

HomeRover

Reach beyond your limits.

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Use Case Requirements

User Experience

- Roundtrip transmission < **100 ms**
- User-side latency < **20 ms**
- RPi screen displays camera footage
- Directional control keypad
- Min. battery life **1 hour**

Rover Capabilities

- Motor latency < **20 ms**
- Suction claw latency < **20 ms**
- Carpet, hardwood and tile capability
- Cost < **\$450**
- Min. battery life **1 hour**

Autonomous Item Detection/Pickup

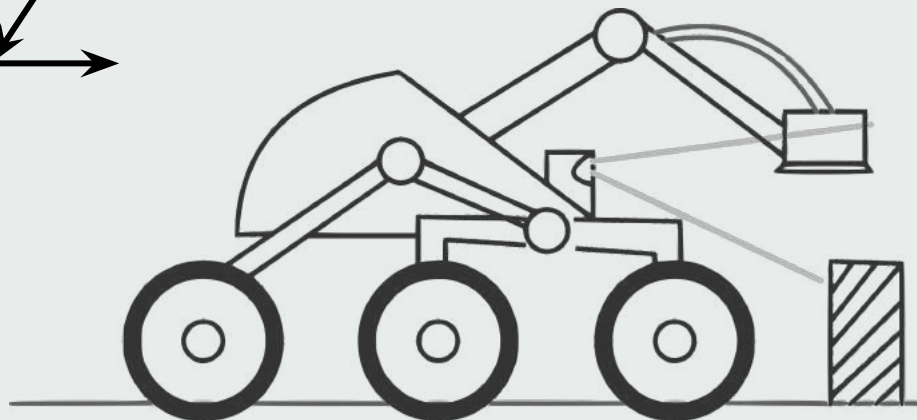
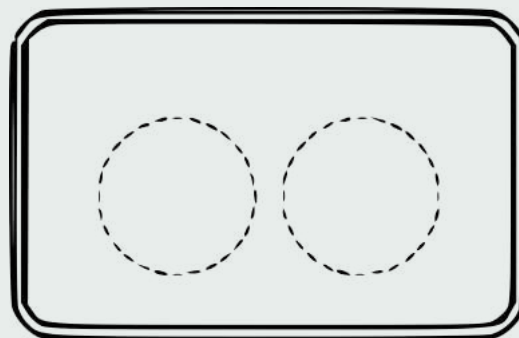
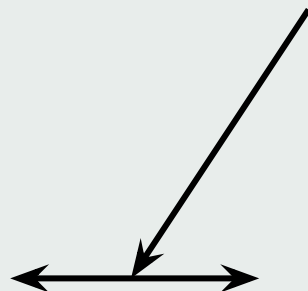
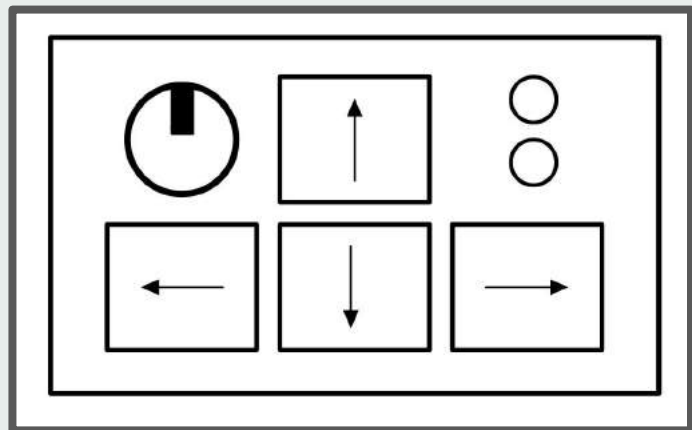
- **80%** pick up accuracy
- Detection range **30 cm**, pickup in **10 sec**
- Suction capable of lifting **700 grams**

