NFPA

Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
Training Wheels Initiative
Gary Bradley
04/08/2024

Meet the Team

		
Brett Acker	**Jonathan Sanchez**	**Mariana Ruiz**
Electronic Design Team & Pneumatic Design Team	Hydraulic Design Team	Mechanical Design Team
Design electronic and pneumatic circuit/components and ensure circuits work efficiently. Test and simulate the circuits. Ensure Electronic design is compatible with the Mechanical and Hydraulic Design.	Design the Hydraulic circuits and ensure the circuits work efficiently. Test and simulate the circuits then implement the circuits onto the bike. Ensure Hydraulic design is compatible with both Electronic and Mechanical Design.	Design and assembled the mechanical components for the bike utilizing Fusion 360. Ensuring Mechanical design is compatible with both Hydraulic and Electronic Design.

Meet the Team

		
Alina Guzman	**Kaleb Lorance**	**Timothy Gnalian**
Mechanical Design Team	Mechanical Design Team	Pneumatic Design Team
Design and assembled the mechanical components for the bike utilizing Fusion 360. Ensuring Mechanical design is compatible with both Hydraulic and Electronic Design.	Design and assembled the mechanical components for the bike utilizing Fusion 360. Ensuring Mechanical design is compatible with both Hydraulic and Electronic Design.	Design the Pneumatic circuit and ensure the circuits work efficiently. Test and simulate the circuits. Ensure Pneumatic design is compatible with both Hydraulic and Mechanical Design.

Meet the Team – Advisors & Mentors

Dr. Bhaskar Vajipeyajula
Faculty Advisor

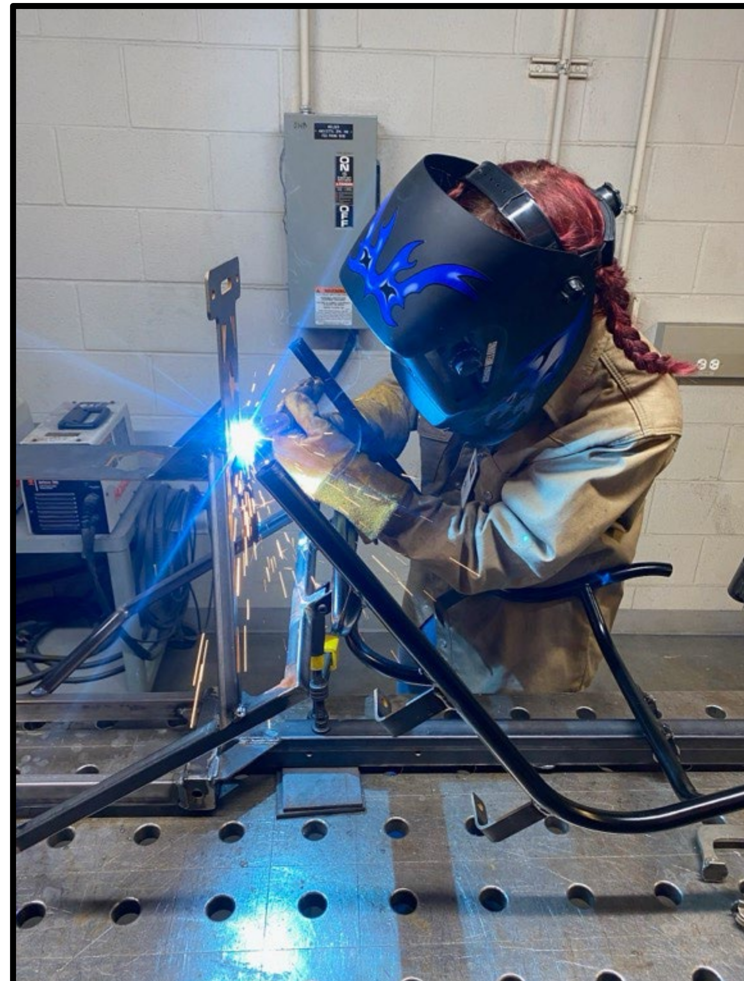
Mr. Michael Haen
Industry Mentor

Mr. Stephen Brunton
Industry Mentor

Professor Gary Bradley
Capstone Instructor

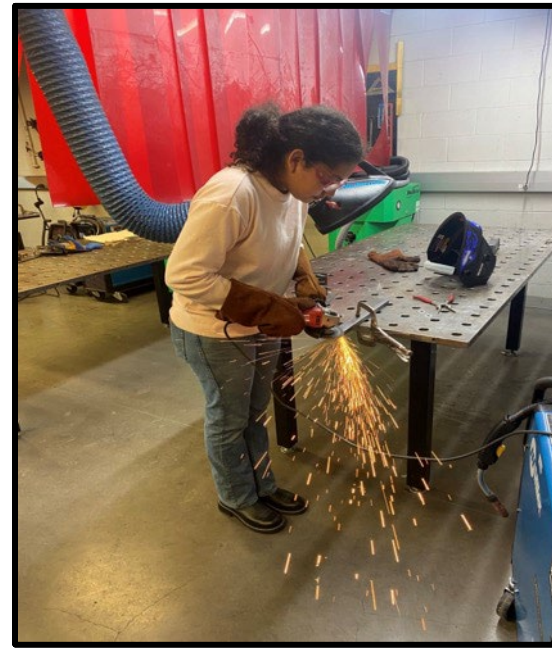
Vehicle Construction Chronology

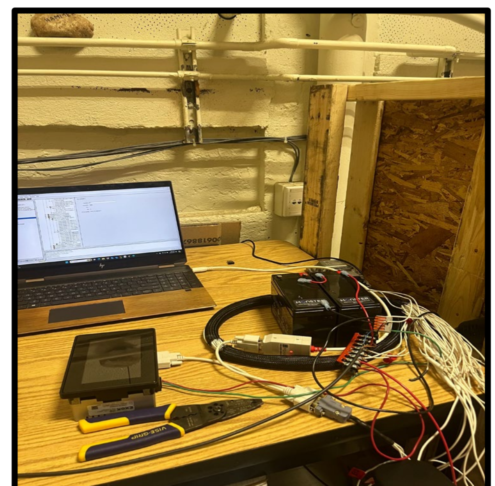
1. Water-jetted sheet metal, cut tubing, then machined on lathe and mill.
2. Welded frame.
3. Painted frame and assembled vehicle components.
4. Programmed and wired.
5. Manufactured manifold and assembled hydraulics.



