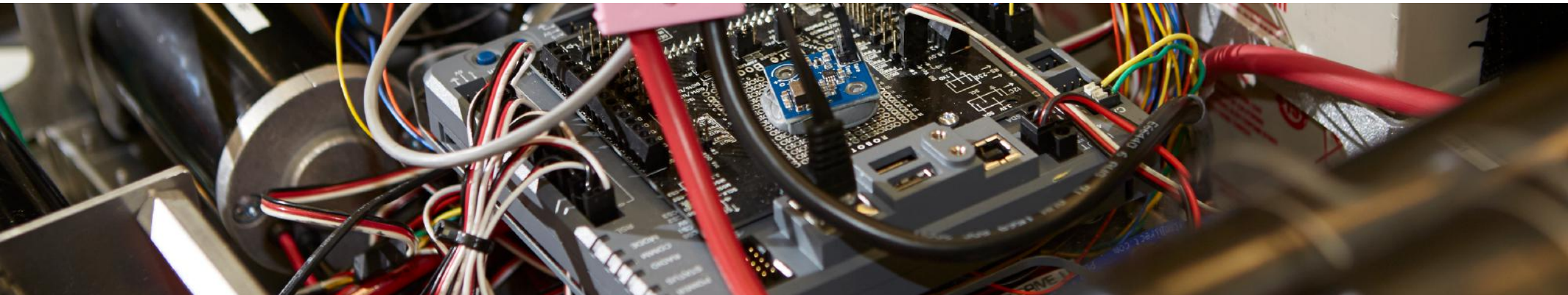


Heather Young & Kayleigh Marshall  
2056 Ways to Inspire Conference  
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# Electronics & Control System



# Heather Young

B.Eng., University of Guelph (2017)

