

N F P A

Fluid Power

VEHICLE

Challenge

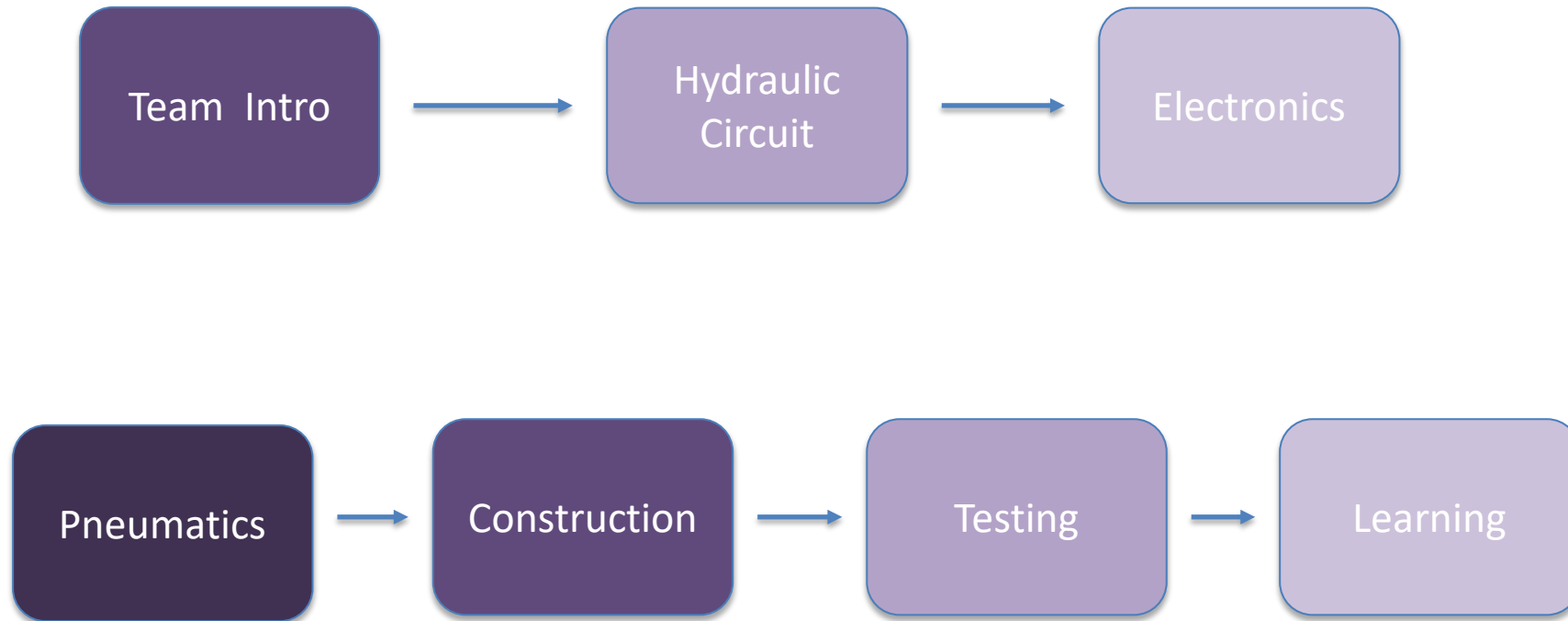


NFPA
Education and
Technology
Foundation

FINAL PRESENTATION &
DESIGN REVIEW
Minnesota State University
Mankato
Jake Swanson
4/20/2026



