NFPA Fluid Power Vehicle Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
Michigan Technological University
David Wanless
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Team Introductions

Members: Derek Flory, Hunter Ransom, Erika Gabriel, Brittney Phillips
Faculty advisor: Dave Wanless
Mentors: Courtney Castelic

Midway Summary

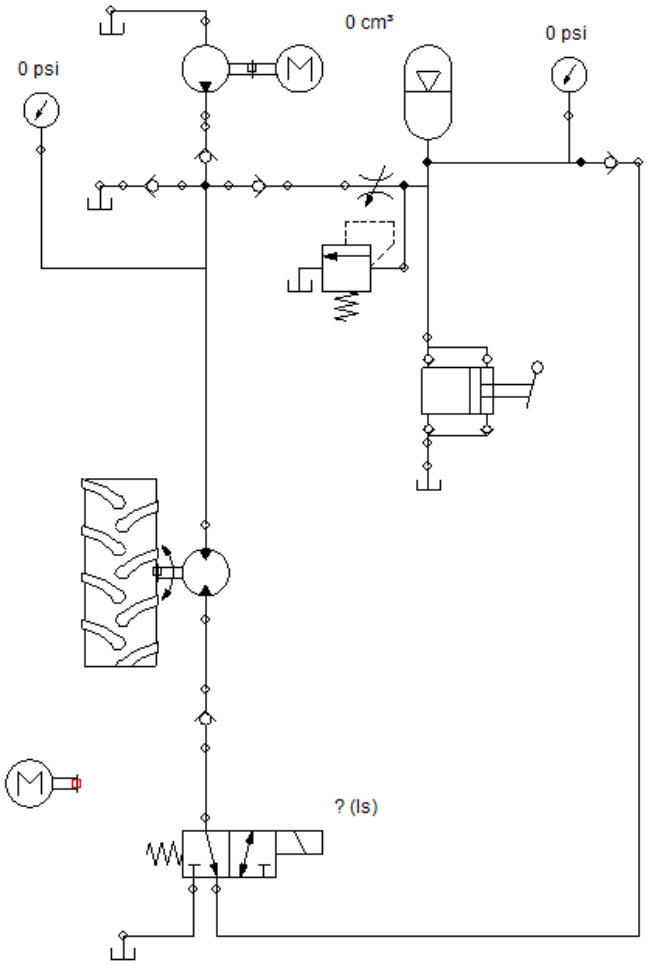
- Tricycle Frame to increase stability and lower mass of hydraulic system
- Update hydraulic system to decrease losses and improve efficiency
- Optimize gear ratios to pump and rear axle
- Incorporate hydraulic manifold

Final Objectives

- Design the physical layout of the bike
- Implement layout design
- Install fixtures to mount the design
- Test operation of bike
- Ensure all safety requirements are met
- Make adjustments where needed