Safety Considerations

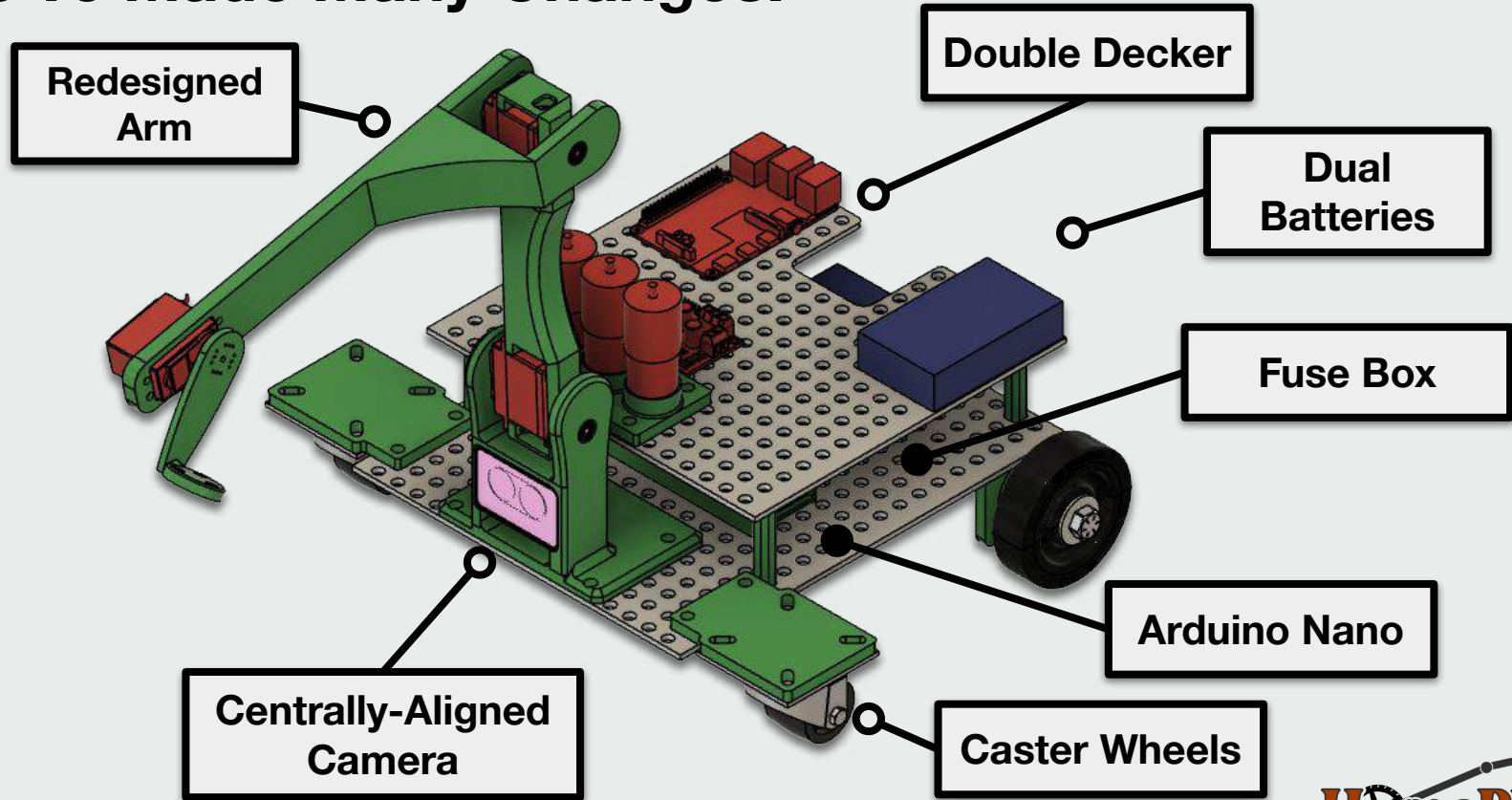
- Durable and safe materials
- System can withstand spills
- Robot must move at safe household speeds < **0.50 m/s**



Solution Approach



We've Made Many Changes.



Changes - continued.

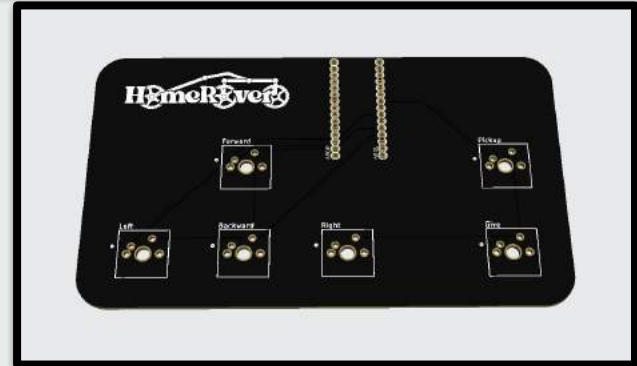
User-Side Controller

- Implemented Serial using an Arduino Nano
- Python Code for Serial and Sockets to communicate with rover wirelessly
- Portable Charger for Safety
- No longer embedded monitor with controller
 - Monitor Assembly with battery and RPi
 - External Controller PCB connected via USB

