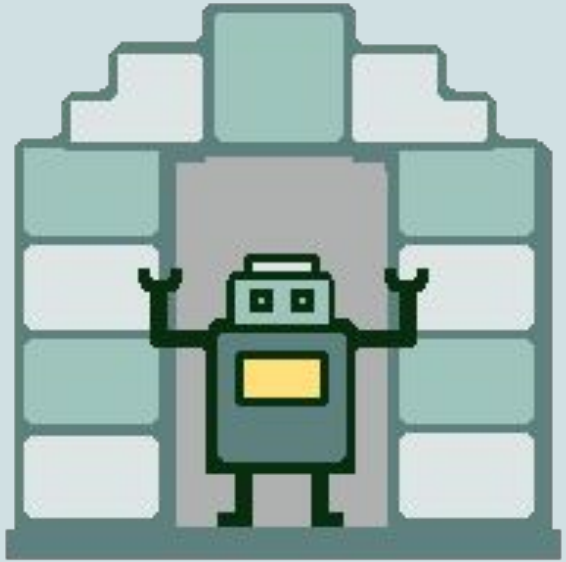
Robot-Assisted Tours

Keystone Robotics



Introduction

- Computer Science Team
  - Hailey Ginther - Team Lead, Client Liaison
  - Shannon Washburn - Code Architect
- Electrical Engineering Team
  - Gabrielle Halopka - Recorder
  - Falon Ortega - Hardware Design Manager
- Mentor - Austin Sanders
- Client - Dr. Michael Leverington
  - Faculty member and Lecturer in NAU's School of Informatics, Computing, and Cyber Systems

Problem Statement

- Primary Problem: Building a robotics project foundation for future students
- Motivation: Build a robot that can give tours of the engineering building
- Typically ~$2,000-$8,000