Mechanical Design Engineer in Training,  
Trudell Medical International



Student 2007 – 2013  
Mentor 2014 – 2017

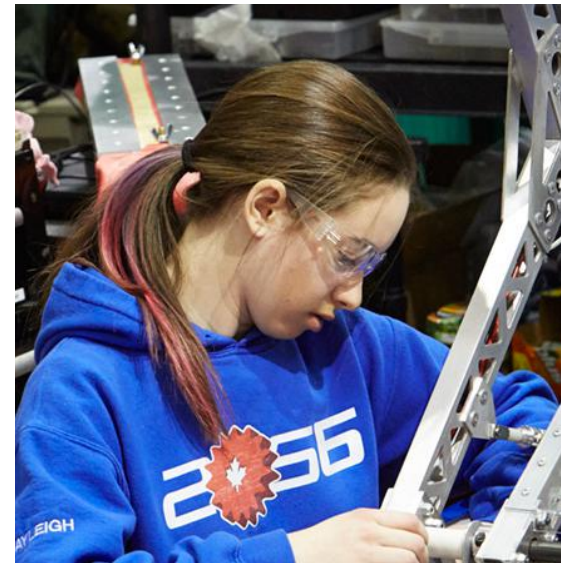


# Kayleigh Marshall

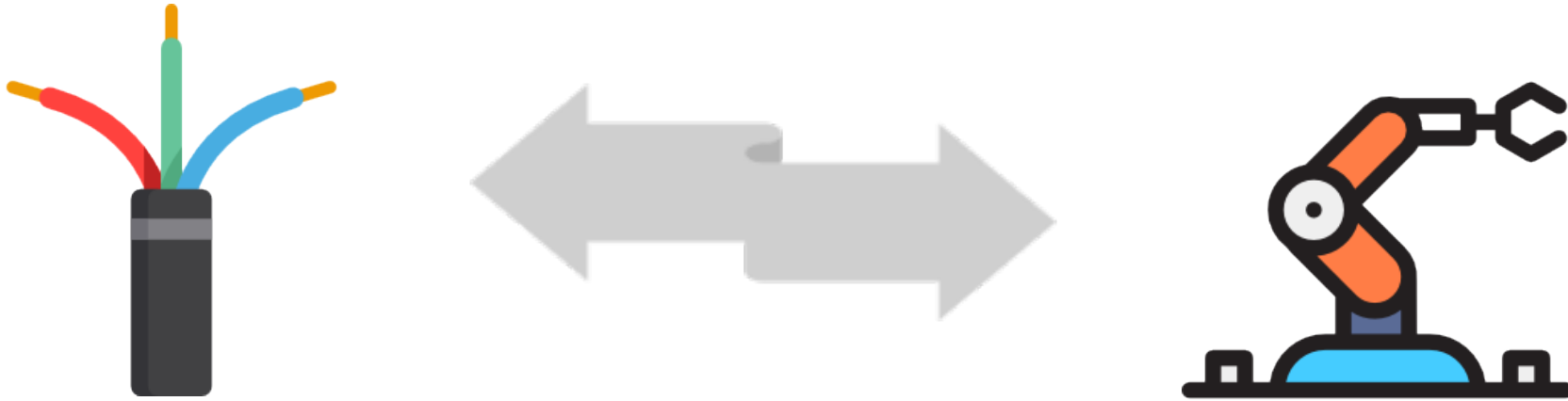
B.Eng. Candidate, Class of 2020  
McMaster University



