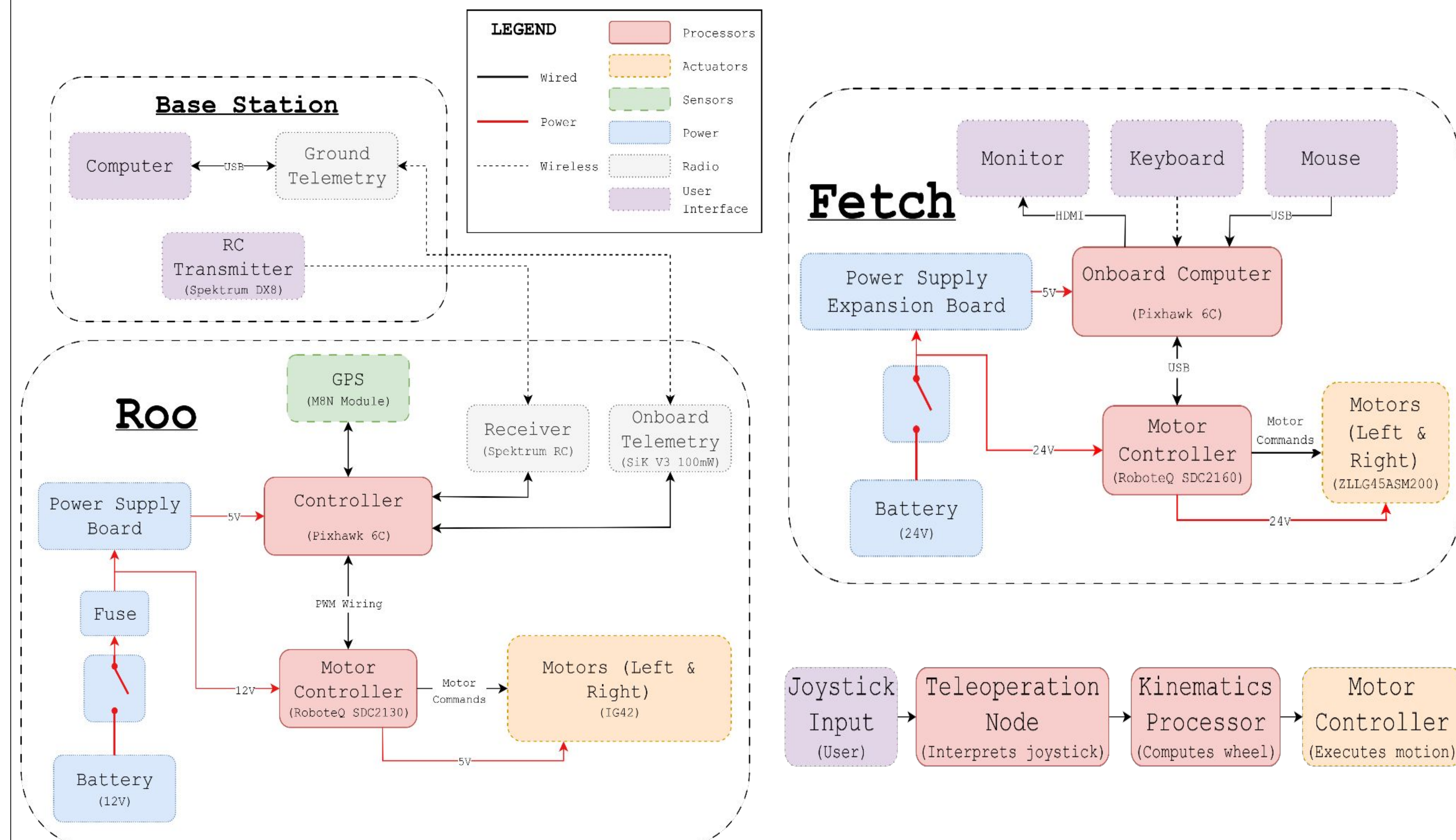- Designed to be accessible with minimal coding knowledge.

Public Safety
- Can scout hazardous or inaccessible areas before humans enter.

Testing and Research
- Serves as a general-purpose rover base for tasks humans cannot easily perform.

Project Design

LEGEND

Pink	Processors
Orange (dashed)	Actuators
Green (dashed)	Sensors
Blue	Power
Purple	User Interface
Black line	Wired
Red line	Power
Dotted line	Wireless
Dashed line	Radio

Base Station — Computer, Ground Telemetry, RC Transmitter (Spektrum DX8)

Roo — GPS (M8N Module), Receiver (Spektrum RC), Onboard Telemetry (SiK V3 100mW), Power Supply Board, Controller (Pixhawk 6C), Fuse, Motor Controller (RoboteQ SDC2130), Motors (Left & Right) (IG42), Battery (12V), PWM Wiring

Fetch — Monitor, Keyboard, Mouse, Power Supply Expansion Board, Onboard Computer (Pixhawk 6C), Motor Controller (RoboteQ SDC2160), Motors (Left & Right) (ZLLG45ASM200), Battery (24V)

Joystick Input (User) → Teleoperation Node (Interprets joystick) → Kinematics Processor (Computes wheel) → Motor Controller (Executes motion)

- Recalibrate Roo controllers.
- Standardize units by rebuilding wiring/control systems.
- Design and build protective casing to mitigate damage from external elements.

