Team Lead: Greg Bonnema
Mohammed Razzak

Electrical

Power Electronics

- Twin 3S LiPo batteries
- Resettable circuit breakers to prevent overcurrent
- Watt meters to measure energy usage for competition
- Switches: emergency stop, remote E-stop, ordinary power switch
- Solid-state relays (SSRs) to toggle power to the robot based on switches

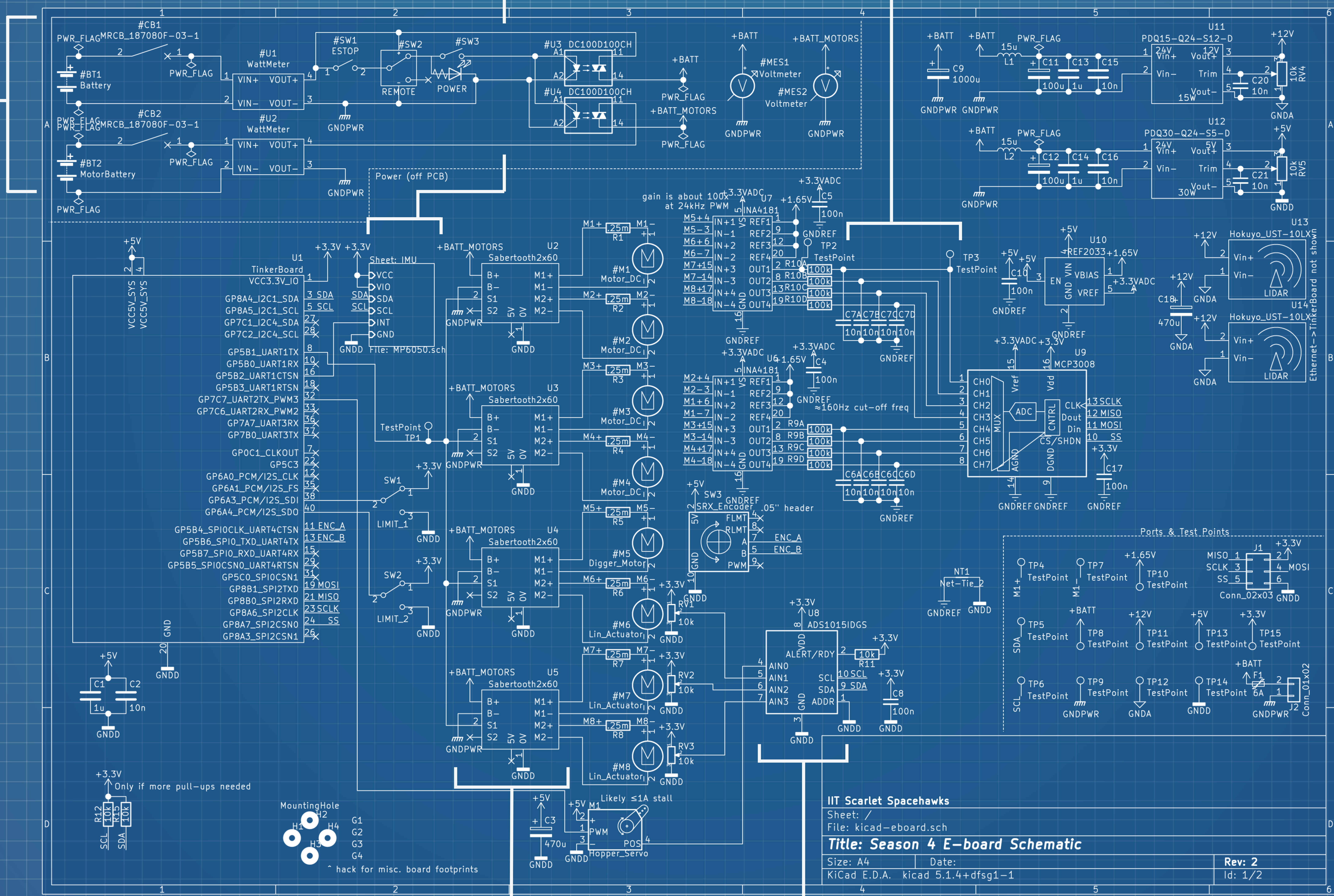
High current to stalled motors caused brownouts. A second battery prevented voltage sags to microelectronics.

Inertial Measurement Unit (IMU)

- Reports velocity and position in space
- Communicates via I2C
- Option to use MPU-6050 directly or use breakout board

Current Sensing

- Detect motor stalls, disconnects, performance
- Current sense amplifiers across 0.25mΩ shunts
- Filtering to remove 24kHz PWM
- ADC reads 8 motor channels



Motor Control

- Sabertooth 2x60 motor controllers
- 60A/motor continuous
- One-way serial comms
- Software closed-loop control

Unfortunately, Sabertooths return no information about motor output or power consumption. For closed-loop control, we added linear actuator position tracking, current sensing, and an encoder on the most critical motor.