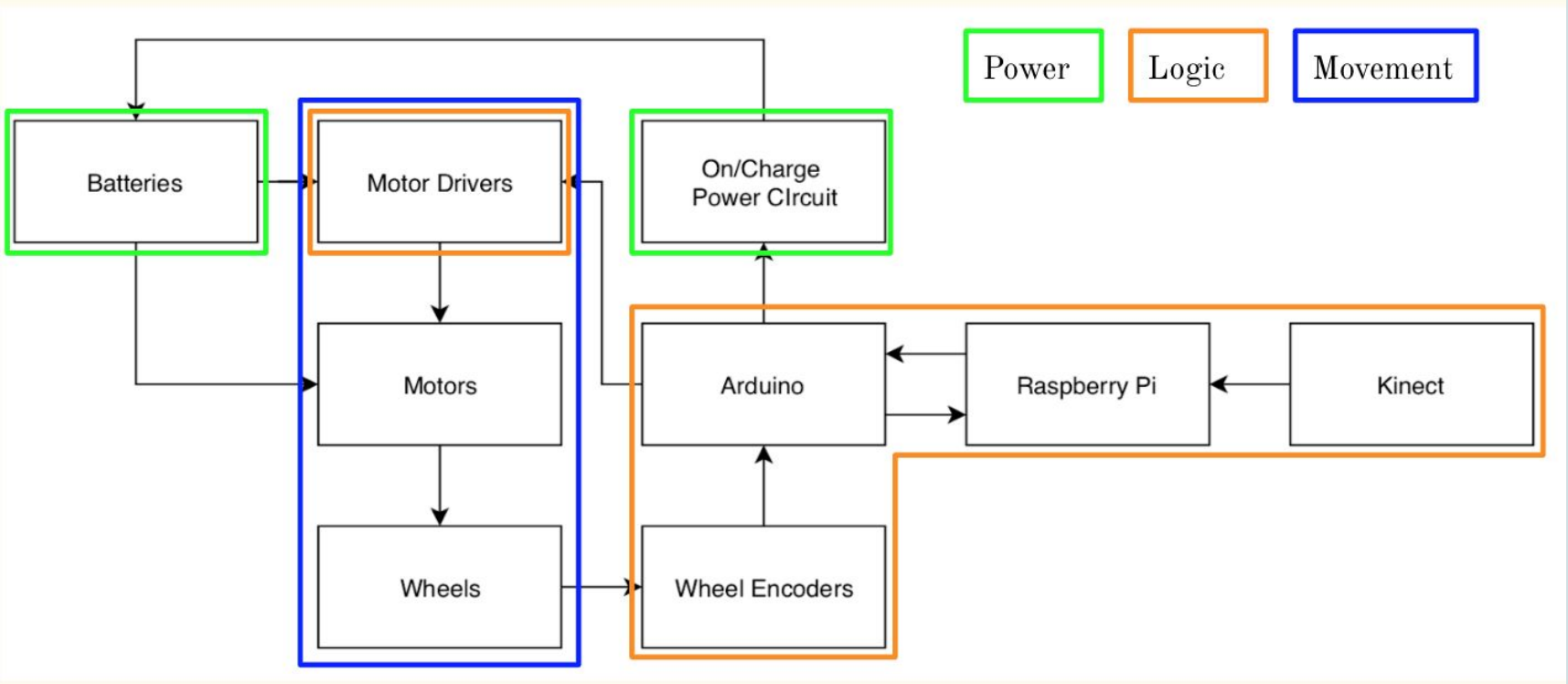
Solution Overview

- Construct a robot that can move around the building with user input
- Documentation of the process
  - Paper trail for other students to follow
- Integratable parts
  - Other projects can be derived from ours
- Cost effective parts

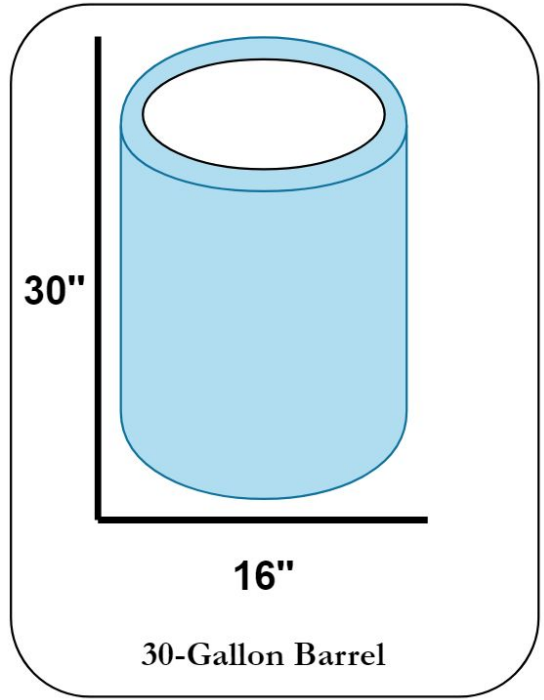
Requirements Overview

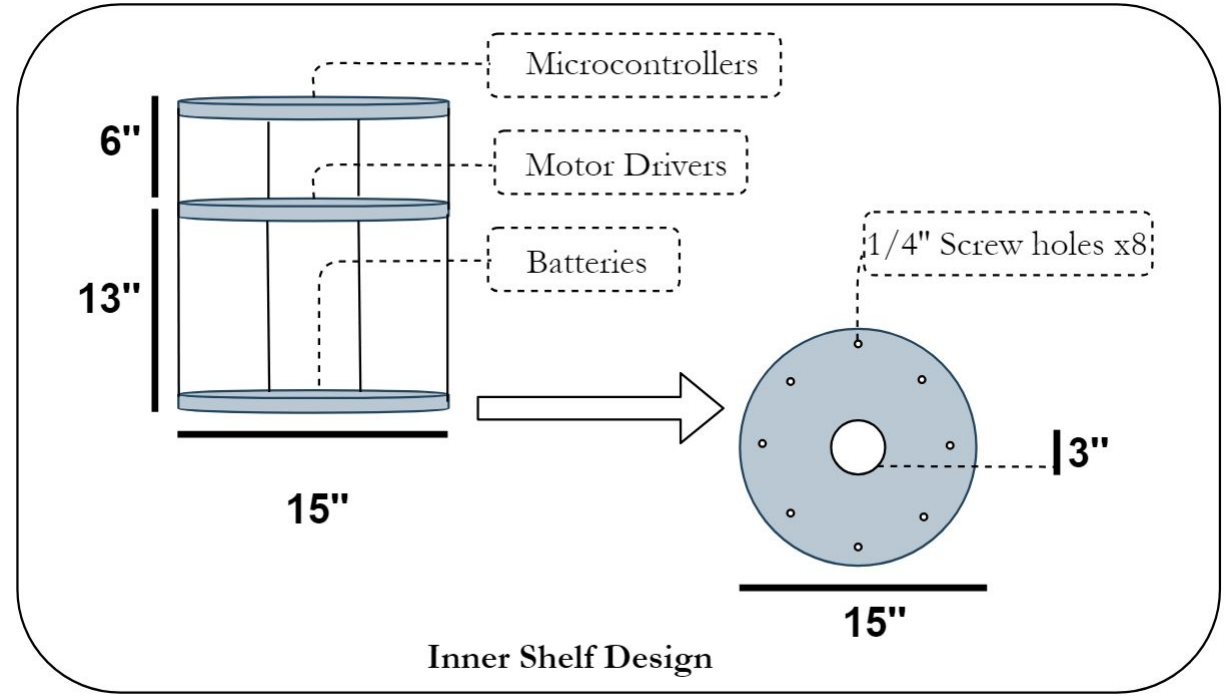
- Will be capable of basic mobility
- Will be expandable to future projects
- Will operate safely
- Will be modifiable for a technical end user

