NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
University of Utah
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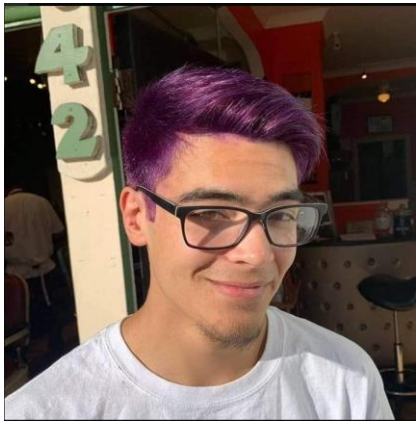

Jonathan Nuttall

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Problem Statement

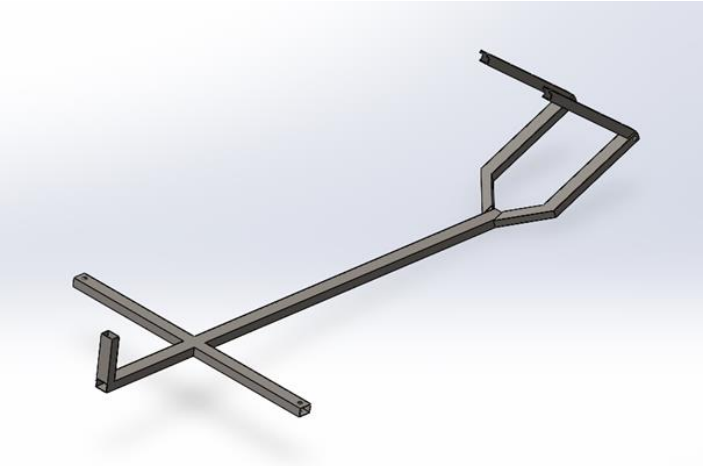
Create a fluid powered vehicle utilizing a hydraulic and mechatronic system to compete in the NFPA Fluid Power Vehicle Challenge, with specific focus on winning **the Efficiency and Endurance Challenge.**

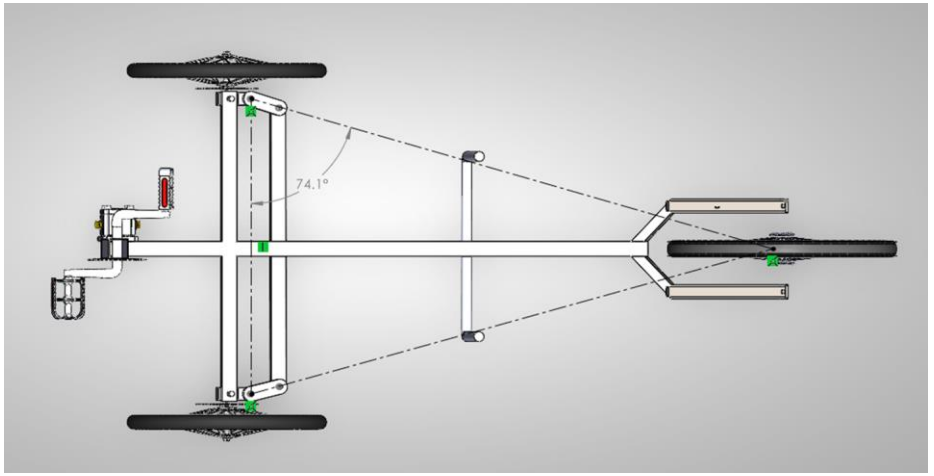
Objectives

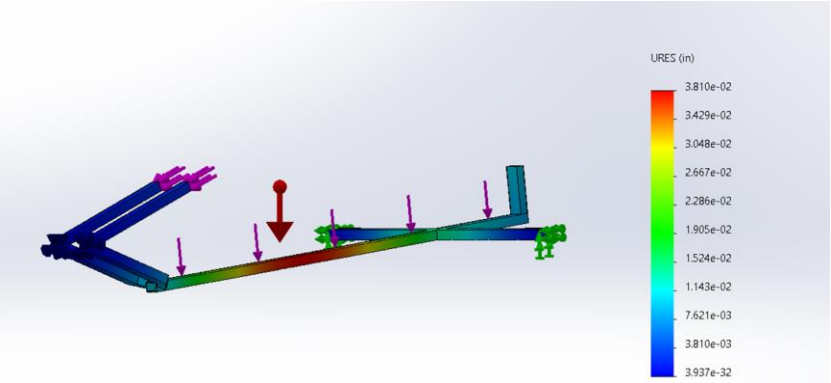
- Build Original Frame – welded from 4130 chrome-moly steel and A36 steel
- Stable while driving
- Able to make turns safely utilizing Ackermann steering
- Last year's hydraulic circuit simplified
  - Single motor
  - Implementation of manifold
  - Only 2 solenoid operated valves