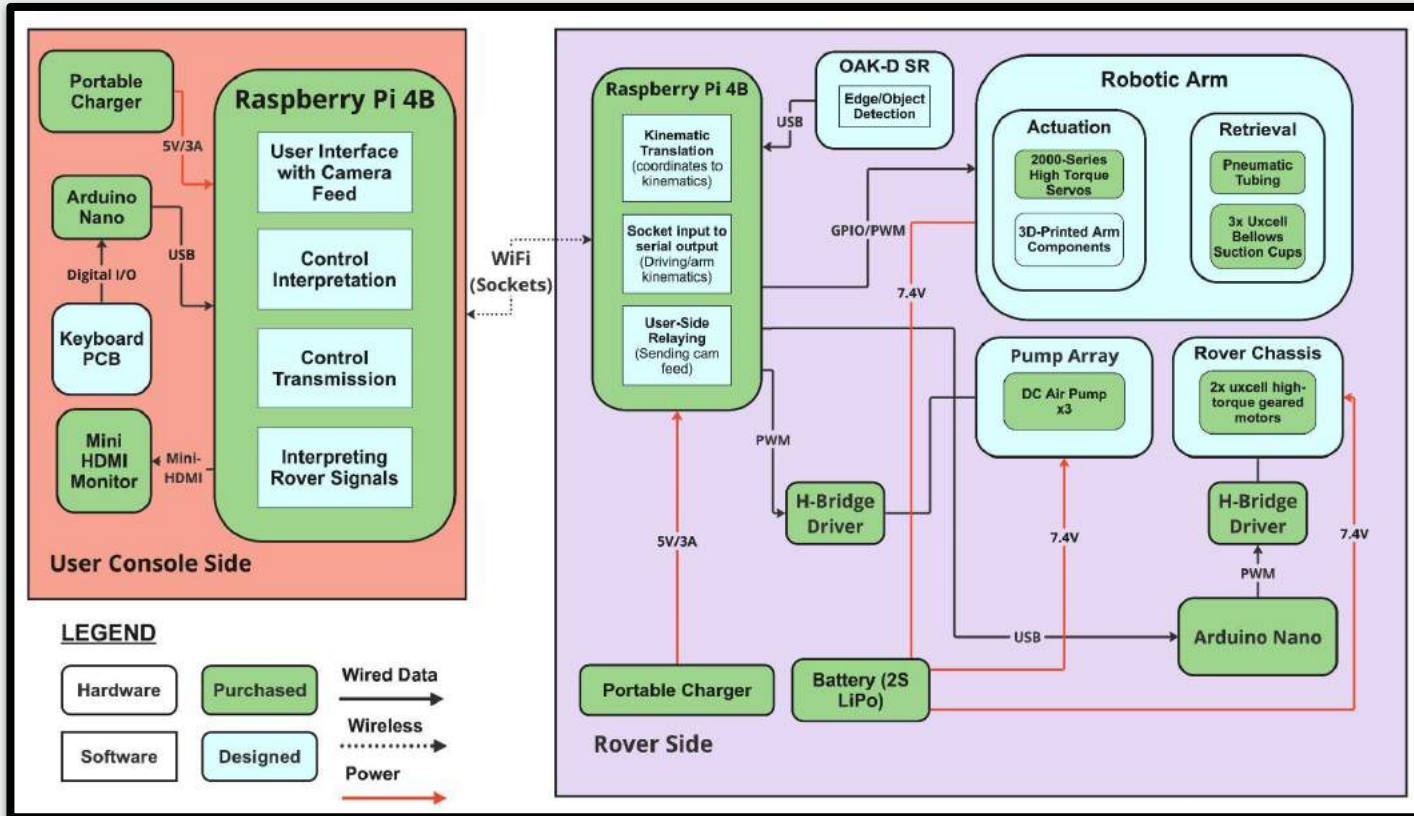
```
import socket
import serial
import time

HOST = "172.26.188.5" # The server's hostname or IP address
PORT = 65432 # The port used by the server

with socket.socket(socket.AF_INET, socket.SOCK_STREAM) as s:
    s.connect((HOST, PORT))
    while(1):
        ser = serial.Serial("/dev/cu.usbmodem21101")
        ser.baudrate = 9600
        s1 = ser.read(1)
```