Architecture Overview

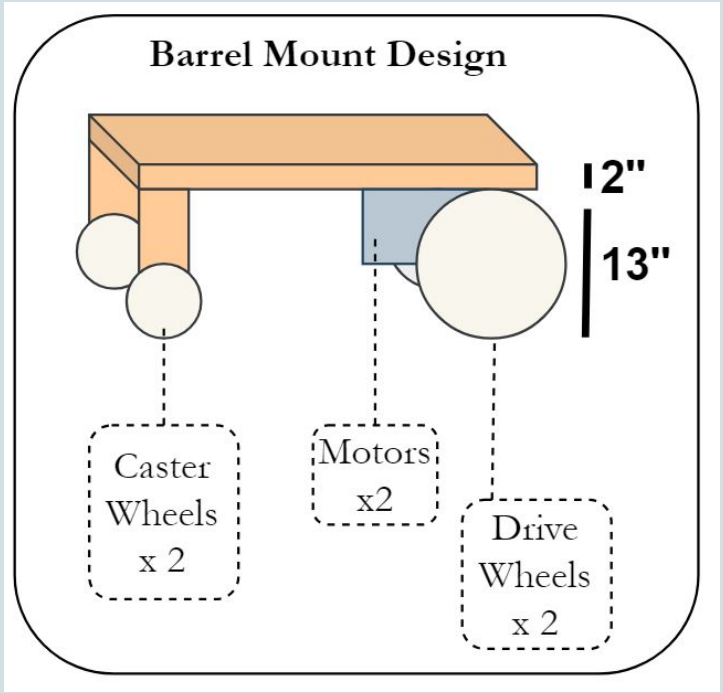


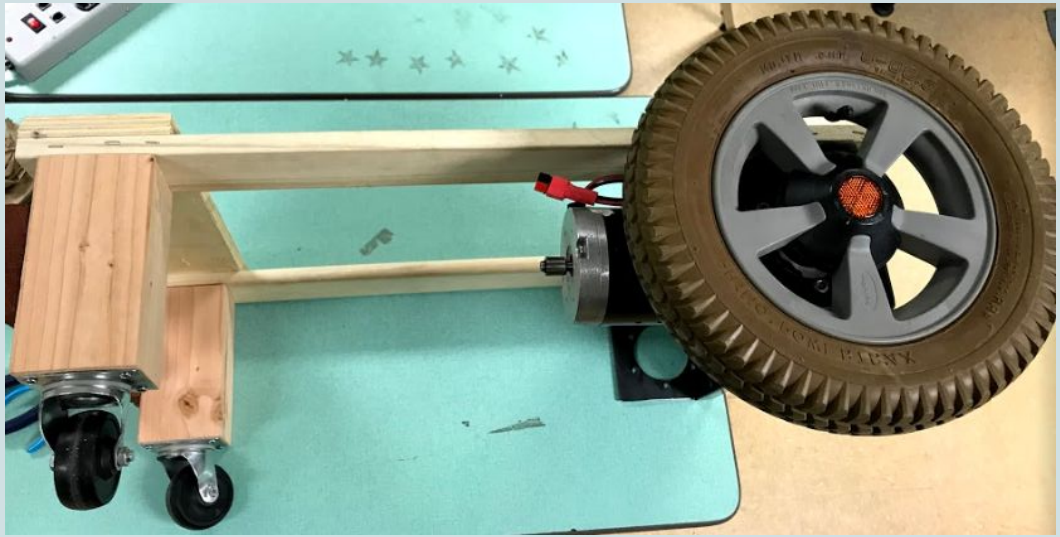
Architecture Overview





Architecture Overview

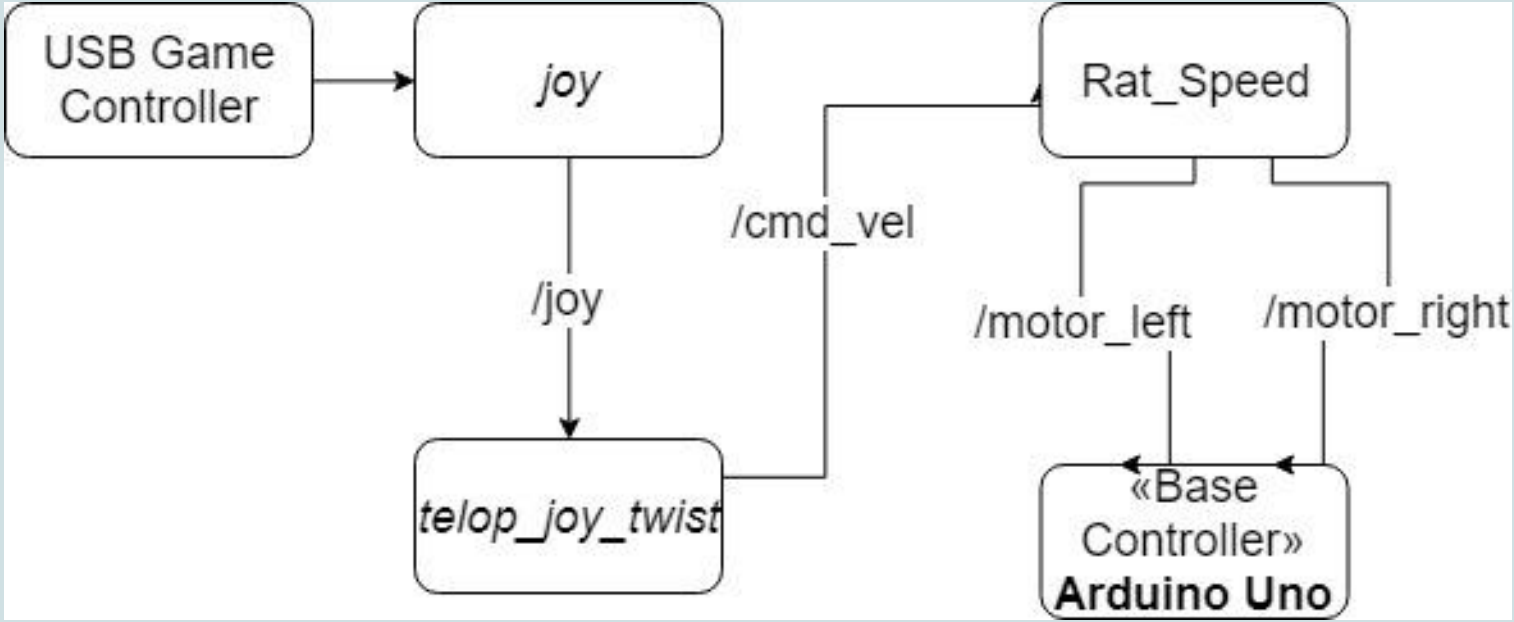




Implementation Overview - Software

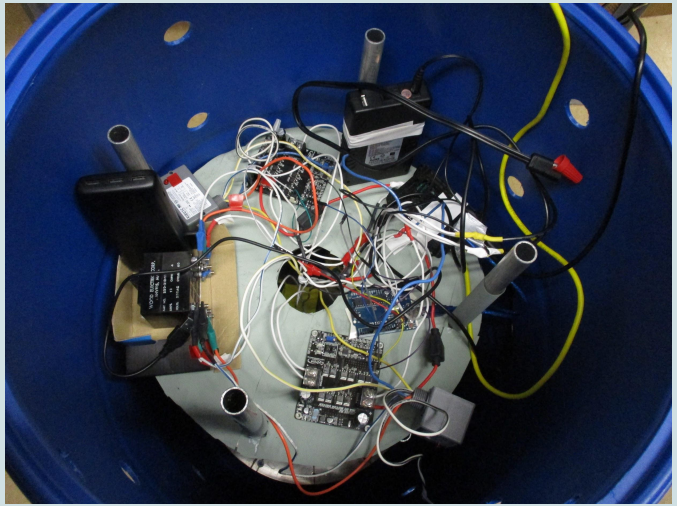
- ROS (Robot Operating System)
  - Framework for robotics applications
  - Provides tools to interface with sensor
  - Running on Raspberry Pi
- Arduino - Interfaces with motor drivers and wheel encoders
- Two Modes of Operation:
  - Manual Control via Joystick
  - Autonomous Navigation