Outline



Meet the Team



**Team Lead:
Aidan Heaton**



**Engineer 1:
Camron Phung**



**Engineer 2:
Anna Knowlton**



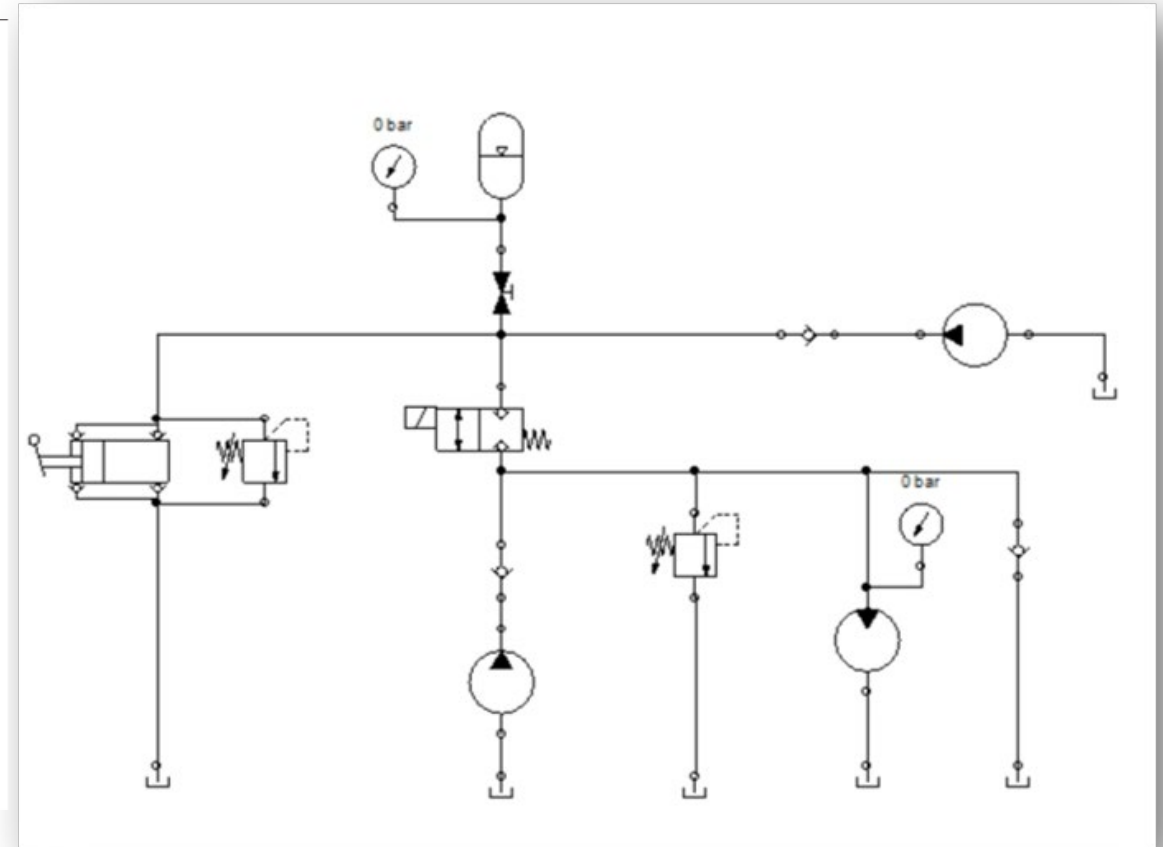
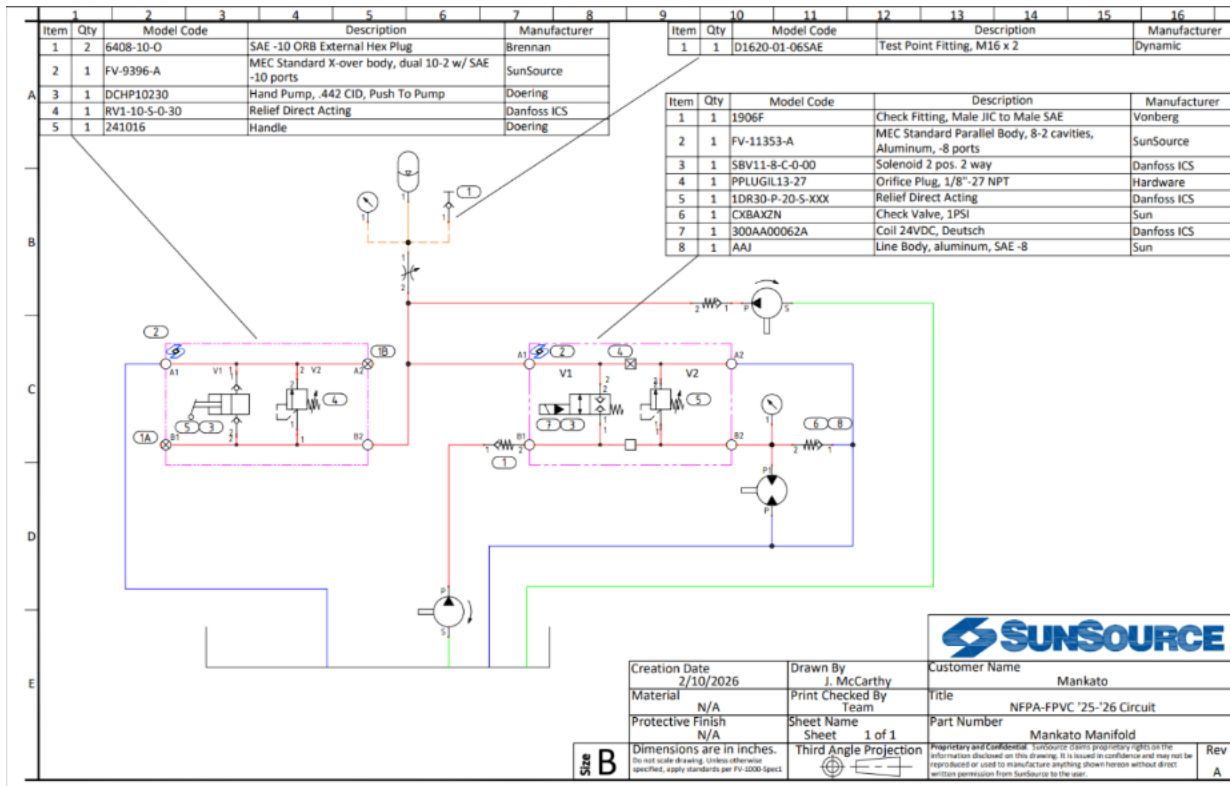
Project Goals



- **Trike design was focused on the sprint race.**
 - Improve last year's regenerative braking design
 - Be at least 40 lbs under weight
 - Easy to pedal