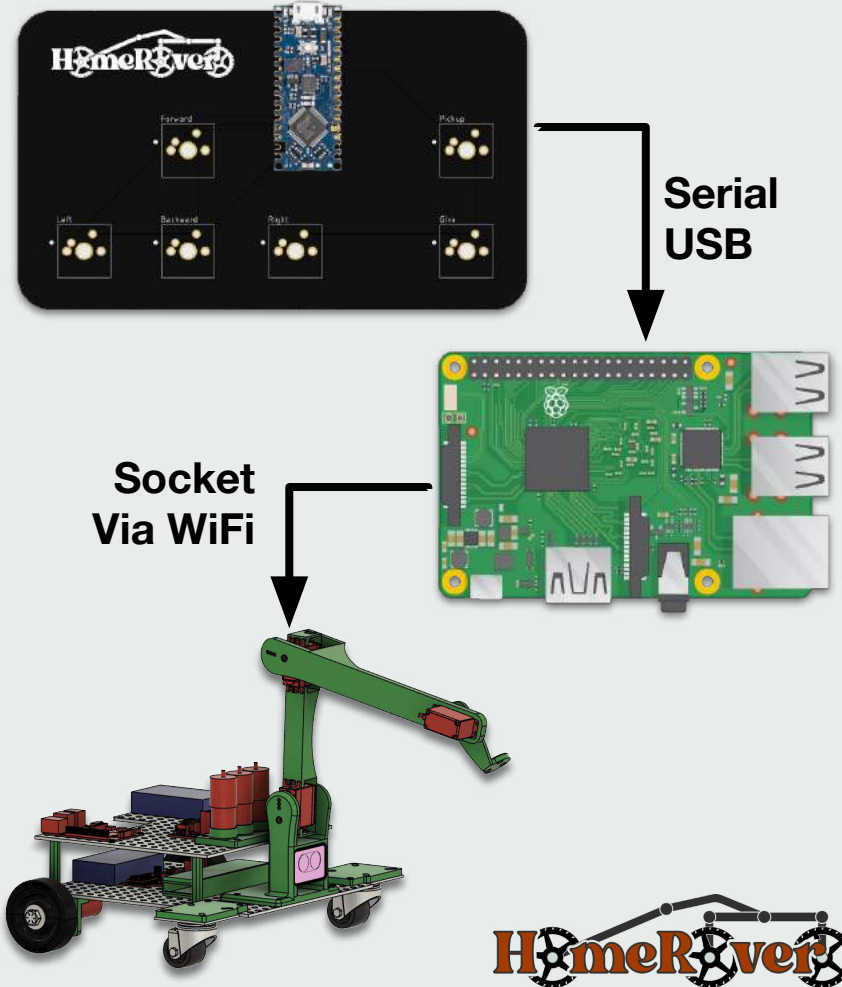
System Specification / Block Diagram:



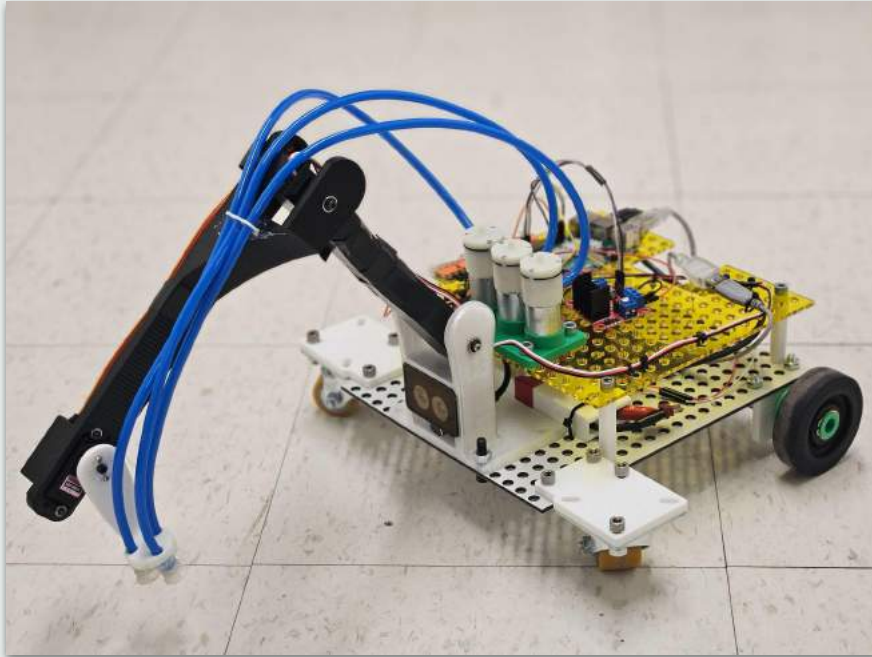
What We'll Have: (User-Side)