Vehicle Construction

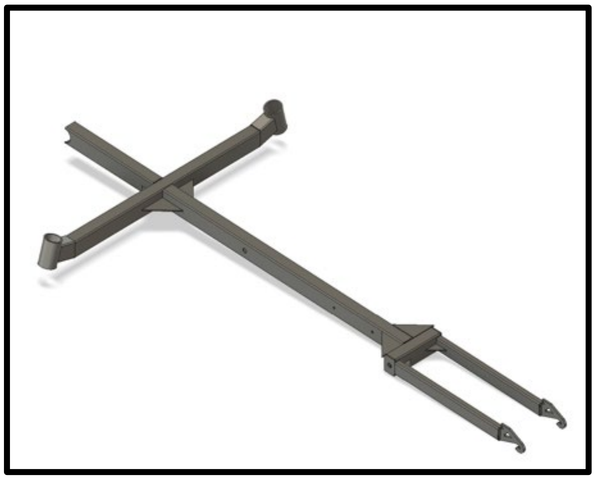
NFPA Fluid Power Vehicle Challenge





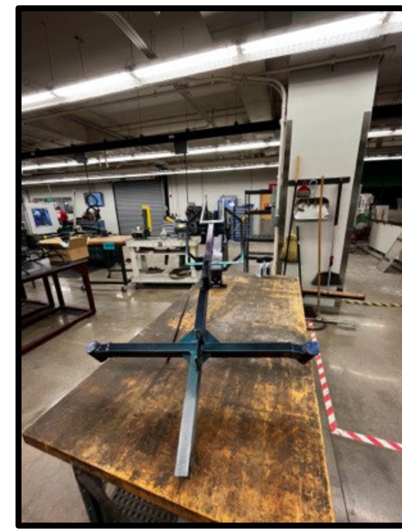
Vehicle Construction

NFPA Fluid Power Vehicle Challenge



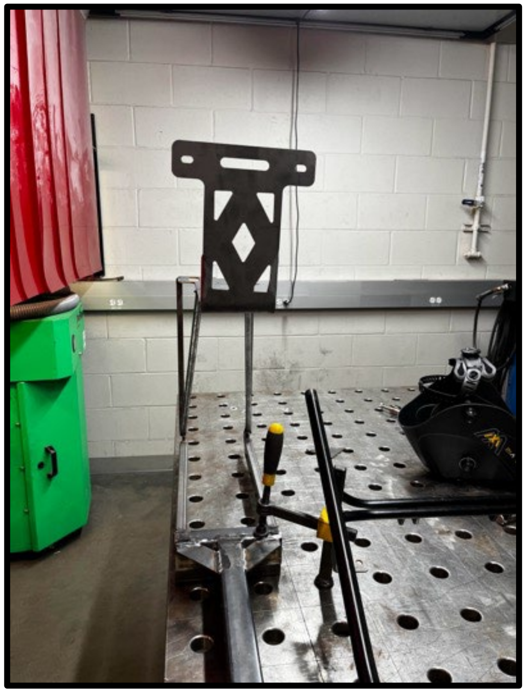
CAD model of the bike frame

Bike Frame at initial stage of welding

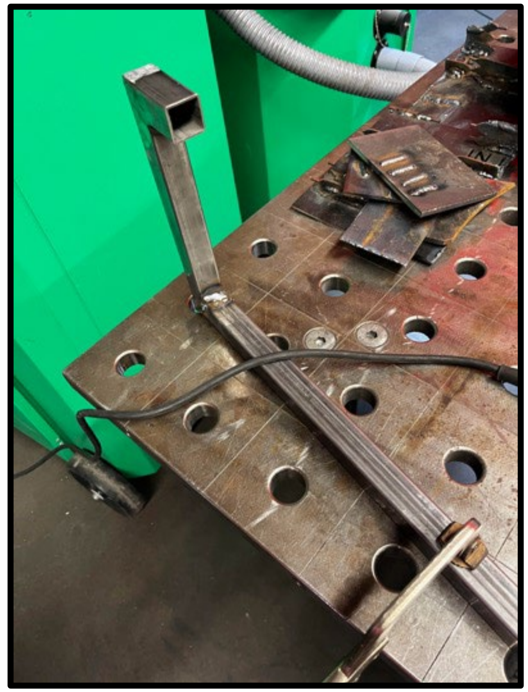


Bike Frame completed with topcoat

Vehicle Construction



Accumulator Mount: Water jetted, welded onto the frame



HMI Stand being welded and grinded

Drilling holes into bracket

Vehicle Construction

Bike base completed

Final bike (Before Testing)

Vehicle Testing

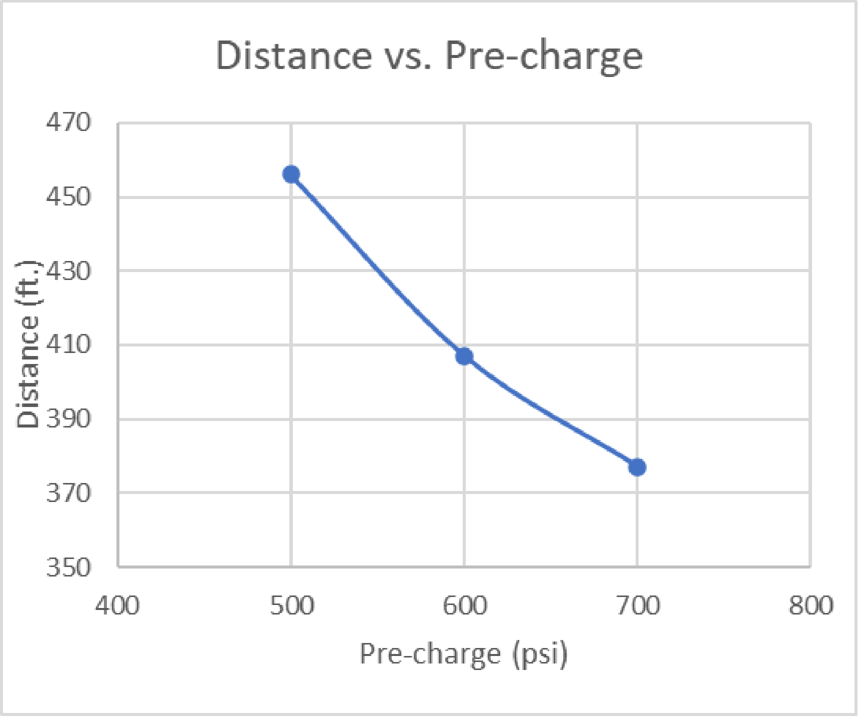
- Findings after testing:
  - Reduce gear ratio from pedals to pump.
  - Increase gear ratio from motor to wheel.
  - Make connections to batteries more secure.
  - Change position of cranks for more ergonomic pedaling.
  - Flip direction of back axle (wheel loosened itself).
  - Buy optimized sized hoses and fittings to reduce dangling lines and increase efficiency.
  - Secure pneumatics when extended and retracted.
  - Change code for tachometer.