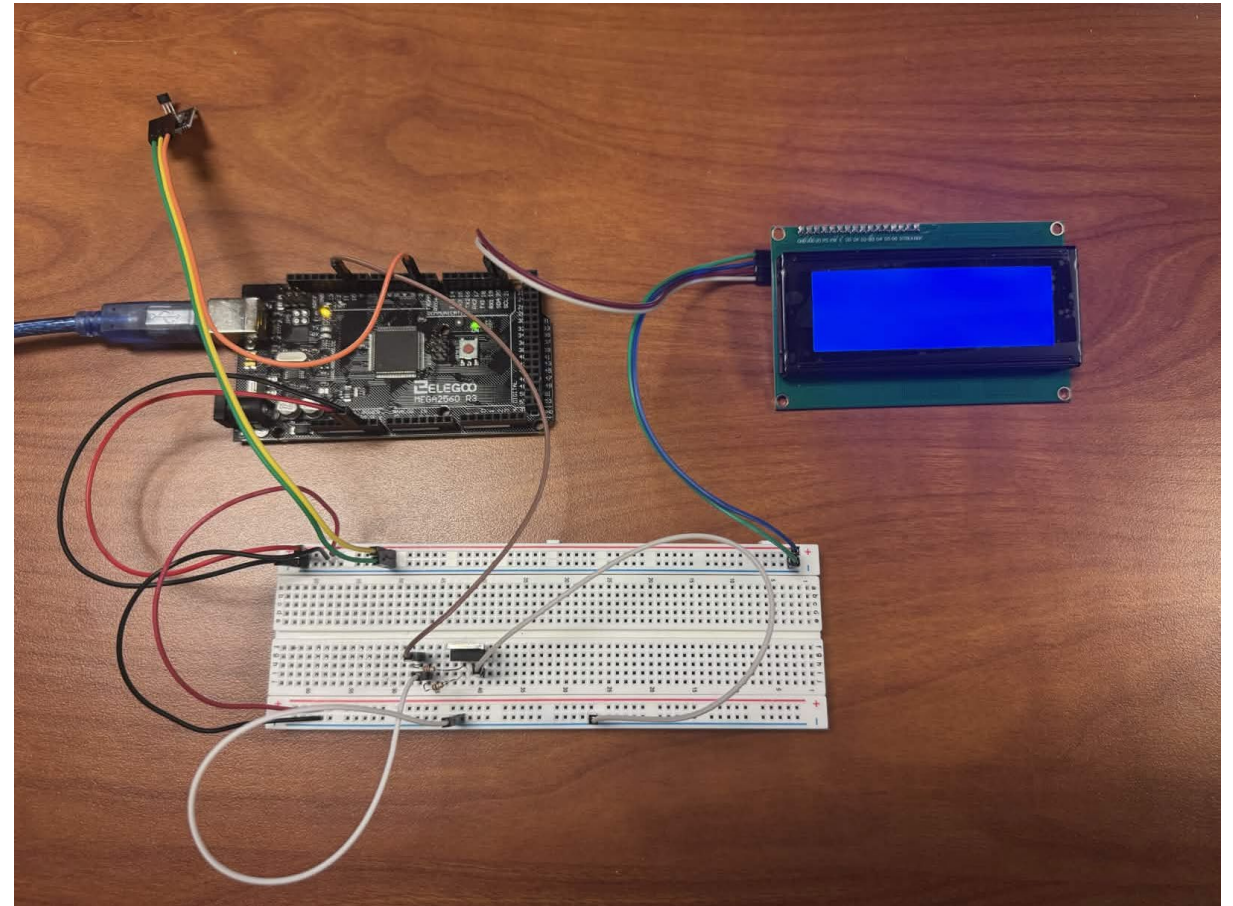
Sprint	Endurance	Efficiency
<u>Primary Obj.</u>	<u>Primary Obj.</u>	<u>Primary Objective</u>
300ft in 45secs - Precharge	7000ft in 15mins	10 % $\frac{\text{Energy in}}{\text{Energy out}}$
<u>Secondary</u>	<u>Secondary</u>	<u>Secondary</u>
- Time to charge - Optimization - gear	- Optimization - Rider - Using Regn - Gears	- Optimization - Weight (Rider) - Precharge (Pressure ~ 1100 PSI #10) - Gears
$\frac{\text{Output}}{\text{Input}} = \frac{W \cdot .005 \cdot D}{A_v \cdot \left(\frac{P_{in}}{P_{max}} \cdot A_v \cdot \frac{2000}{P_{max}} \right) \cdot \left(\left(\frac{P_{max}}{P_{pre}} - \frac{P_{pre}}{P_{pre}} \right) \cdot .29 + P_{pre} \right)}$ <p>Output: W=135, D=2 Input: 231, 900, 170, 100</p>	12	min pneumatic charge: 40PSI indoor testing perimeter: 150ft