Implementation Overview - Software



Manual Control Flow

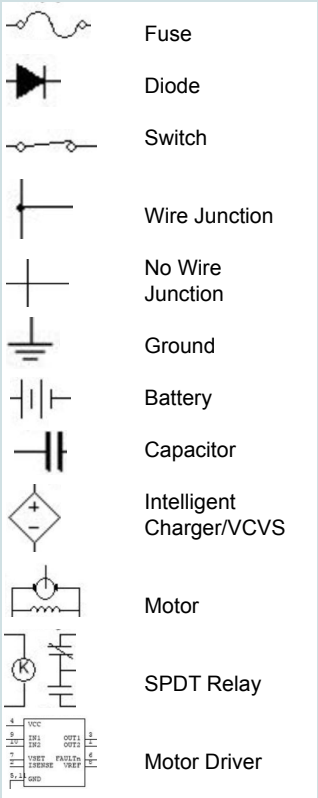
Implementation - Hardware

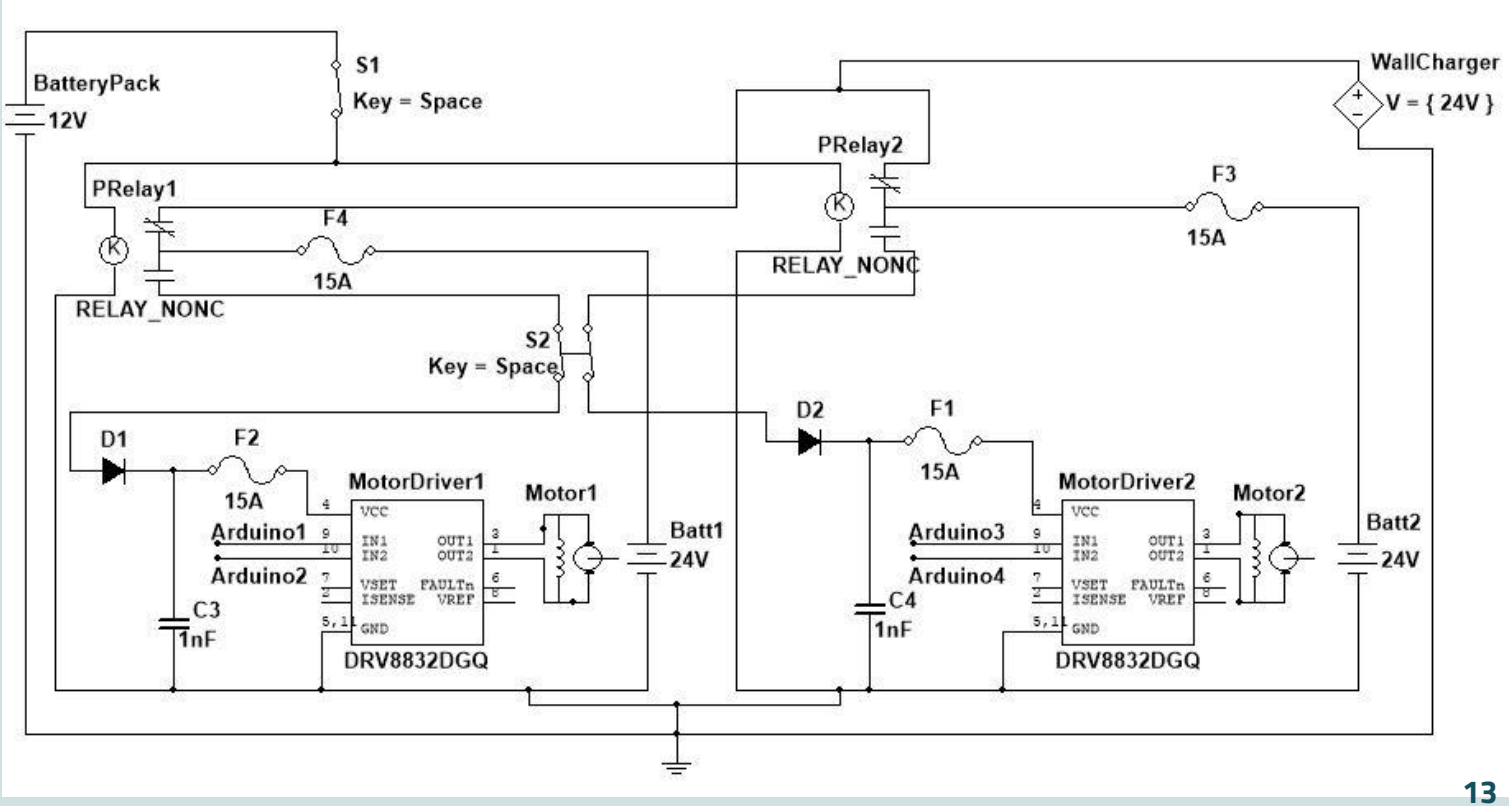


Implementation Overview - Circuitry

- Client requirements:
  - Off switch that cuts motors from batteries
  - Plug one wall plug in to charge batteries