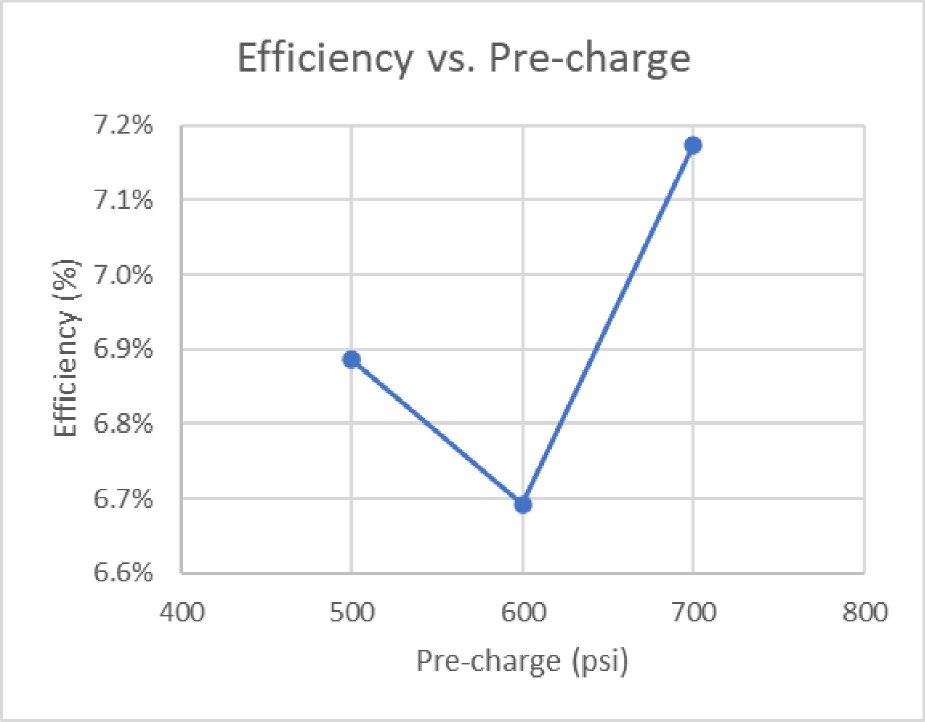
Vehicle Testing

- Findings of 3rd test – Pre-charge Testing

Precharge (psi)	Oil Pressure (psi)	Distance (ft)	Efficiency
700	1320	377	0.072
600	1405	407	0.067
500	1480	456	0.069