Hydraulics

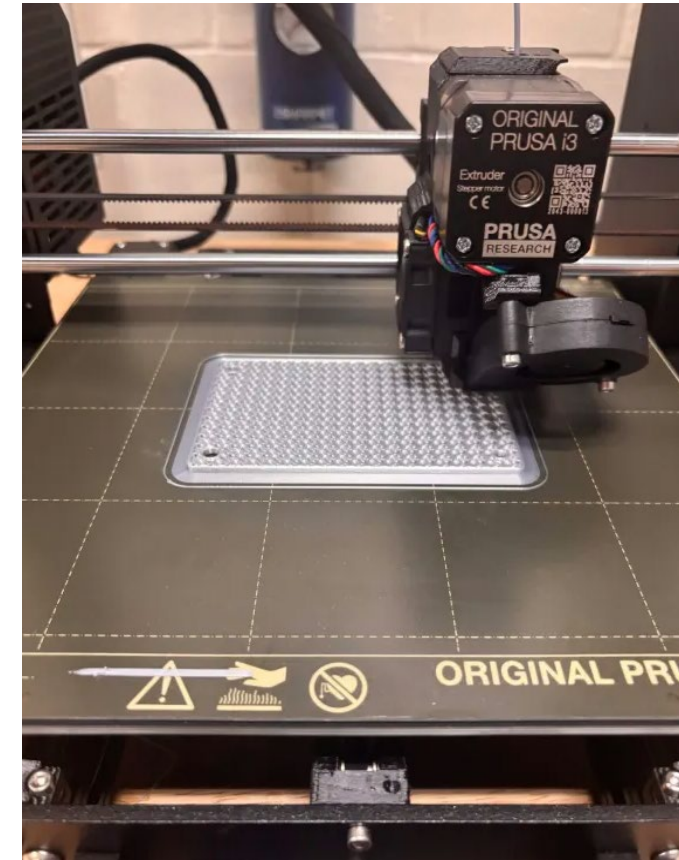
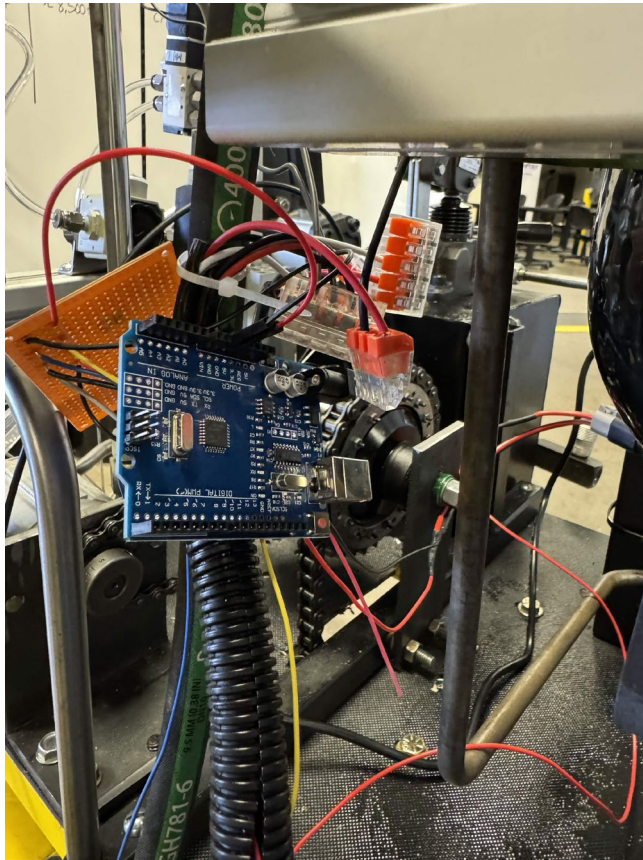


Electronics

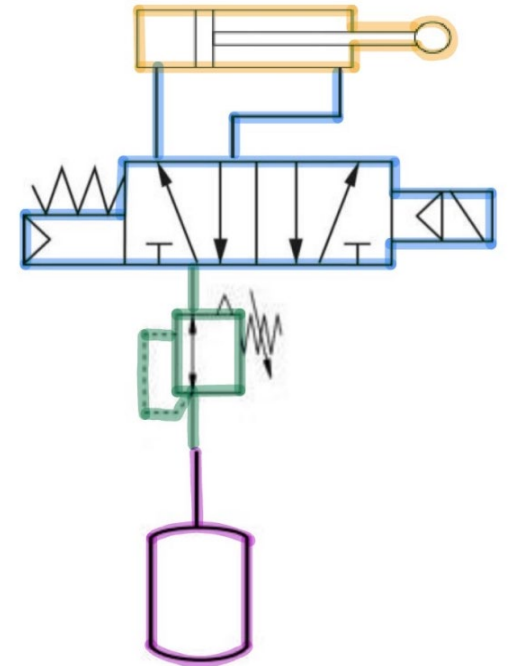
```
1  #include <Wire.h>
2  #include <LiquidCrystal_I2C.h>
3
4  // ----- LCD -----
5  LiquidCrystal_I2C lcd(0x27, 20, 4);
6
7  // ----- Hall Sensor -----
8  const int hallPin = 2;
9  volatile unsigned int pulseCount = 0;
10
11 // ----- Pressure Sensor -----
12 const int pressurePin = A0;
13
14 // Pressure scaling (0.5-4.5V -> 0-7500 psi)
15 const float sensorMinVoltage = 0.5;
16 const float sensorMaxVoltage = 4.5;
17 const float pressureMaxPSI = 7500.0;
18
19 // ----- Timing -----
20 unsigned long lastUpdate = 0;
21 const unsigned long updateInterval = 1000; // ms
22
23 // ----- Wheel -----
24 float wheelCircumference = 2.20; // meters (update later)
25
26 // ----- Variables -----
27 float rpm = 0.0;
28 float speedMPH = 0.0;
29 float pressurePSI = 0.0;
30 float sensorVoltage = 0.0;
31
32 // Interrupt for hall sensor
33 void countPulse() {
34   pulseCount++;
35 }
36
37 void setup() {
38   lcd.init();
39   lcd.backlight();
40   Serial.begin(9600);
41
42   lcd.setCursor(0, 0);
43   lcd.print("Fluid Power Bike");
44   lcd.setCursor(0, 1);
```