HomeRover Control Suite



What We'll Have: (Rover-Side)



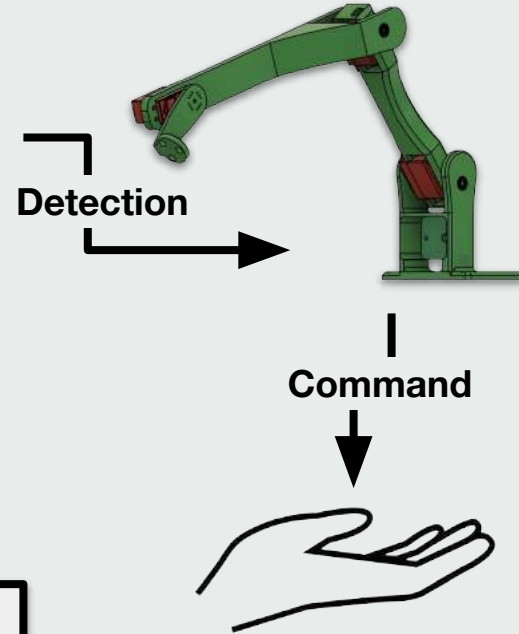
HomeRover



Roving

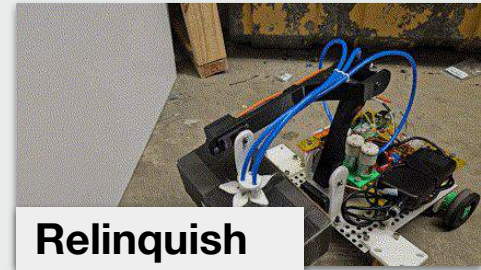
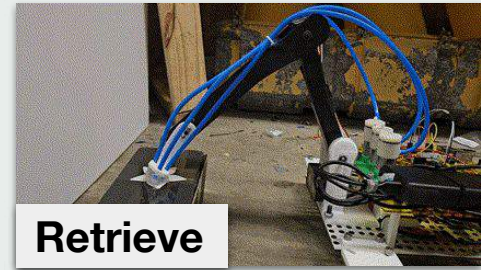
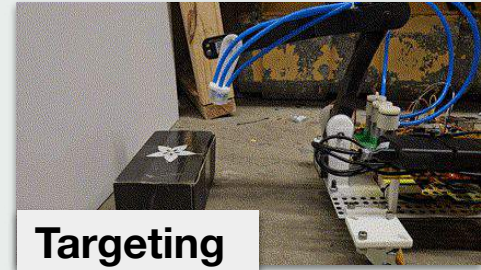
Retrieving

Relinquishing



Validation for the Use Case

User Experience	Transmission Latency: Measure inter-RPi data transmission delay with sim'd time. Control Center Latency: Record time between button press and RPi recognition using high frame-rate video
Autonomous Item Detection/Pickup	Accuracy: Multiple trials, measuring % of first-time pickup success Suction: Verify lifting of objects with different weights
Rover Capabilities	Motor/Suction Latency: Measure delay between RPi signaling and motor/servo response using high frame-rate video
Safety Considerations	Speed: Measure distance/time under normal operating conditions Safety: Responsible cable management, adequate height standoffs



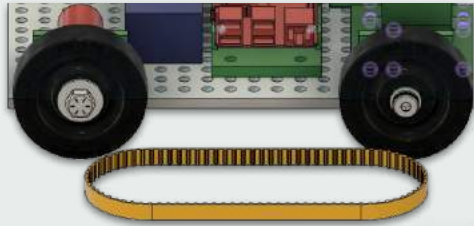
Testing HomeRover Against its Requirements:

User Side			Rover Side		
Specification	Requirement	Test Results	Specification	Requirement	Test Results
Transmission Latency	< 100 ms	~15 ms	Pick up weight	700 grams	600g @ 5V
Control Center Latency	< 20 ms	~10 ms	Pick up accuracy	> 80%	~60%
Battery life	> 1 hour	1.25 hours active	Item detection and pickup range	30 cm - 1m	33 cm
Cost	< \$450	\$544.19	Driving speed	< 0.5 m/s	~0.238 m/s
Video Feedback	Available	Not Fully	Rover Latency	< 20 ms	~10 ms



Some Important Trade-Offs Were Made.