Student 2012 – 2015  
Mentor 2016 – 2017



# FRC Robots

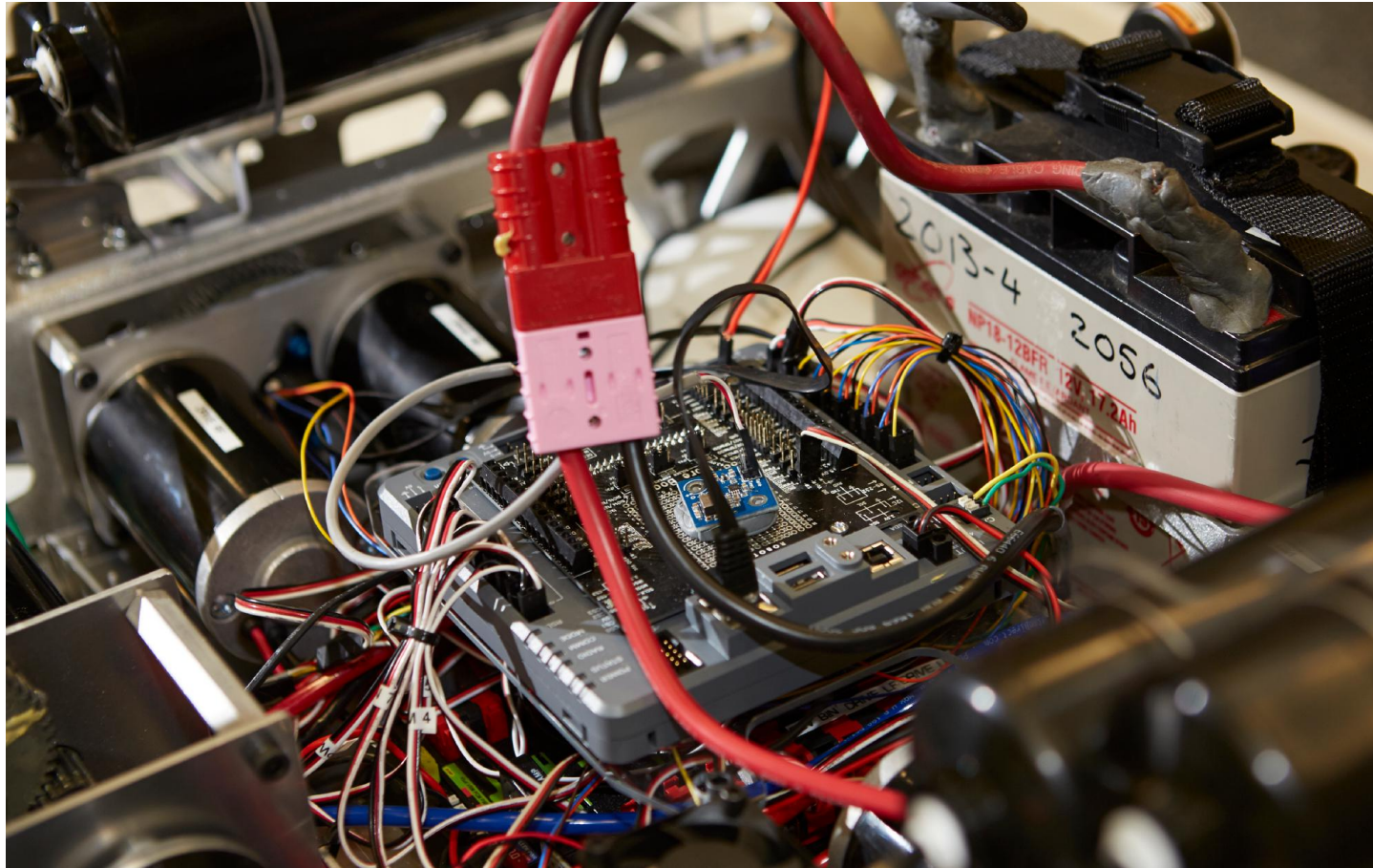


A cohesive robot system is required for mobility.

All mechanical designs rely on the electrical control system as support.



# Electrical Design



- ▶ Components
- ▶ Layout
- ▶ Tips and Tools
- ▶ Sensors

# Power Distribution Panel (PDP)



- Connections
- Can wires
- Fuses

# Voltage Regulator Module



- Converts voltage depending on where it needs to go
- Some components needs different voltages