Electronics



Pneumatics



Regenerative Breaking

2024-25

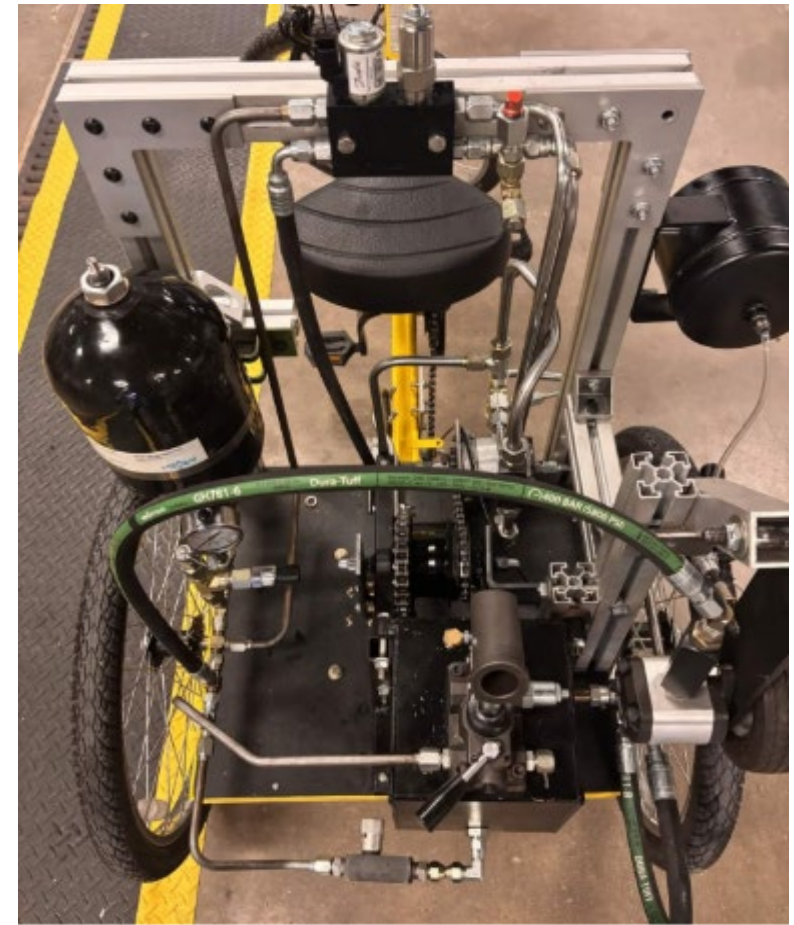


2025-26



Vehicle Design

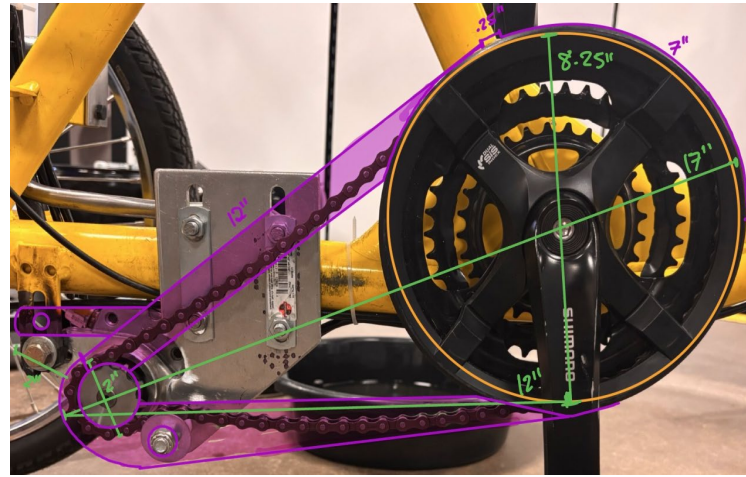
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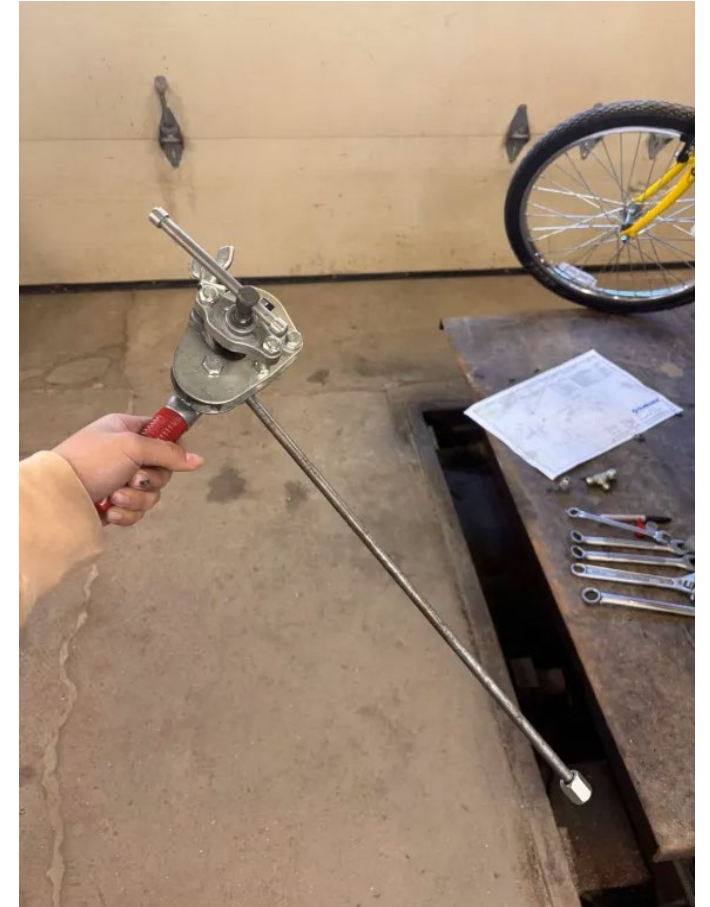
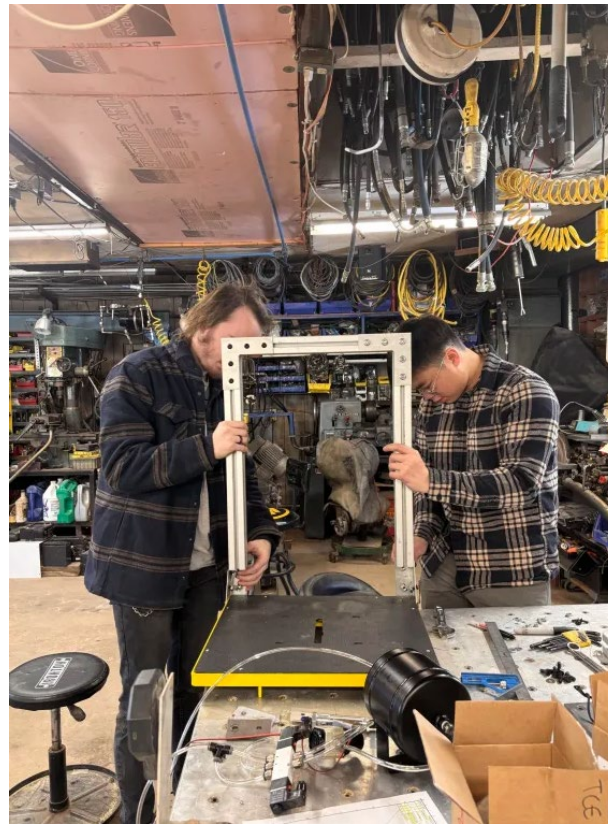
SunSource Trip