Hydraulic Schematic

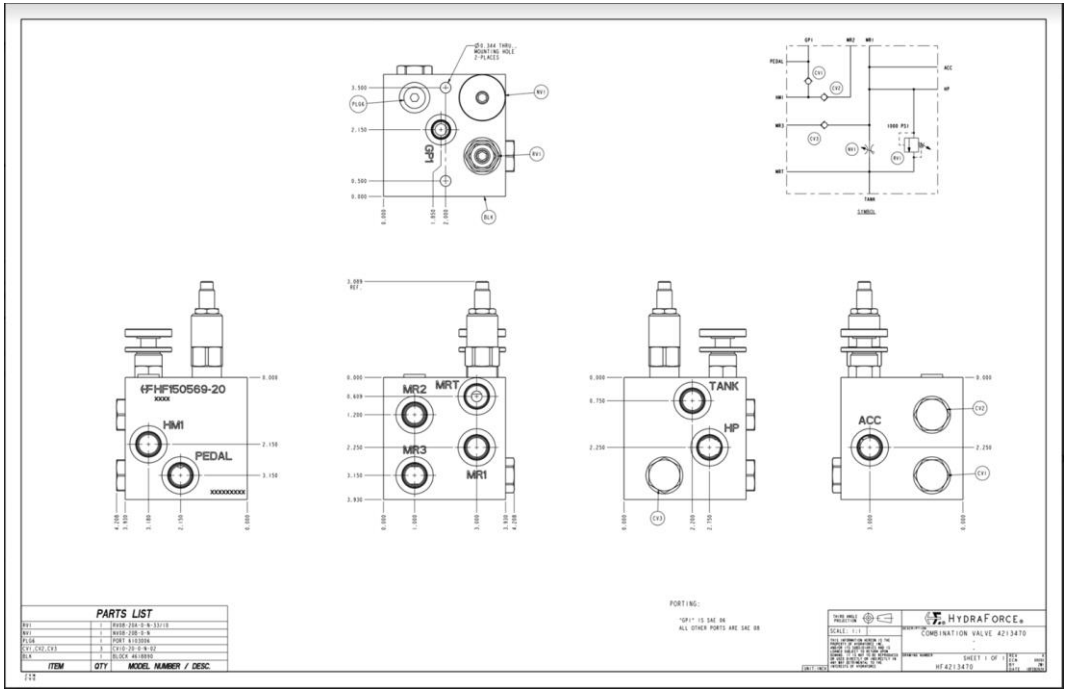
- Less valves creating a more simple operation
- Three phases
  - Direct Drive
  - Accumulator Drive
  - Regeneration (Braking)



Manifold

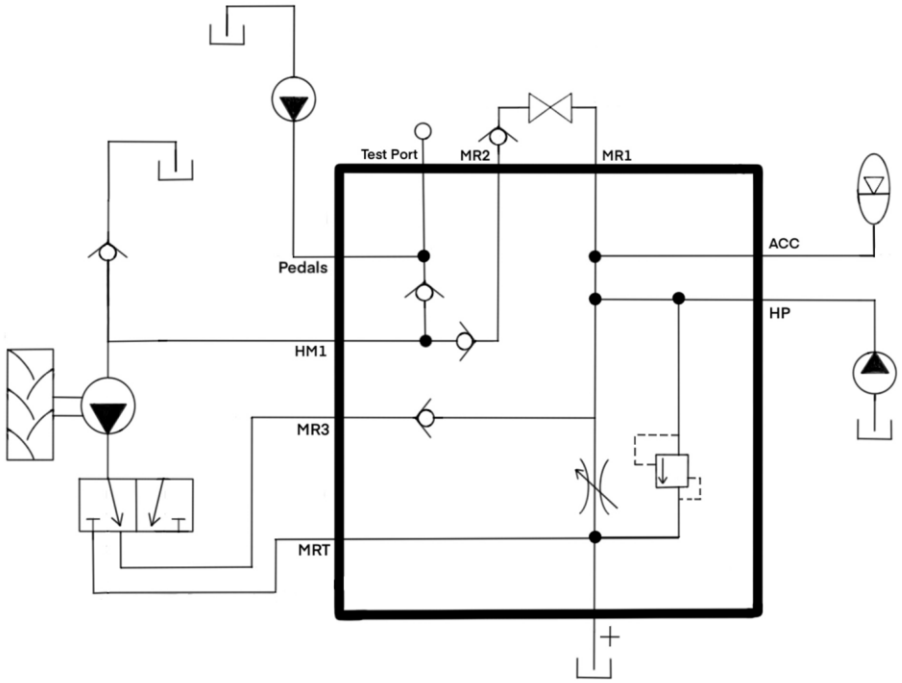
- Use of a manifold decreases loss through unnecessary hoses and greatly simplifies the circuit design.

- Our manifold is fitted with a relief valve to regulate the pressure in the system and a needle valve to bleed the system and release any excess pressure without powering the motor.