*based on NFVC's official efficiency calculator

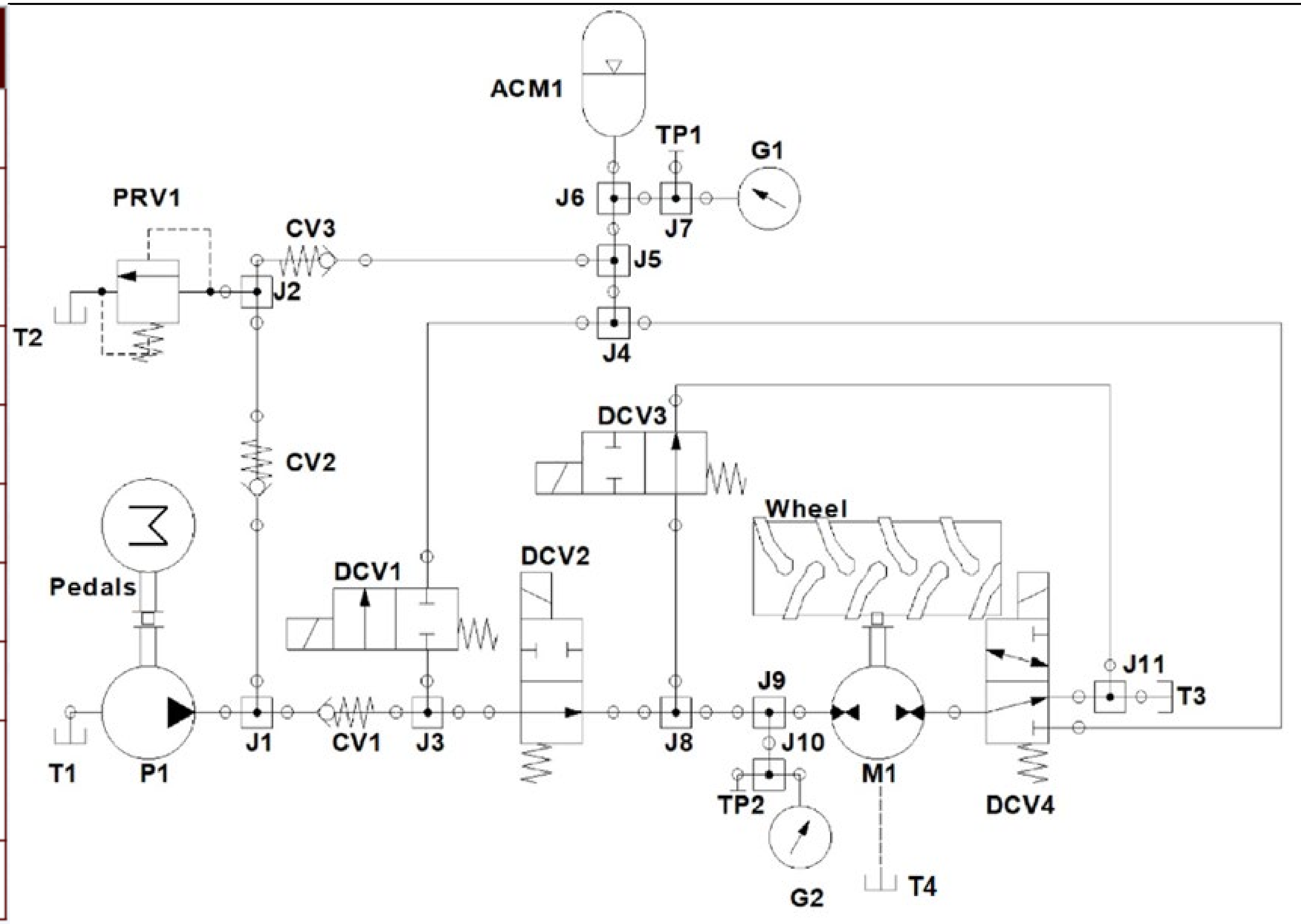




Vehicle Design Review

Previous Texas A&M Team Hydraulic Circuit

Label	Component
P#	Pump
T#	Tank
J#	T-Joint
CV#	Check Valve
PRV#	Pressure Relief Valve
ACM#	Accumulator
TP#	Test Point
G#	Pressure Gage
DCV#	Directional Control Valve
M#	Motor



Advantages & Disadvantages of Last Year's Design

Advantages

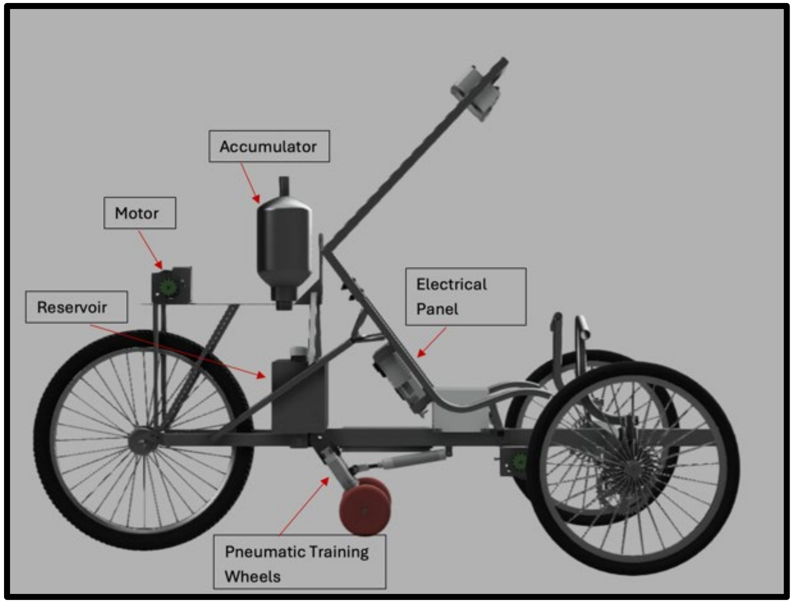
- Utilizing an already built frame
- Efficient Pump and Motor Size
- Light Weight
- Thorough Electronic Controls

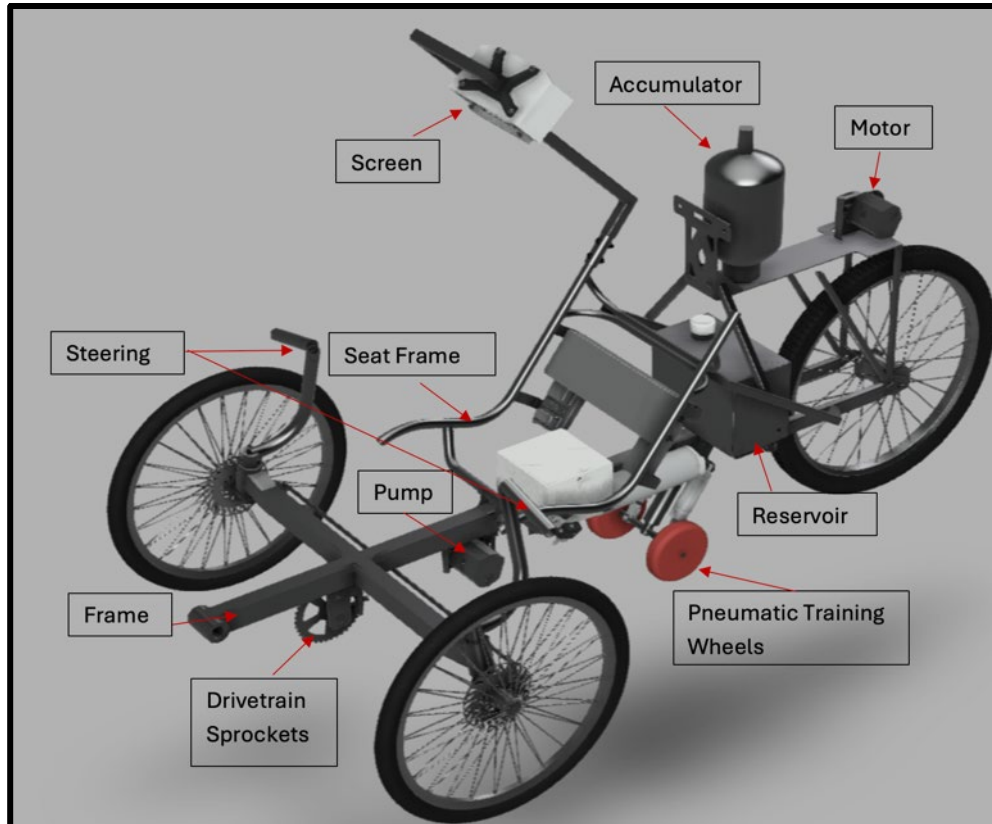
Disadvantages

- Pneumatic Design was not implemented
- Unpainted Metal Components
- Over engineered drivetrain
- Exposed Wiring