Construction



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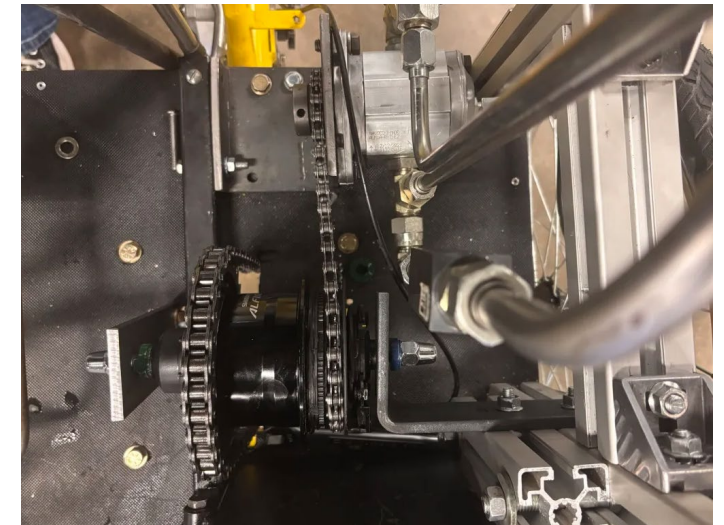
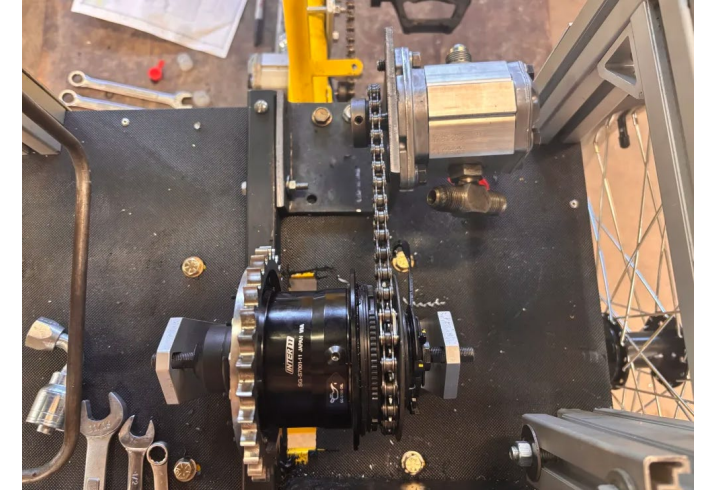
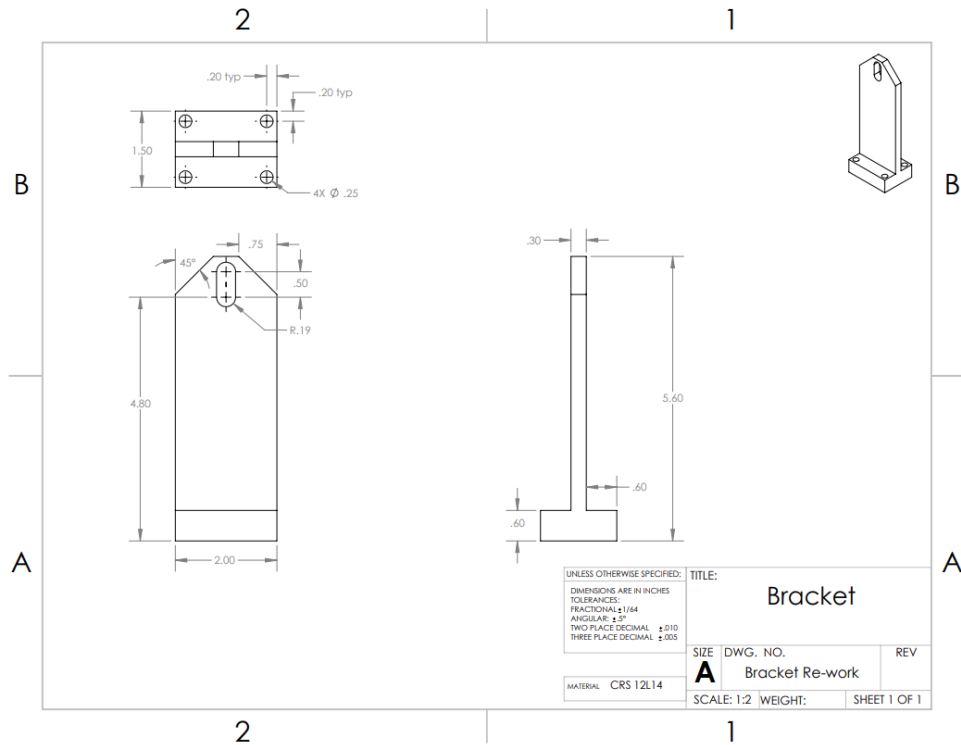