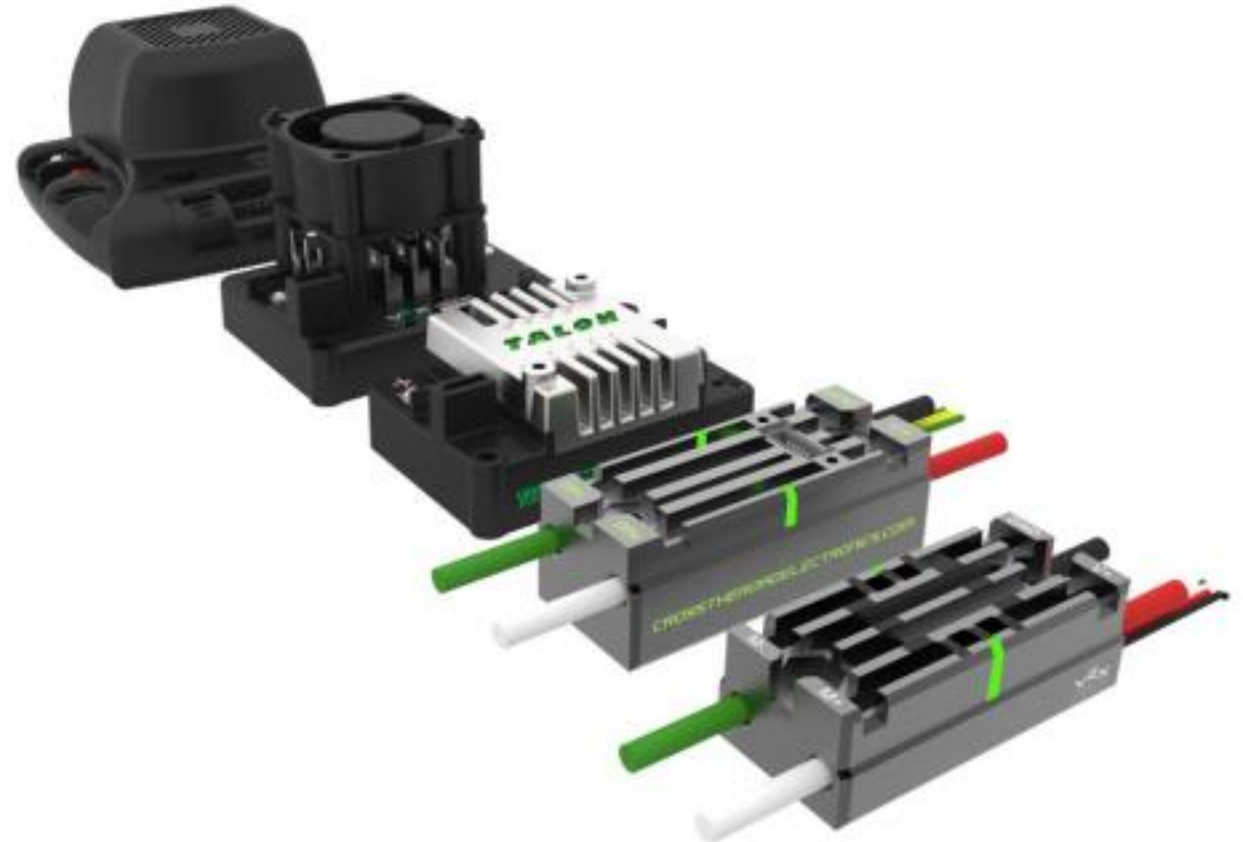
# roboRIO

- Digital IO
- PWM connections
- Analog connections



# Motor Controllers

- Types of controllers
- Control of motor speeds





# Pneumatic Control Module

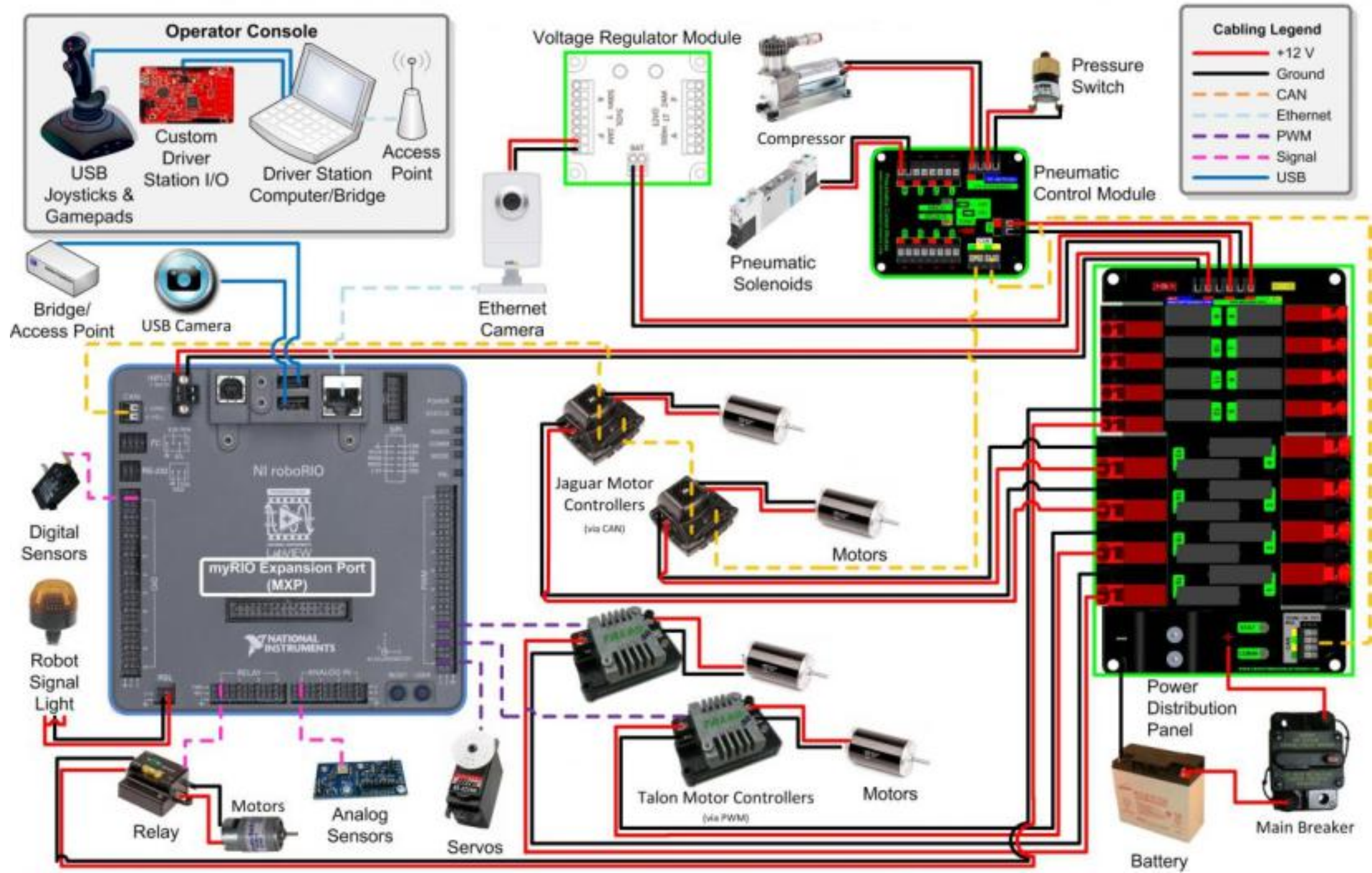


- Air compressor
- Solenoids
- Pressure switch

# Radio

- Communication between the driver station and the robot





# Plan

~~fasten it  
wherever  
it fits~~





# Component Considerations

Main Circuit Breaker

Visible  
Easily accessible  
Protected from exterior elements

---

Battery

Keep low, at the base of the robot  
Easily accessible  
Keep well secured

---

Speed Controllers

Close to PDP, directly in line to  
corresponding motor  
Accessible for calibration and  
assessing electrical issues

---

Radio

Status indicators visible  
Protected from exterior elements

# General Guidelines

- Keep wire runs short when possible
- Securely mount all electrical components to the robot frame

## Wire Gauge Reference

Minimum recommended wire sizing

PDP 40 amp circuit	12 AWG
PDP 30 amp circuit	14 AWG
PDP 20 amp circuit	18 AWG
roboRio/bridge/5A circuits	20 AWG
Main breaker/battery (50 amp)	6 AWG