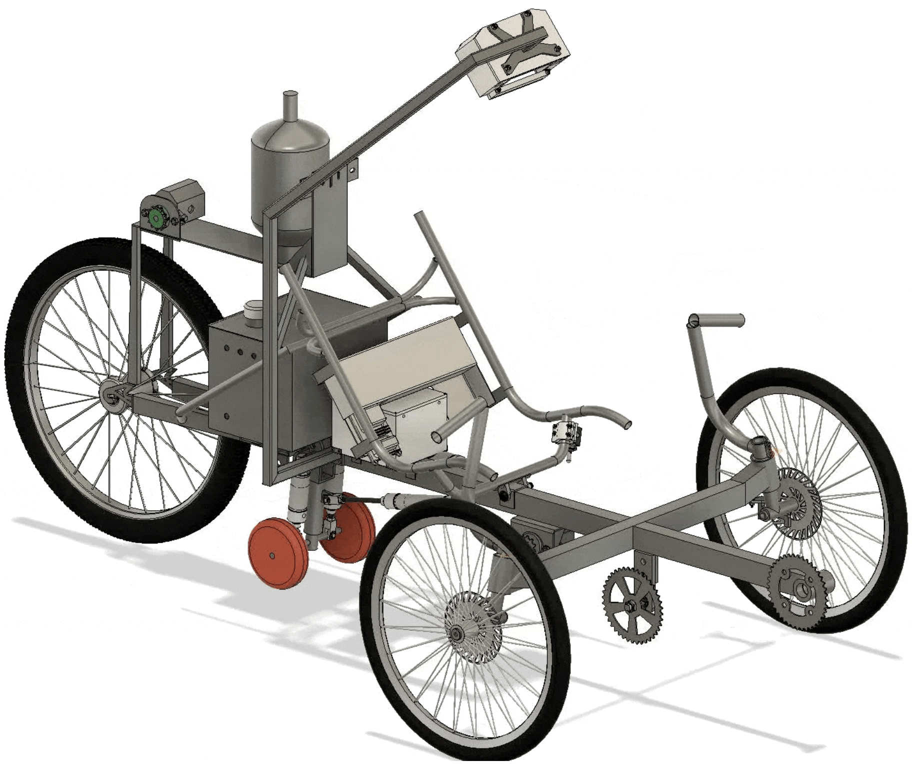
*This year Texas A&M built the bike **__FROM SCRATCH__** and is entirely independent from last year's design.*