Construction

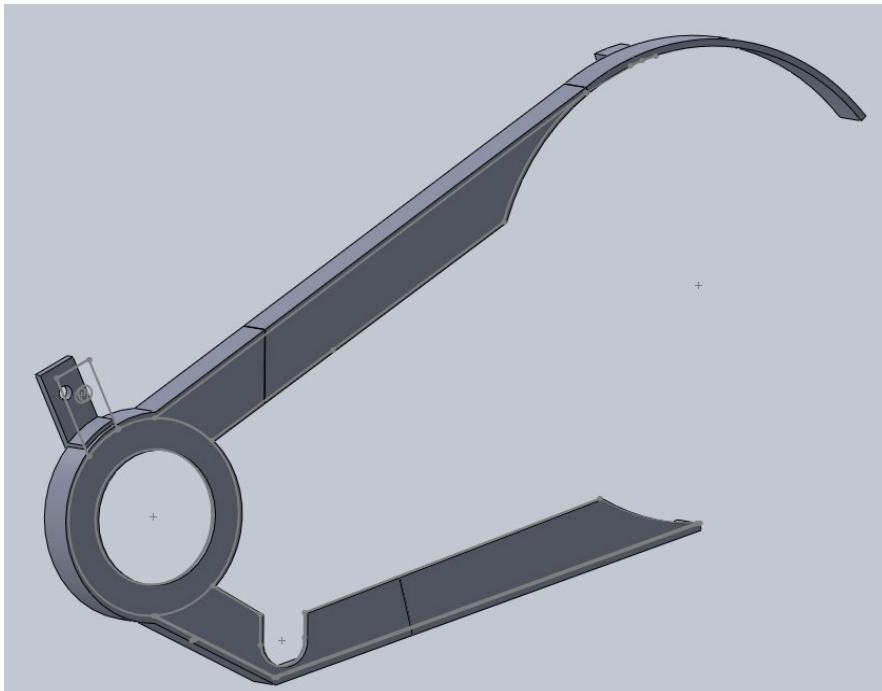
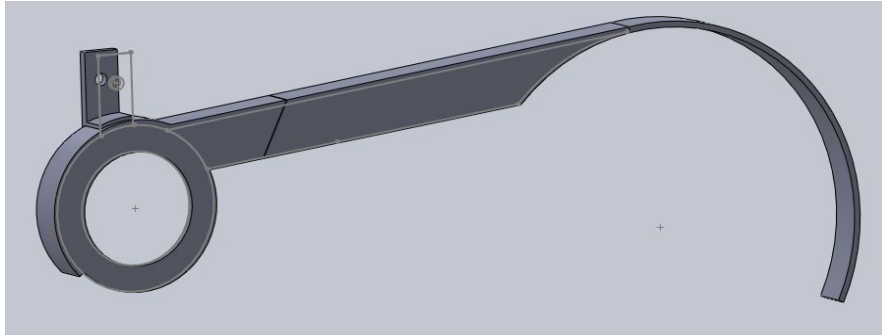
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Gear Mount Iterations