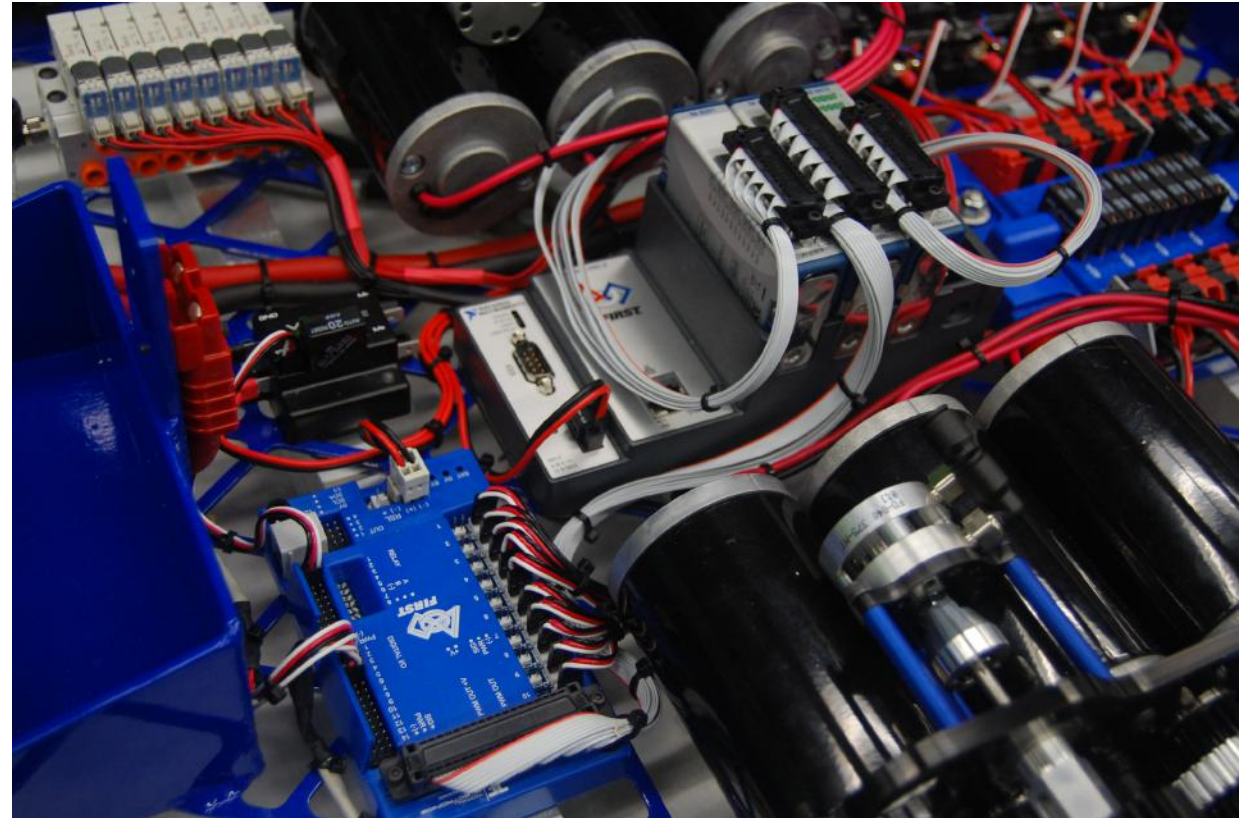


# Wiring Tips

1

## Keep it neat

- Helps to avoid connection issues
- Allows for easier troubleshooting & diagnosis



# Wiring Tips

2

## Zip ties, bundles & mounts

- Bundle and route like wires along definitive paths from one component to the next
- Hardware helps keep wire stationary and attached to surfaces





# Wiring Tips

3

## Disconnects & terminal

- Anderson Powerpole connectors allow for quick disconnect of wires and easy component replacement
- Use quick disconnect terminals on motors



# Wiring Tips

4

## Label

- Channels on the PD board
- CAN and PWM connections into roboRIO
- Use meaningful naming conventions