Mechanical Design

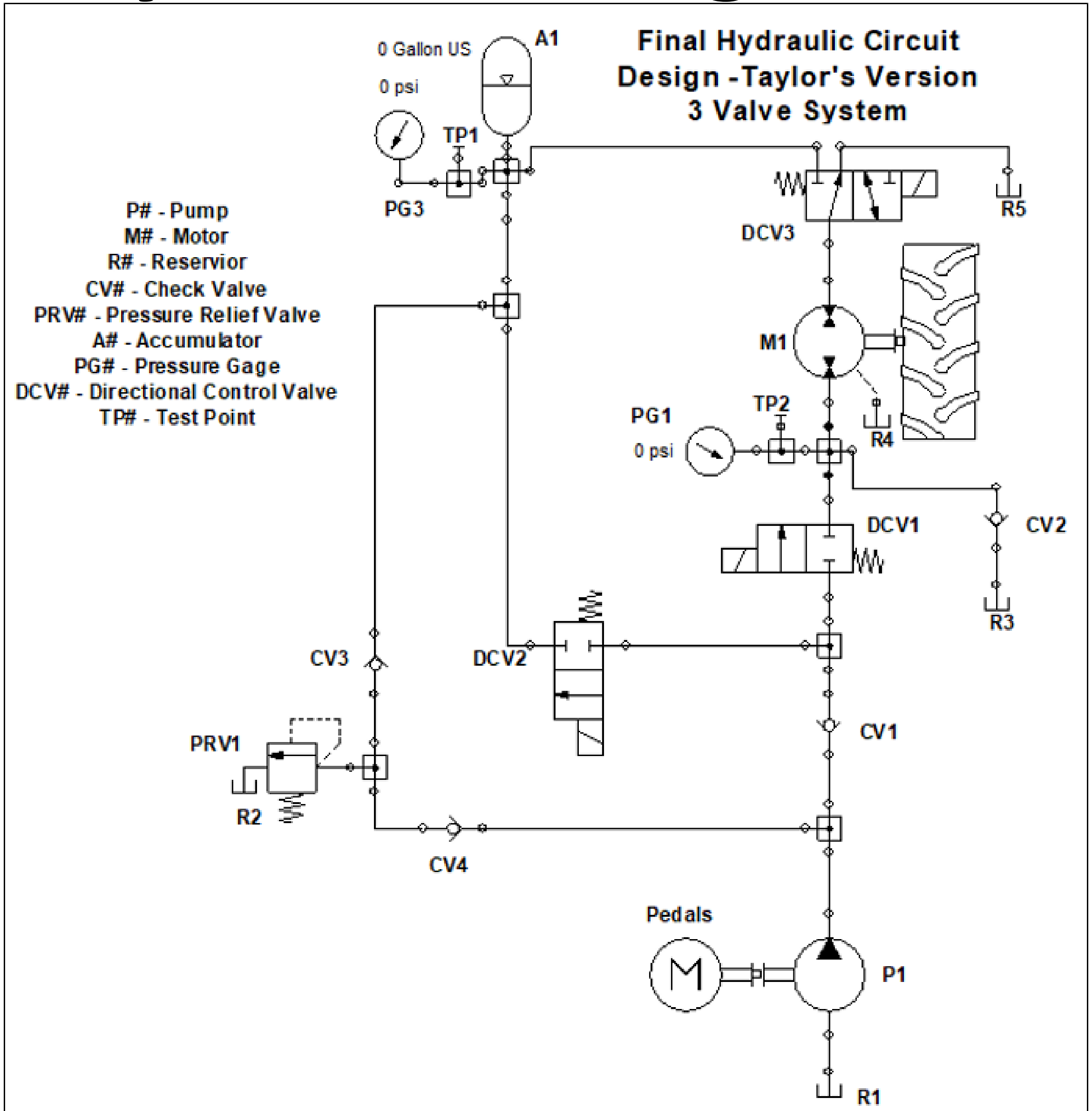




Mechanical Design



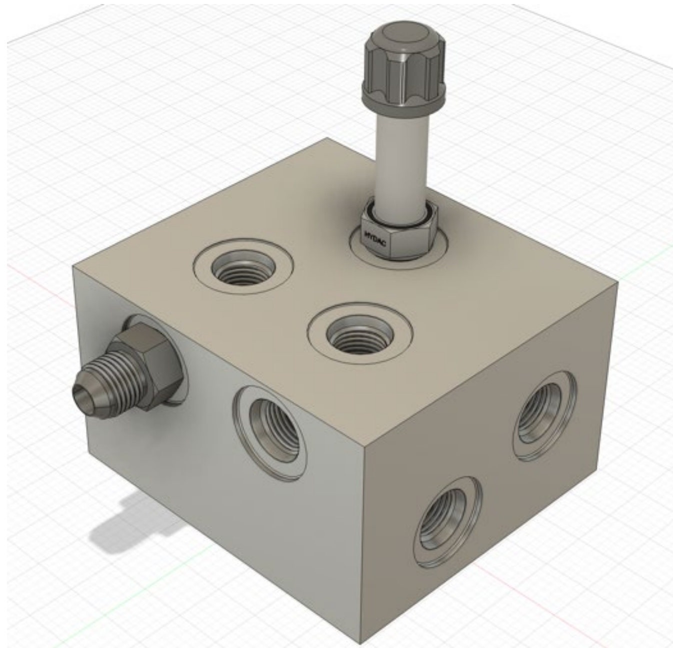
Hydraulic Design

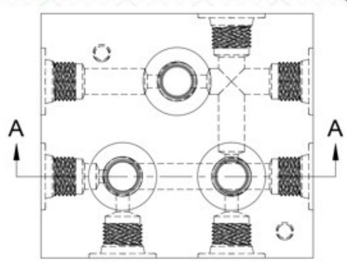


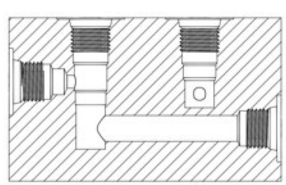
- Reduced Directional Valve count from 4 to 3.
- Regeneration line implemented directly to motor.
- Reduction in joints and line lengths.
- Design approved by Professor Bhaskar and Ernie Parker
- Normally Open 2/2 Way valve used at DCV1 and a Normally Closed 2/2 Way valve used at DCV2 to make the default no power mode drive mode.

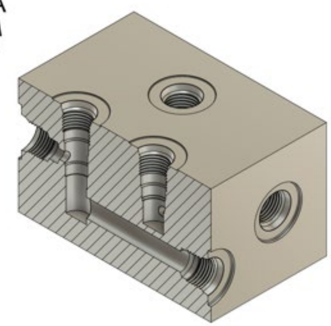
Hydraulic Design Cont.

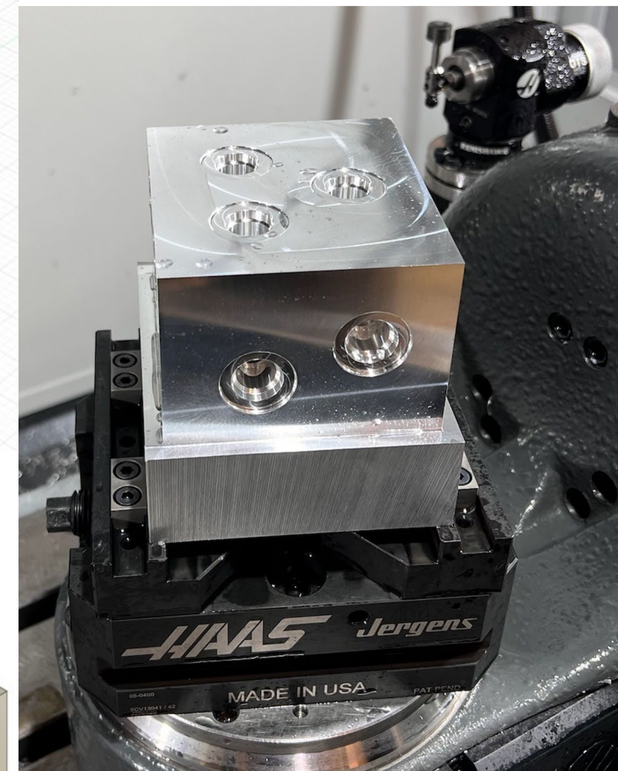
- Hydraulic Manifold designed and manufactured from scratch.
- Used Fusion360 and HYDAC Cavity Manuals to design manifold line bodies.
- Required cut angles and surface finishes so valves have a good seal.
- Leak tested at high pressure to assure safety and quality.
- Machined in-house by department technician.