  - Physical components don't overheat and malfunction
- On/Charge Circuit
  - Knife Switch, 3 in 1
  - SPDT Relays
  - Motor Drivers/H-bridges
  - Heat Sinks
  - Fuses

Implementation Overview - Circuitry





Prototype review

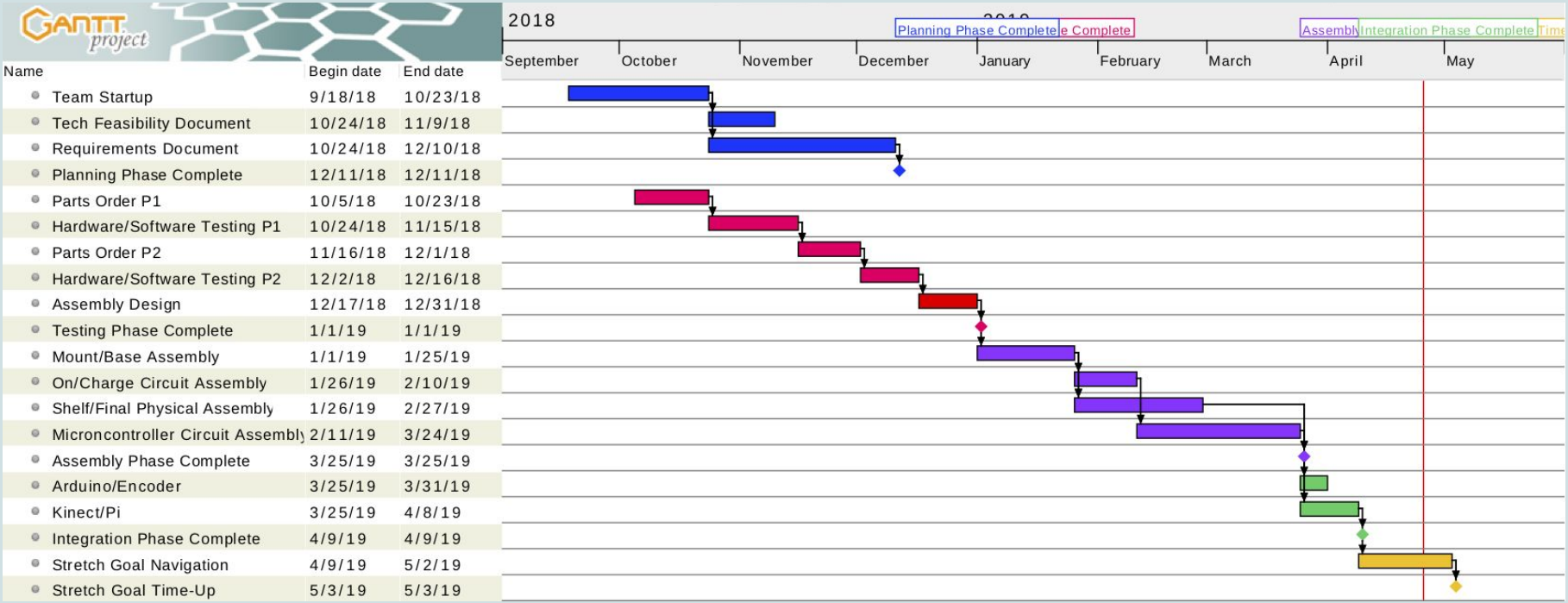
- Key features:
  - Differential motor control
  - Adjustable speed
  - Reverse driving