# Sensors

Allow comprehensive control of the robot

Internal robot state

Relative field positions

*Here are a few of Team 2056's most commonly used sensors*



# Potentiometer

Converts angular position into analog measurement

Measures the variable resistance, which can be read as an analog value

Can determine position and direction of rotation



Example of use: Rotating turret with potentiometer PID control



# Encoders

Converts angular position or motion of a shaft/axle to digital signal

Determine translation distance, rotational velocity or angle of robot component

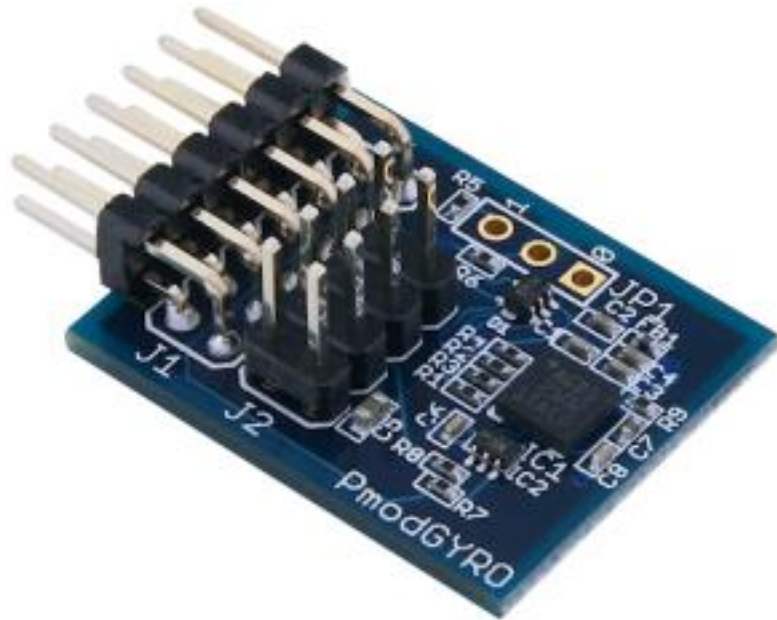
Main components:

1. Rotating disc
2. Light source
3. Photosensor



Example of use: Variable speed shooter wheel controlled by encoder PID

# Gyro

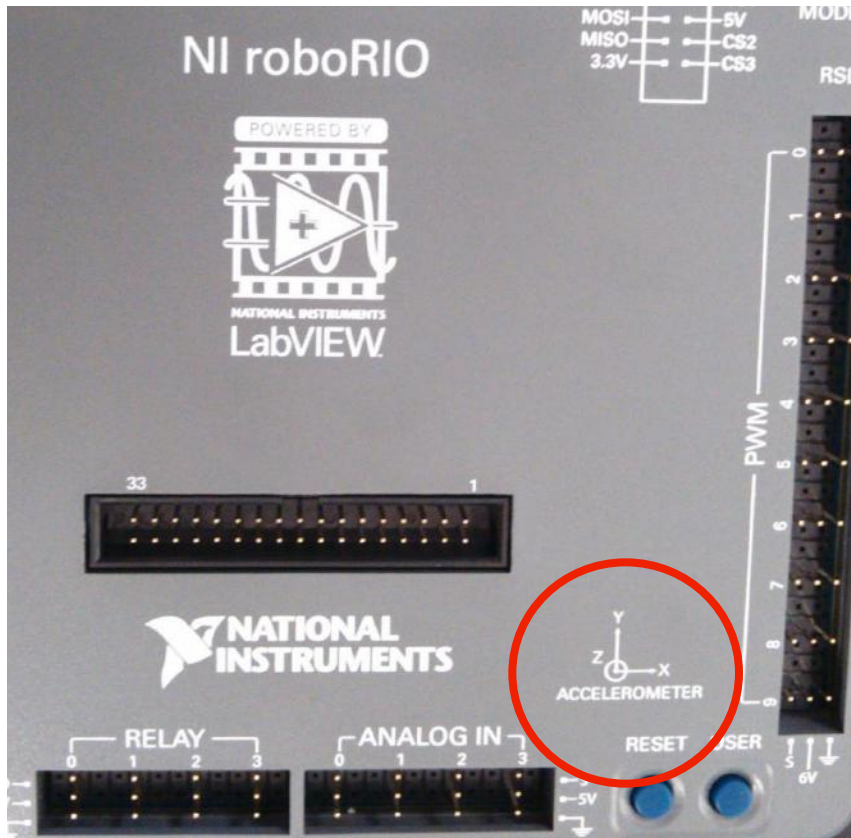


Sense rotational movement and changes in orientation

Changes in vibration are read as analog values

Functions best at the center of robot axis of rotation

# Accelerometer



3-Axis accelerometer, conveniently located on the roboRIO

Used to determine acceleration of the robot, for example the degree to which the robot is tilted

# Switches

Simple to implement and use...

but only provide feedback on single position of a moving part

Detect a fixed position, ensure mechanical limits are not exceeded

Identify presence of game piece or object



# Thank you!

Heather Young

&

Kayleigh Marshall