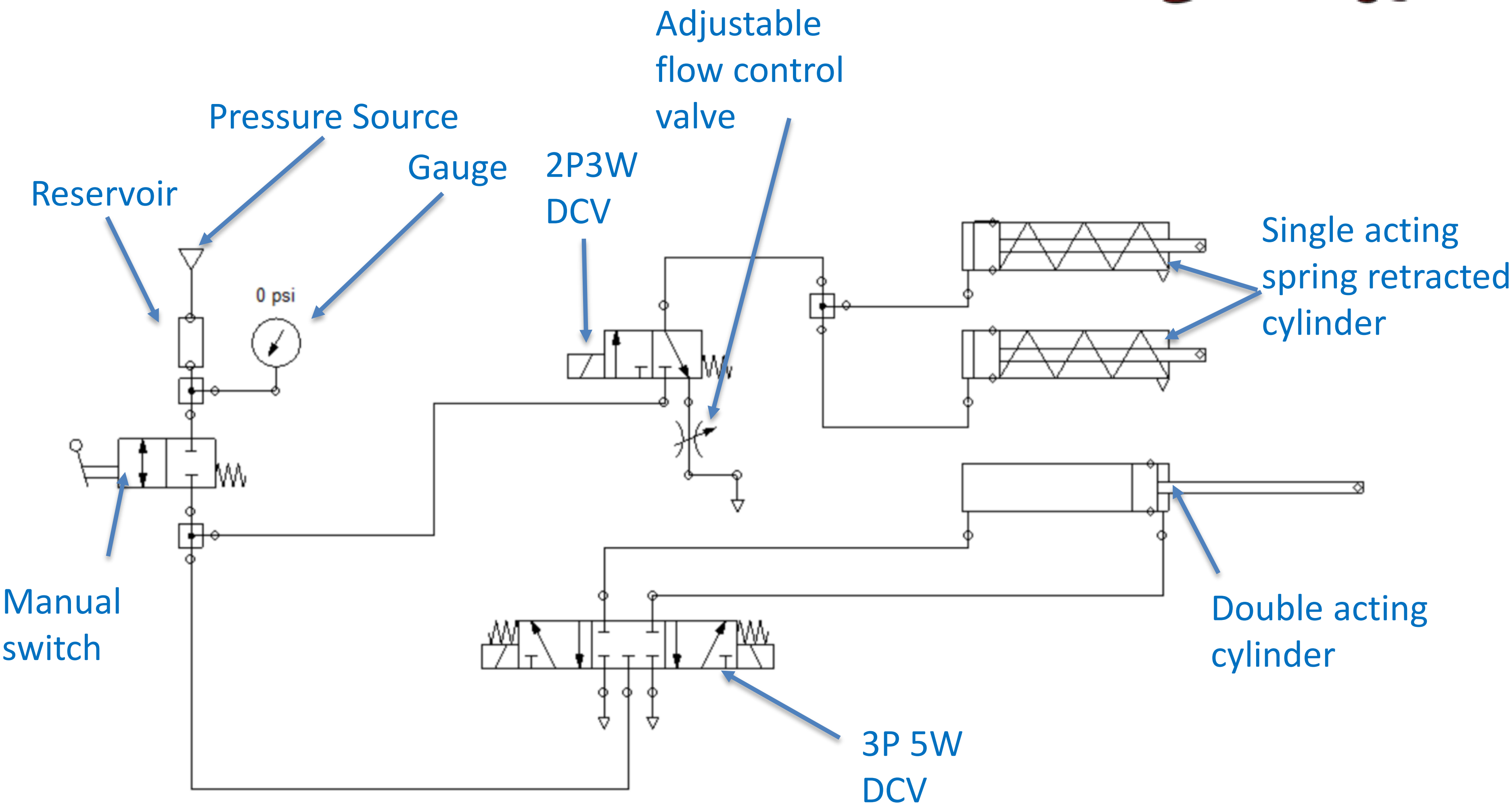








Pneumatics


Adjustable flow control valve
Pressure Source
Gauge
2P3W DCV
Reservoir
0 psi
Single acting spring retracted cylinder
Manual switch
Double acting cylinder
3P 5W DCV

Pneumatics

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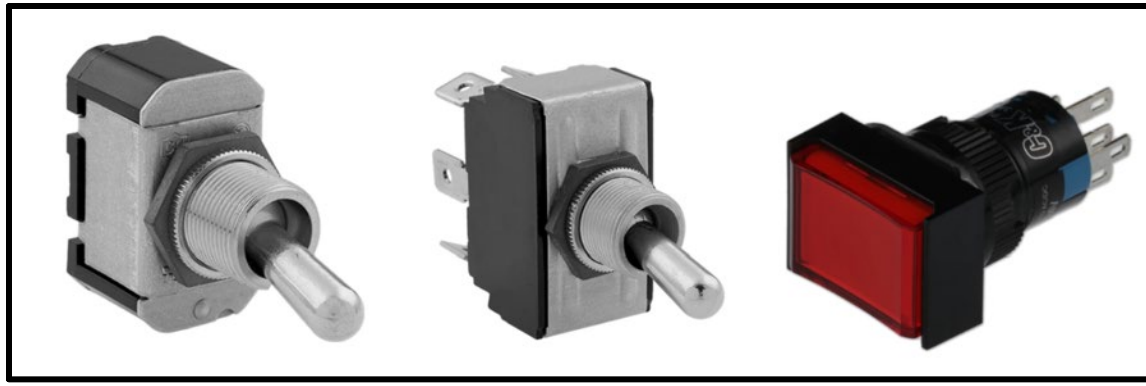
- Purpose
  - Jack up the bike
  - Move bike backwards
- Cylinder Function
  - 2 types of cylinders
  - One extends the jack
  - One jacks up the bike
- Safety features
  - Manual switch
  - Prevents cylinder malfunctions

Electronics - Hardware

HY-TTC-32



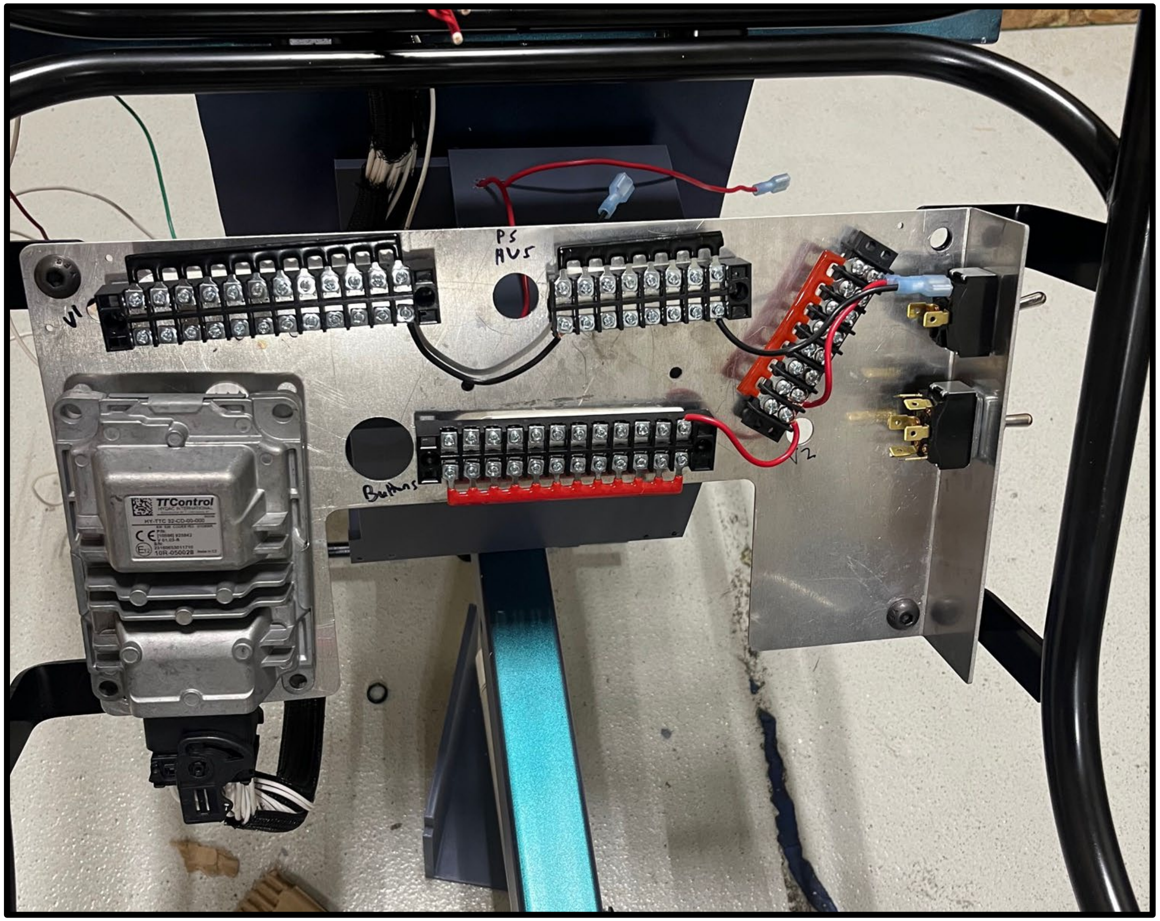
2 Toggle Switches and 5 momentary push buttons