Video

Challenges and Resolutions

- Possible corrosive liquid in original barrel
- Precision needed in encoder installation underestimated
- Unexpected sensor data readings
- Intelligent Charger
- Fuses and Current Mitigation
- Part Integration

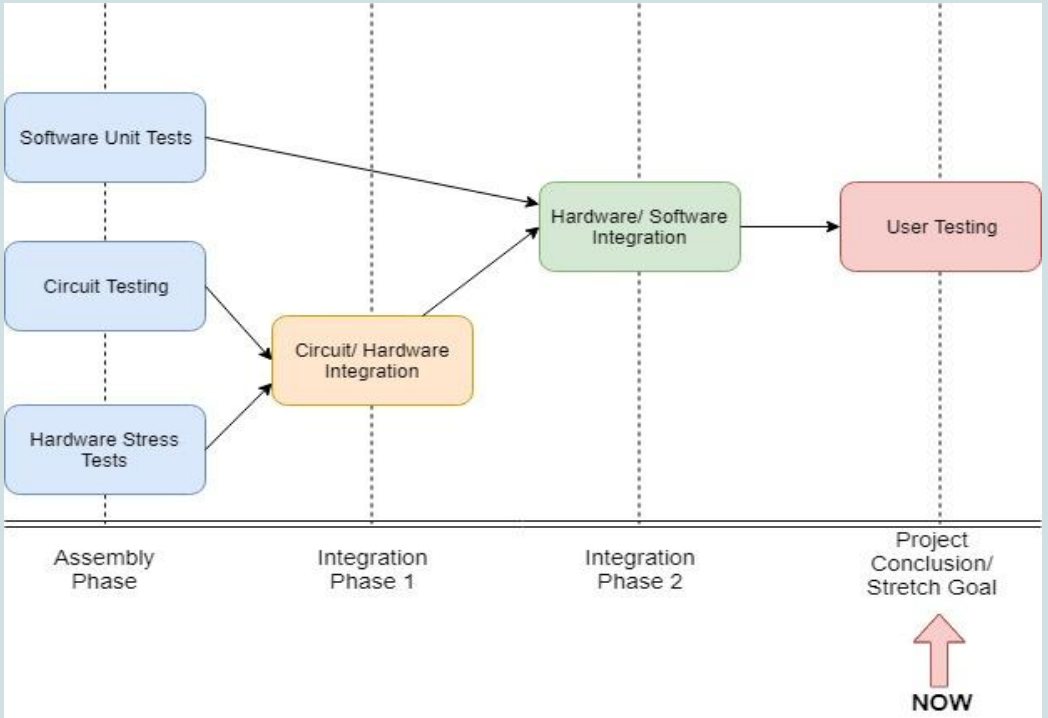
Scheduling



Name	Begin date	End date
Team Startup	9/18/18	10/23/18
Tech Feasibility Document	10/24/18	11/9/18
Requirements Document	10/24/18	12/10/18
Planning Phase Complete	12/11/18	12/11/18
Parts Order P1	10/5/18	10/23/18
Hardware/Software Testing P1	10/24/18	11/15/18
Parts Order P2	11/16/18	12/1/18
Hardware/Software Testing P2	12/2/18	12/16/18
Assembly Design	12/17/18	12/31/18
Testing Phase Complete	1/1/19	1/1/19
Mount/Base Assembly	1/1/19	1/25/19
On/Charge Circuit Assembly	1/26/19	2/10/19
Shelf/Final Physical Assembly	1/26/19	2/27/19
Microncontroller Circuit Assembly	2/11/19	3/24/19
Assembly Phase Complete	3/25/19	3/25/19
Arduino/Encoder	3/25/19	3/31/19
Kinect/Pi	3/25/19	4/8/19
Integration Phase Complete	4/9/19	4/9/19
Stretch Goal Navigation	4/9/19	5/2/19
Stretch Goal Time-Up	5/3/19	5/3/19

Each phase has a different color. The diamonds represent milestones, and the vertical red line indicates the current date.