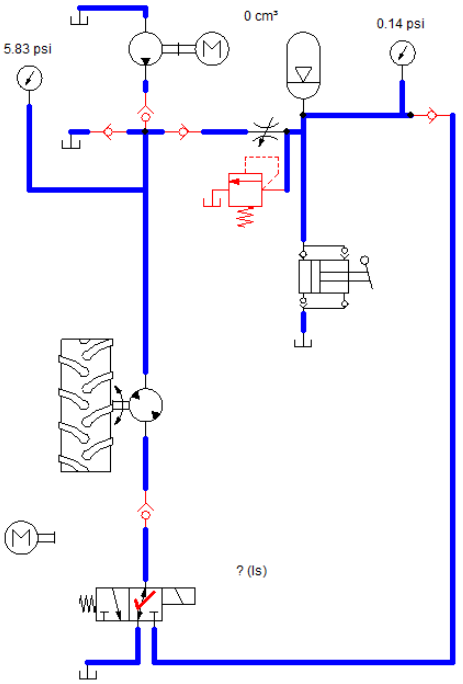
Final Schematic

- Supply lines ½”
  - Flow velocity < 4 ft/sec
- Pressurized lines ⅜”
  - Flow velocity < 15 ft/sec

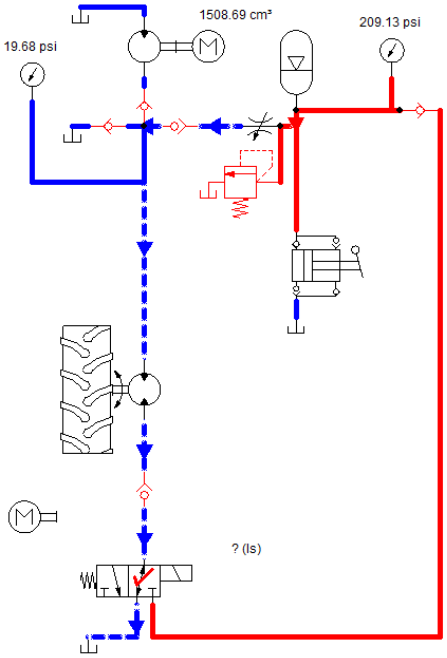


Analysis

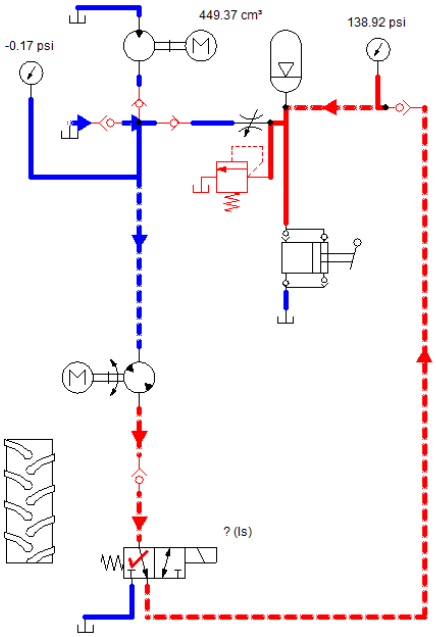
- Automation Studio Simulations



- Direct Drive



- Accumulator Drive

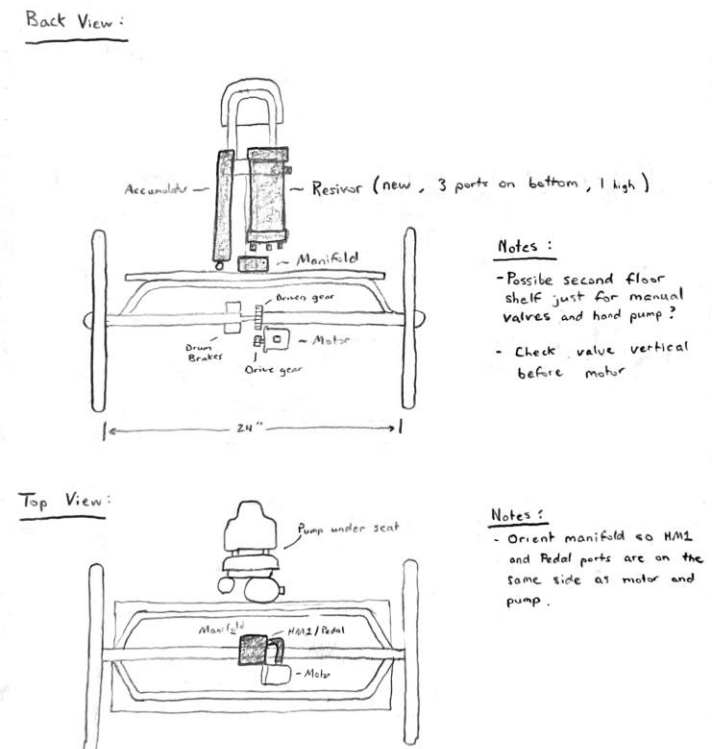


- Regenerative Braking