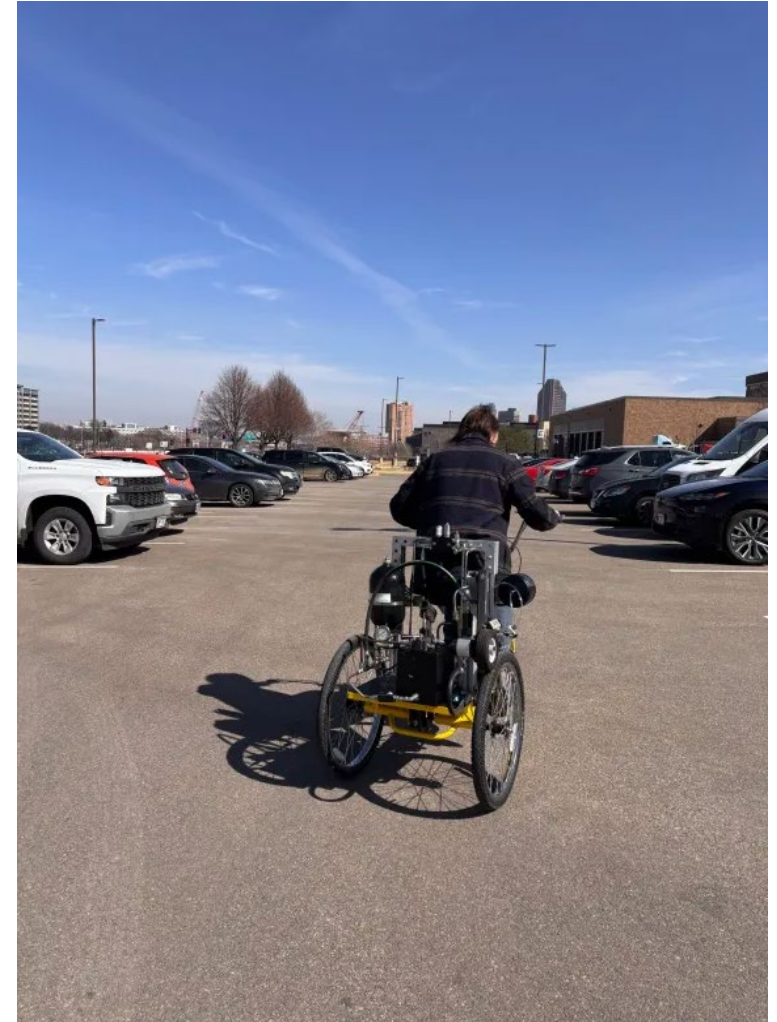


Chain Guard Iterations



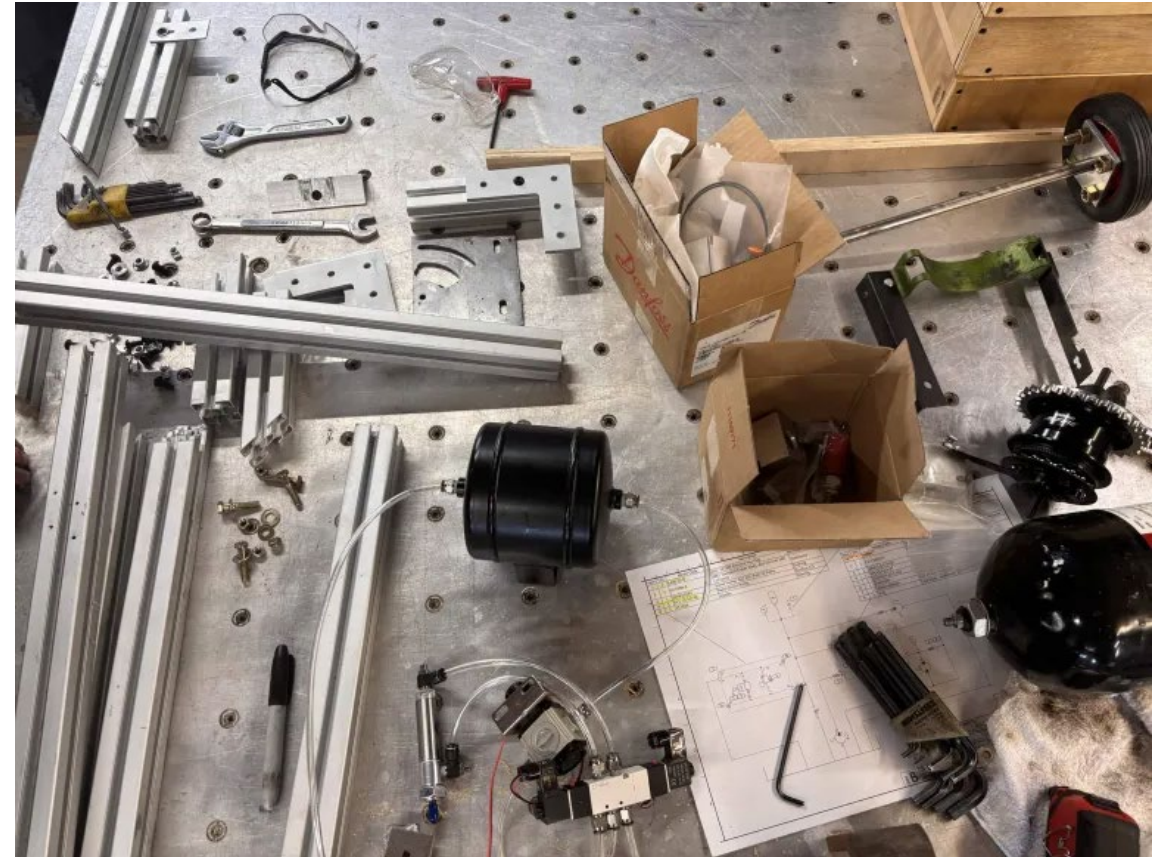
Testing

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Vehicle Testing

- Manifold testing
 - Testing the pressure
- Motor testing
 - Testing functionality
- Pump testing
 - Pump sprocket replaced
 - Reservoir leak
- Gearbox testing
 - Functionality of gears
- Stress test
 - Bracket shear



Lessons Learned

- Measure twice cut once
- Leave room for Failure
- KISS(Keep It Simple Stupid)
- Take advantage of Technical Liaisons
- Use Industry standard parts when able



Questions?