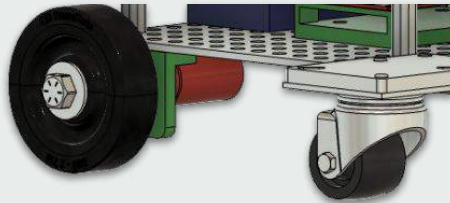
Tank Drive Vs Caster Wheels



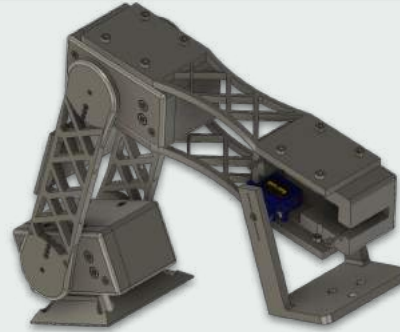
**Encoder
Feedback**

VS

**Smooth
Turning**



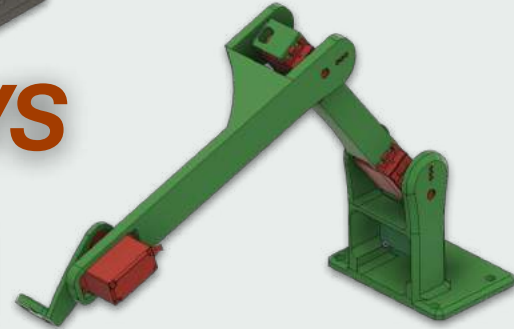
Multi-Arm Vs Simple Arm



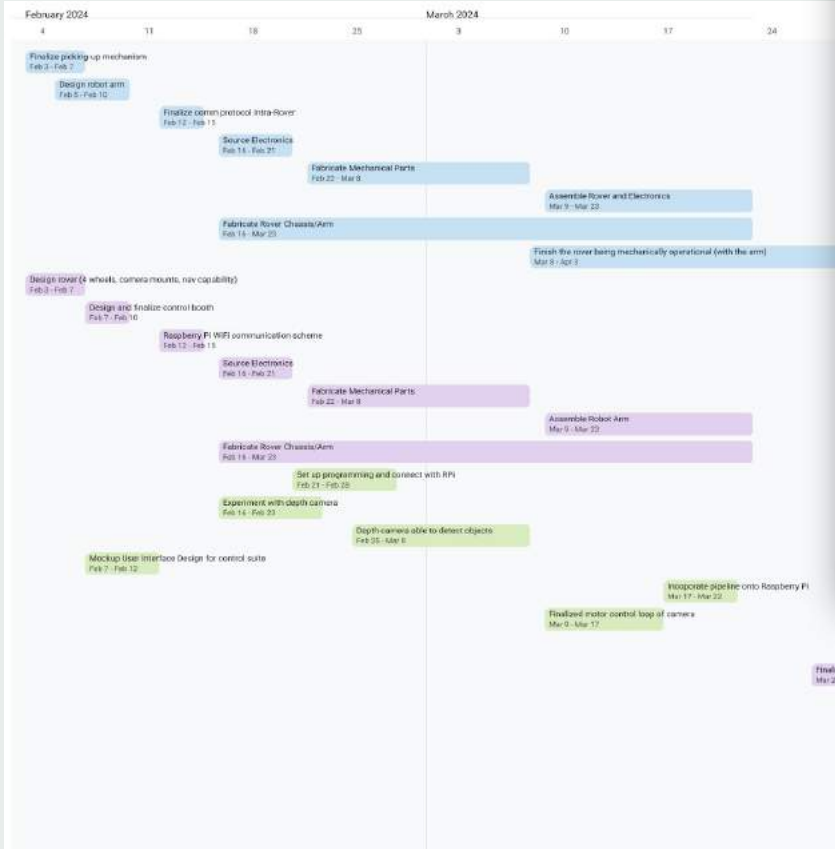
Modularity

VS

Simplicity



Project Management



Remaining Work

Implement the kinematics with the Rover
Apr 8 - Apr 15

Finetune the kinematics
Apr 15 - May 3

Finalize the control PCB
Apr 22 - May 3

Video feed on the mini monitor
Apr 22 - May 3

Finish incorporating camera data
Mar 20 - Apr 1

Tweaking a kinematics scheme
Mar 27 - Apr 9

Implement the kinematics with the Rover
Apr 9 - Apr 15

Finish the kinematics
Apr 15 - May 3

Finalize the control PCB
Apr 22 - May 3

Video feed on the mini monitor
Apr 22 - May 3