Vehicle Construction

Layout Process

- Accounted for all needed components
- Drafted basic layout and mocked up positioning
- Finalized design and made order for hoses and fittings



Vehicle Construction

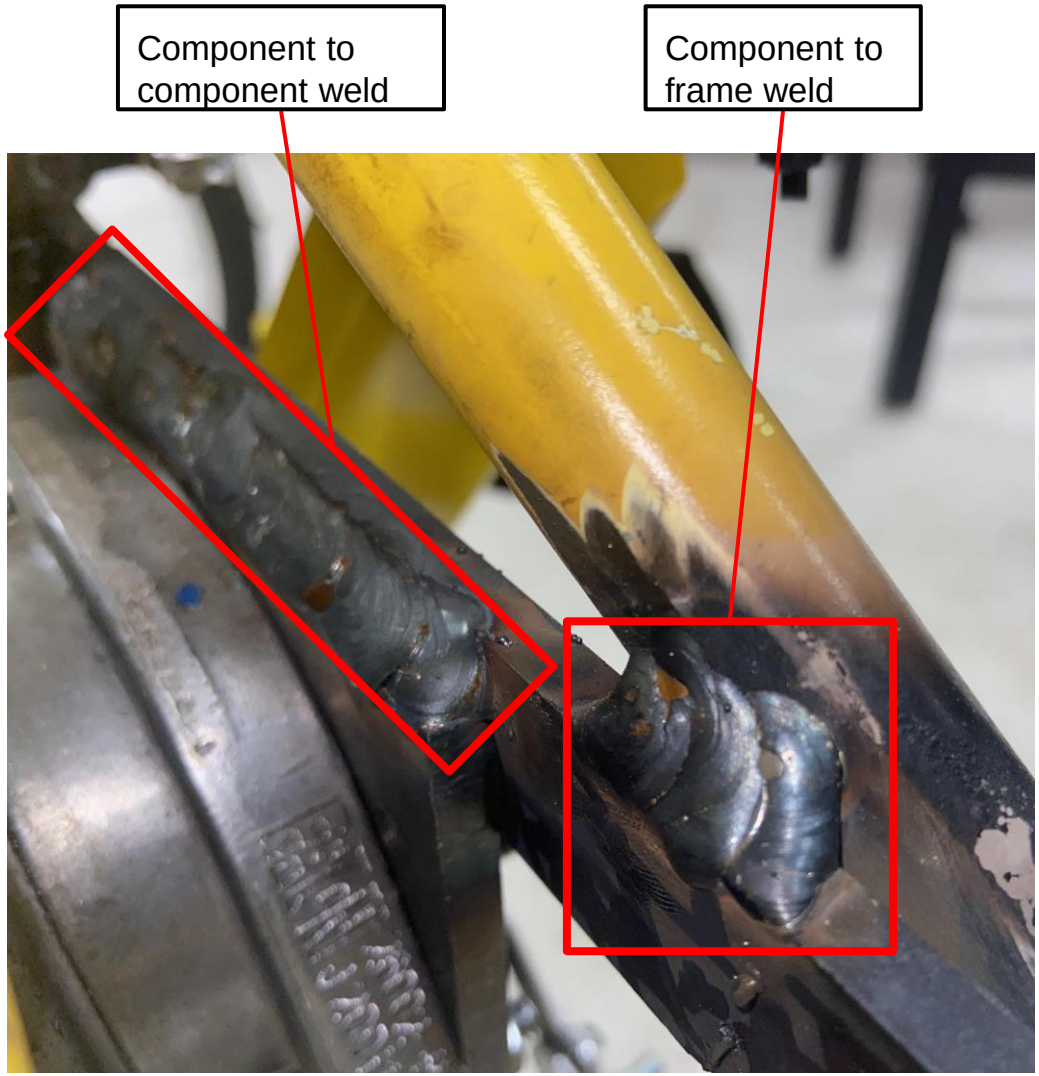
Early Progress

- Focused on mounting components and routing lines
- Placed valves in locations to promote operator comfort