eX705 Multitouch

2 pressure sensors, 1 inductive sensor

5 Directional Control Valves

Electronics - Electrical Panel

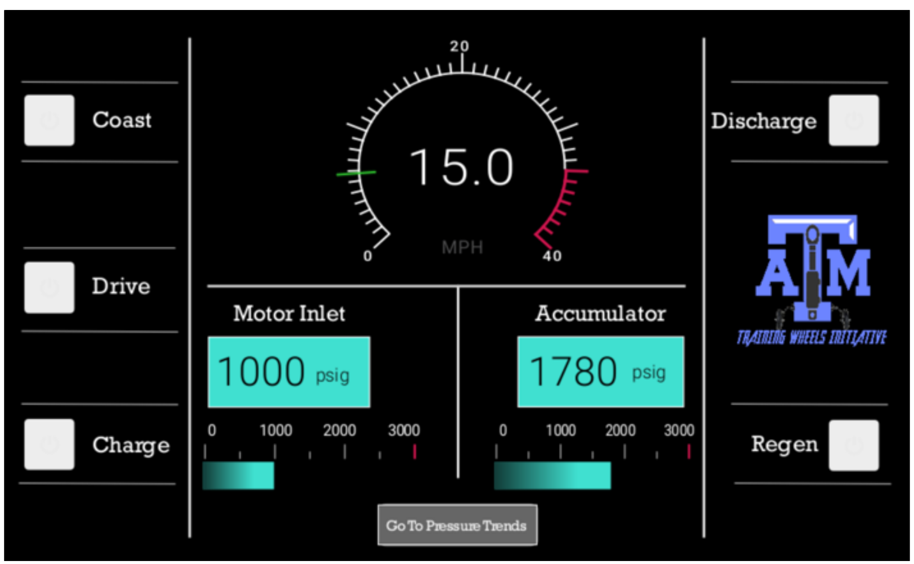


- Bolts to back of seat
- Removeable Lid for protection
- Room for busses to mount on the inside
- Holes for neatly routing wires
- Pneumatic valves bolt to back and pneumatics switch secured to side

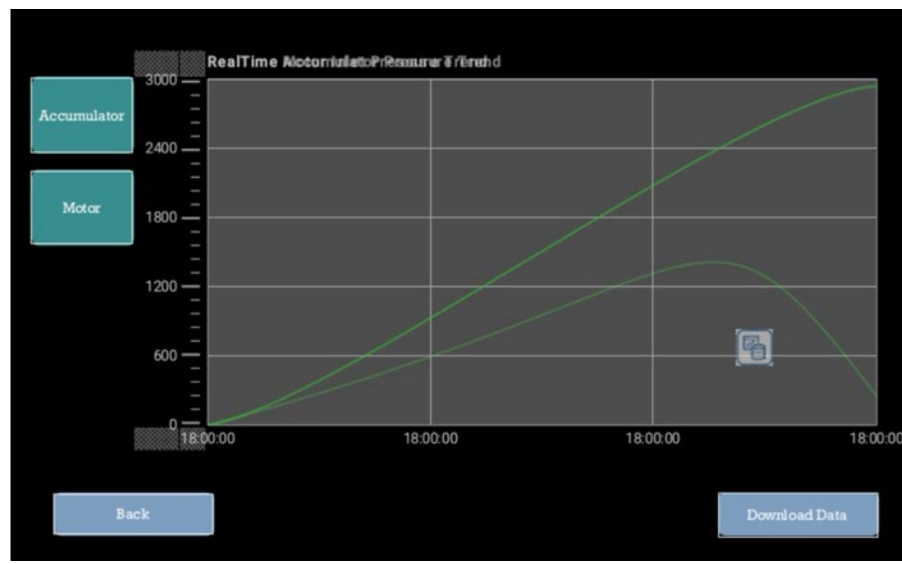
Electronics - HMI UI

Mode
Control
Buttons

Page 1 - Mode, Speed, and Pressure Display



Page 2 – Pressure Charts and Data Download



Final Vehicle

Finalized vehicle after testing

Vehicle crate built and shipped

Lessons Learned

- Technical Lessons:
  - Use Aluminum for the frame instead of steel to help with the vehicle weight.
  - There was no need to use thick and bulky 14ga wire for electronics as opposed to thinner 18ga.
  - Make Manifold ports size 8 to have less reductions in lines.
  - Add Oil level dipstick to easily check oil amount.
  - Have better spacing between accumulator, manifold, and motor to allow lines to be installed easier.
- Abstract Lessons:
  - Finishing a project without cutting corners takes a lot of dedication and time, even if it seems simple from the outside.
  - Your first design will probably not be the best option.
  - Small mistakes can turn into bigger problems, have contingencies for your contingencies.
  - Collaborating with others outside of the team can lead to a different perspective of your project and problem you're facing.
  - When sourcing components ensure vendors understand what you need and efficiently communicate with vendors to reduce miscommunication.

Thank You

To all the companies/associations that helped us create our bike. We could not have done this without them.

Ernie Parker @

Josh Scarbrough @

Thank You,
Any Questions?