Testing Plan

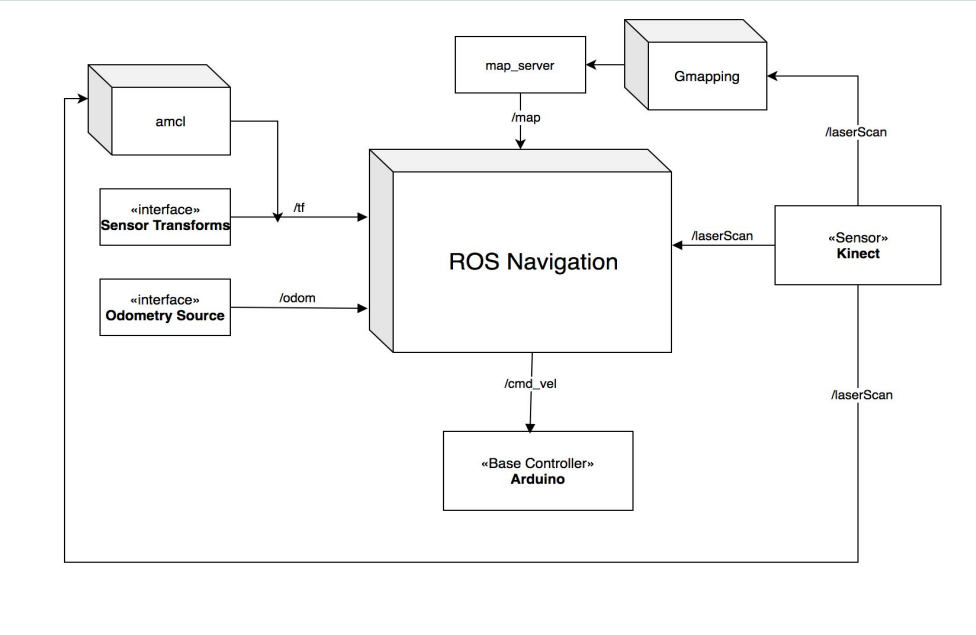


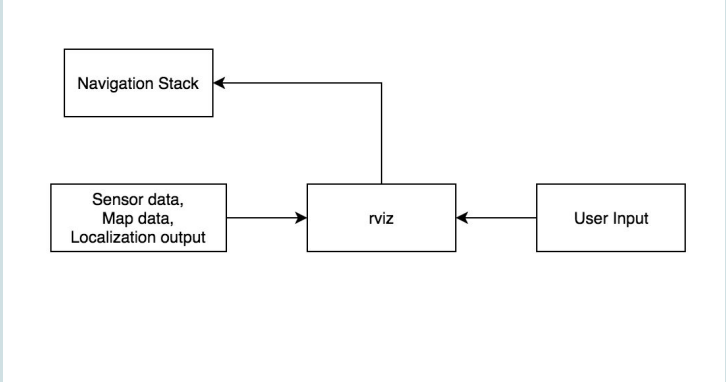
The team has implemented a number of unit tests on the software side and hardware side. Each function was tested in C++ , including a mock Arduino class used to test the Arduino code.

Future Work

- Autonomous navigation
- Providing a foundation for SICCS students
- Up to our client what direction future capstones take

Future Work





Autonomous Navigation Flows

Conclusion

- Problem
  - Need expandable, robotics platform
  - Idea stems from time-consuming tours at NAU Engineering Building
- Solution
  - Physical: dolly, motor mount, shelving
  - Electrical: on/charge circuit, heat sinks
  - Software: ROS, Microcontrollers
- End product cheaper than alternatives
- Client satisfied with product and excited for future capstone projects