- Install RoboteQ motor controller.
- Replace Fetch control board with Raspberry Pi 5.
- Upgrade battery system with Lead Acid batteries.
- Rewire robot and document internals.

Outcomes

- Achieved full manual control of two Roo robots via remote controller and started putting together third Roo.
- Enabled Roo to interpret and execute autonomous navigation commands.
- Designed and built a protective enclosure for Roo.
- Demonstrated successful operation of Fetch's wheels under sensorless, no-load conditions.
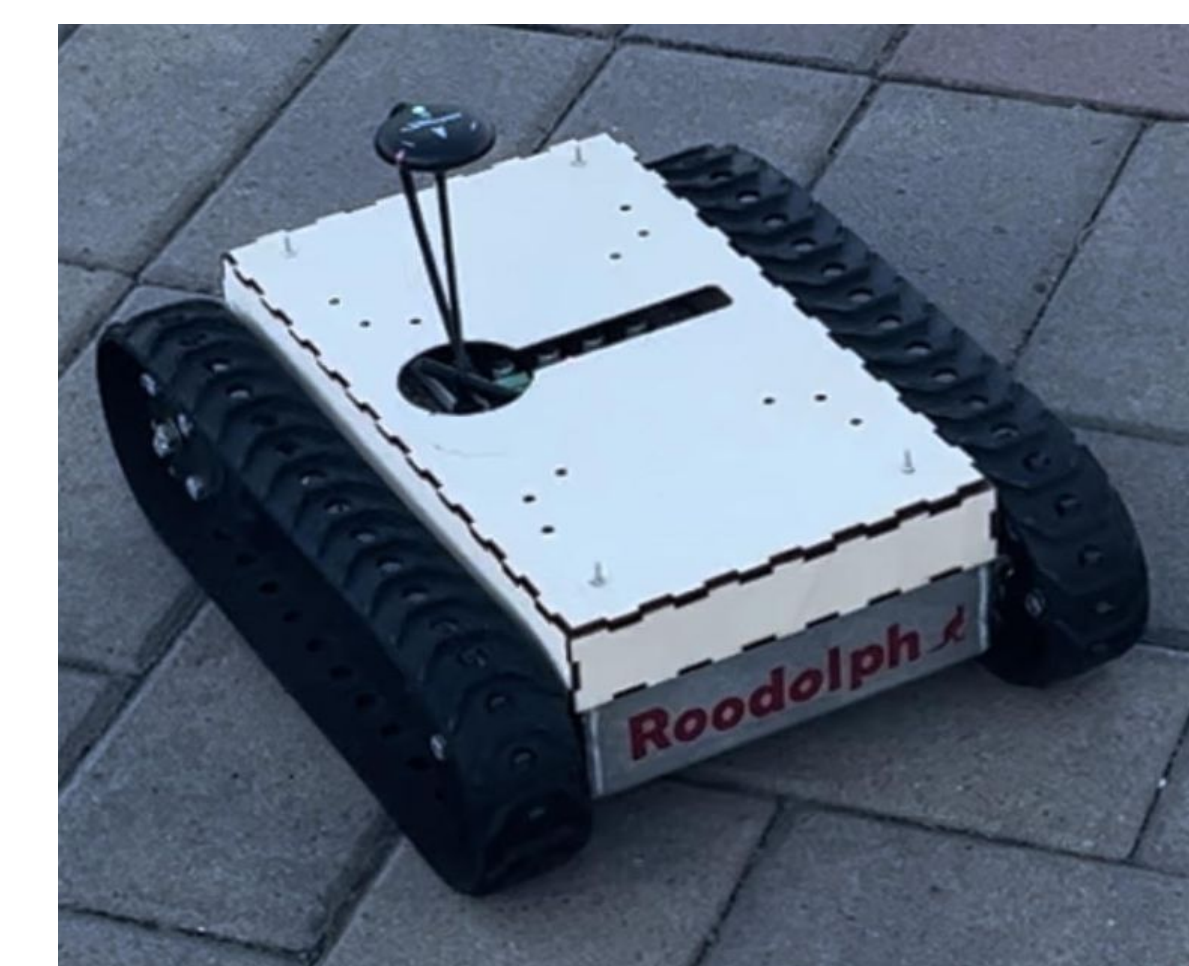
Challenges

- Faced a steep learning curve with Pixhawk, ROS, and autonomous systems.
- Encountered extensive hardware and electrical issues during motor calibration and wiring.
- Dealt with Pixhawk firmware incompatibilities that required downgrading.

Next Steps

- Fine-tune Roo's motors for precise autonomous navigation.
- Add brackets to further secure Roo's protective casing.
- Complete wiring third unfinished Roo robot.
- Enhance Fetch's motor torque & utilize encoders to reliably move the full robot base.

Acknowledgements