Vehicle Construction

Welding

- Mig
- Difference in materials
- Number of welding points: 16
  - 12 component to frame
  - 4 component to component



Testing

- Proof of Working Vehicle
  - walk through functions of vehicle and verify proper function
- Test reliability of construction
  - endurance testing to find weak points
  - Ensure operator comfort and ease of use
- Make adjustments where necessary
  - Redesign or implement solutions to unforeseen design flaws

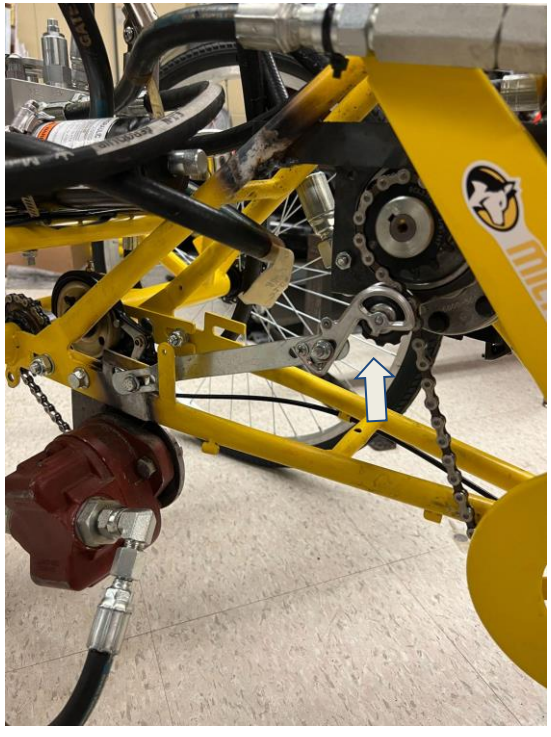
Chain Drives

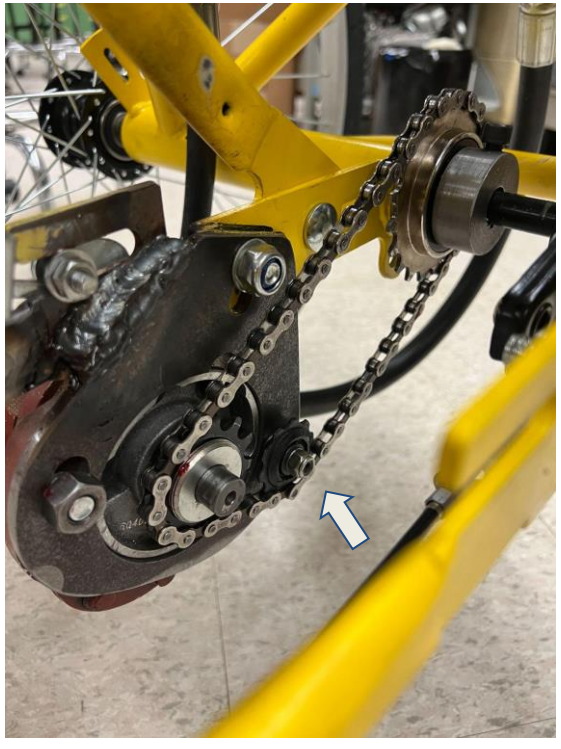
Chain tension

- Rear chain drive failure when regenerative braking: Slack side becoming tension side
- Alignment issues: Chain popping off motor gear

Solutions

- Added location for set screw on shaft gear
- Added shim on motor mount to correct alignment
- Added tensioner for each chain





Pedaling

- Inconsistent pedaling force
  - Poor Operator comfort
  - Poor Efficiency
- Added pedal straps and new aluminum pedals to provide a smoother and more comfortable ride.

Final Product