Potentiometer ADC

- Three linear actuators, four-wire servo
- Raspberry Pi can't read analog inputs
- I2C ADC measures these voltages

Team Lead: Andrea de Fonseca
Jiyeoun Jang
Anil Kumar
Jordan Lauer

Mechanical

Hopper

- 6″ linear actuator to raise and lower depending on the location of the trench digger at any given time

- Allows for the easy deposit of regolith into the competition collection bin.

- Designed bending arm to allow actuator to pull hopper down even further, getting it closer to trench digger and creating an easier angle for regolith collection

- Beams are made of 1/4″ x 3/4″ aluminum with a 23-gauge wire with 1/4″ square mesh opening that allows any BP-1 to be released and regolith to remain

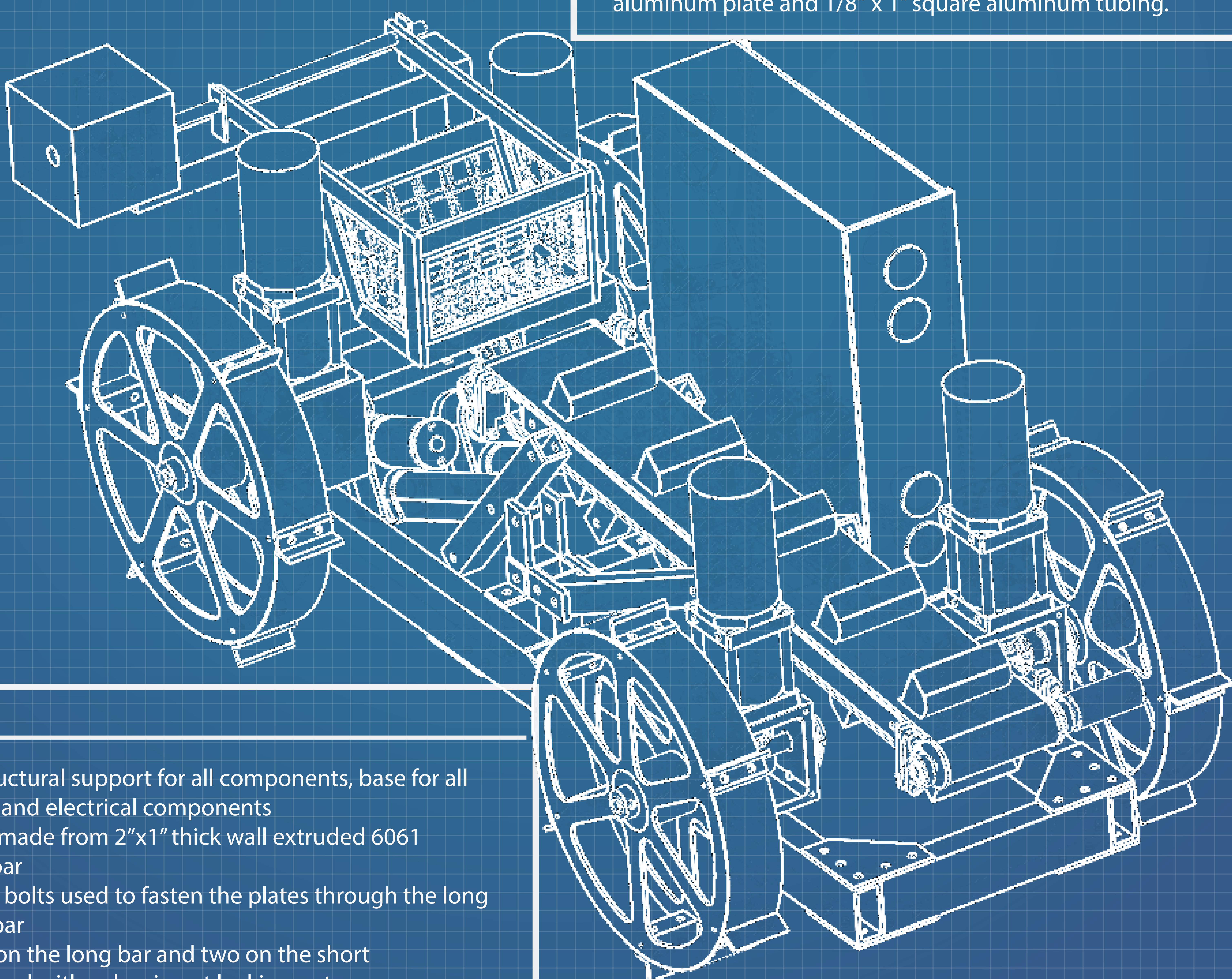
Trench Digger

- Belt and frame: Belt and frame from 2019 rover were reused, length reduced by 3cm to allow clearance between chassis and belt buckets.

- Rollers and mounting assemblies: Rollers and mounting assemblies from 2019 rover were reused. The BAG motor by VEX Robotics with a 1:50 planetary gearbox and encoder was utilized.

- Buckets: Designed with a height relative to belt of about 4cm, assuming a regolith average diameter of 2cm. Width of buckets set to match trench diggers. Also designed with slits on sides so BP-1 dust could be deflected as we dig.

- Linear actuators: Two-linkage linear actuator system allows constraint of diggers movement and get depth required for regolith extraction. Custom-fabricated mounting brackets designed for belt's supporting linkages. To simplify fabrication, bracket redesigned as an assembly of several pieces of 1/8″ aluminum plate and 1/8″ x 1″ square aluminum tubing.



Chassis

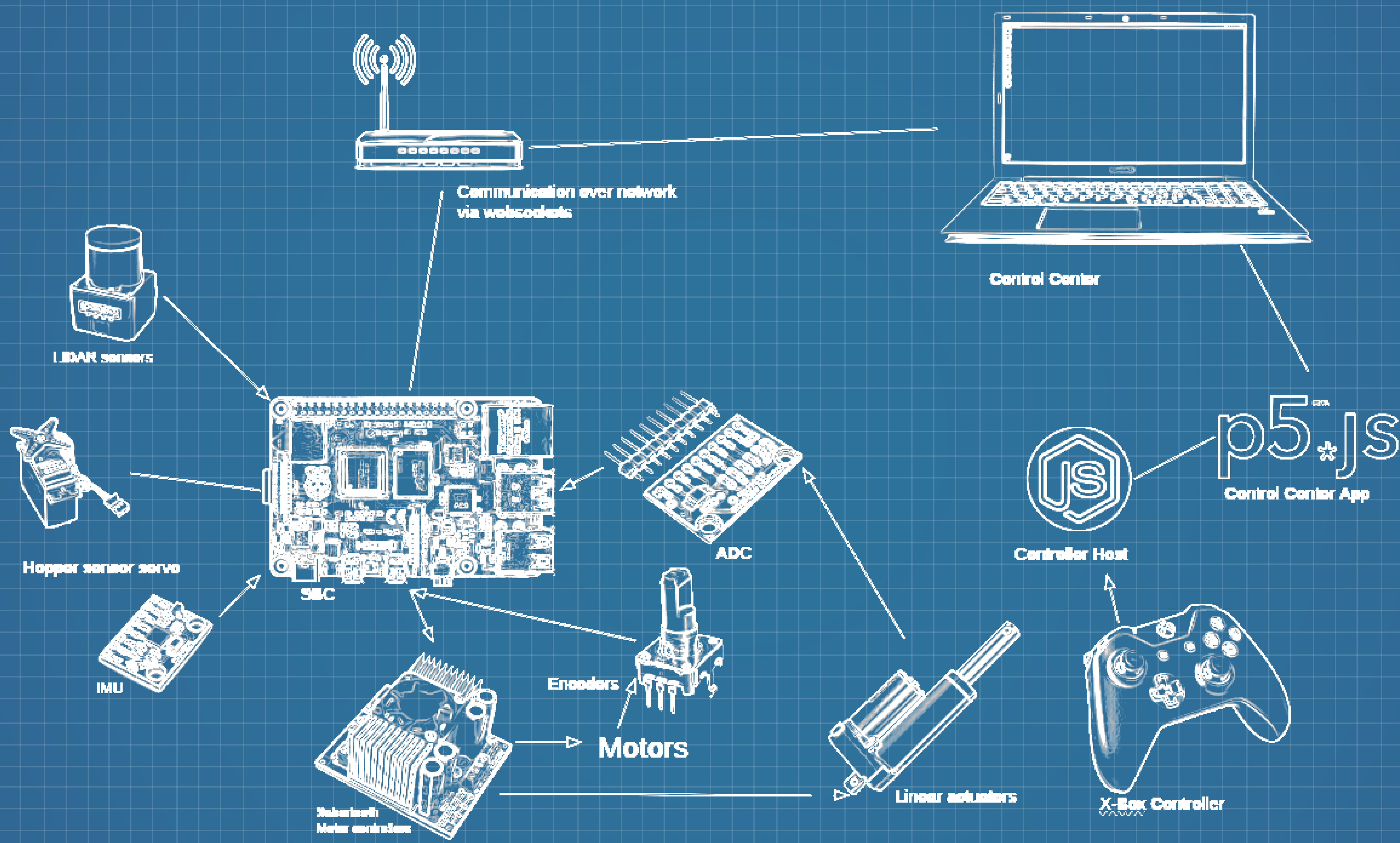
- Provides structural support for all components, base for all mechanical and electrical components
- Main frame made from 2″x1″ thick wall extruded 6061 aluminum bar
- ¼″ diameter bolts used to fasten the plates through the long side of the bar
- Three bolts on the long bar and two on the short
- Bolts tightened with nylon-insert locking nuts
- All mounted features used this mounting system
- Use of thick wall aluminum allowed fasteners to be tightened heavily without deforming the material

Team Lead: Cameron Haley
Eyob Ghebreiesus
Peter Kwiecinski

Programming

Software

- Frontend
- Xbox controller host
- Robot main program
- Motors module
- IMU module
- Vision module
- Kalman Filter Module



Scoops

Systems Engineer: Kristin Petersen

Outreach Coordinator: Daberechi Onyeacholem

Faculty Advisor: Dr. Mahesh Krishnamurthy

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