Midway Review Summary

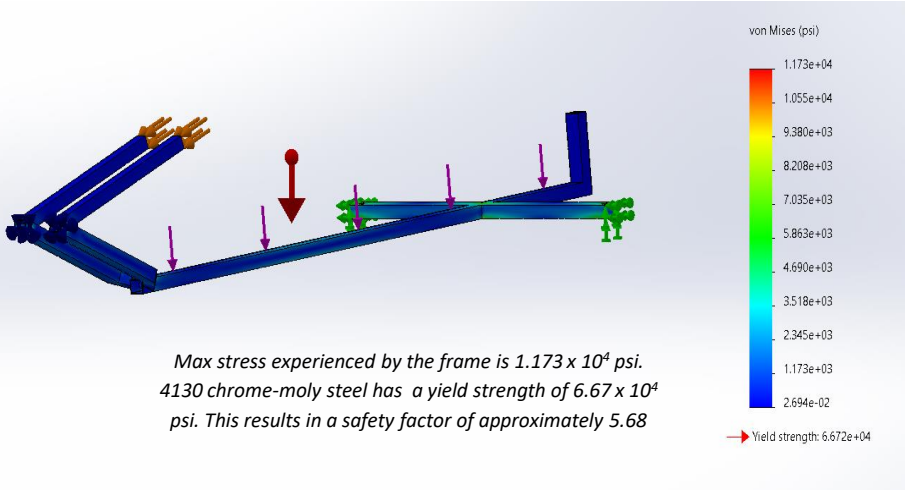
Frame Design





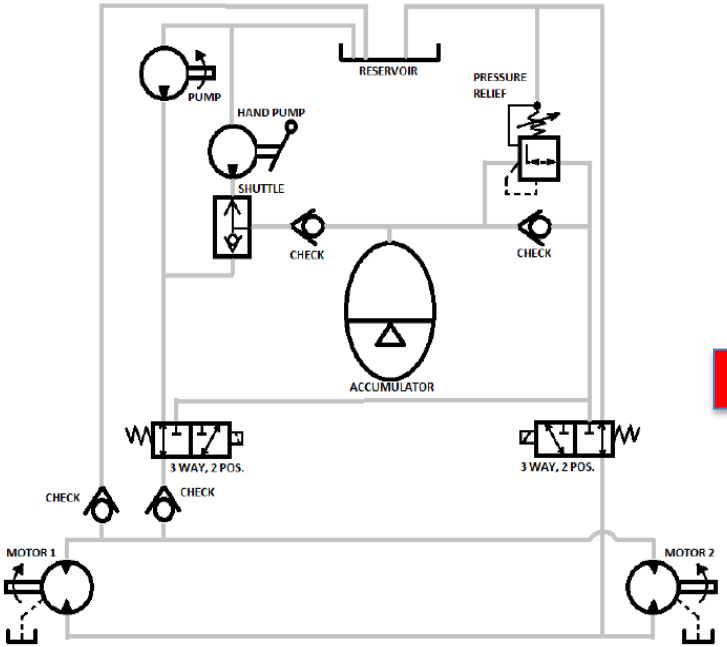


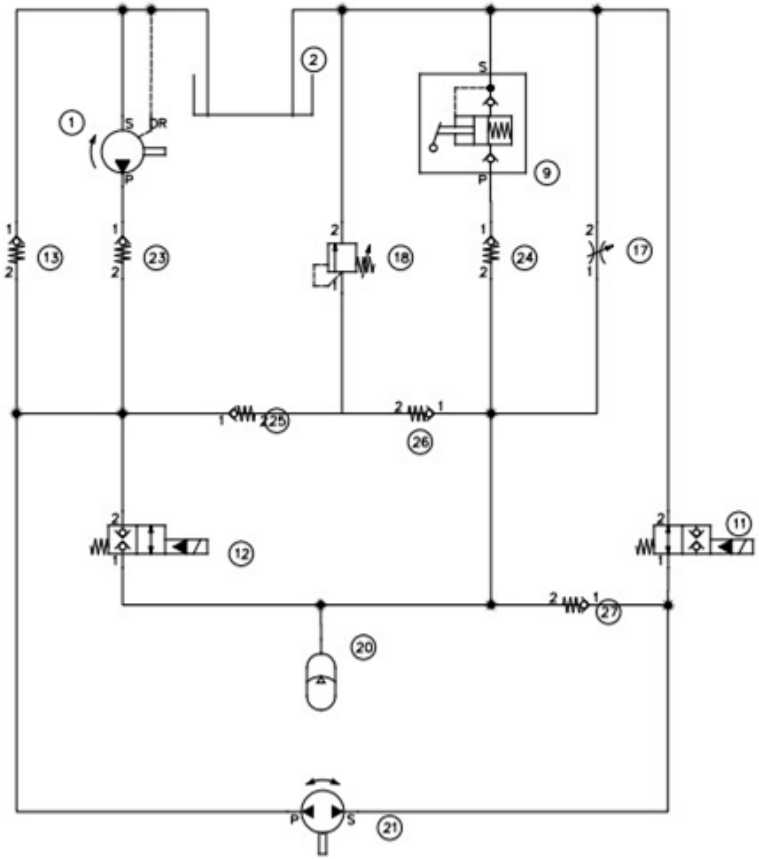
Max displacement experienced by the frame is 0.038 in



Max stress experienced by the frame is 1.173 x 10^4 psi. 4130 chrome-moly steel has a yield strength of 6.67 x 10^4 psi. This results in a safety factor of approximately 5.68

Hydraulic Circuit Design



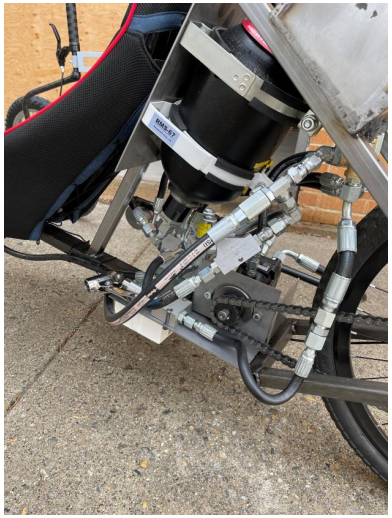


- Single motor
- Remove shuttle valve
- Simplify valve from 3 way to 2 way.
- Utilize SunSource manifold
- Kept solenoid operation for simplicity

Vehicle Construction

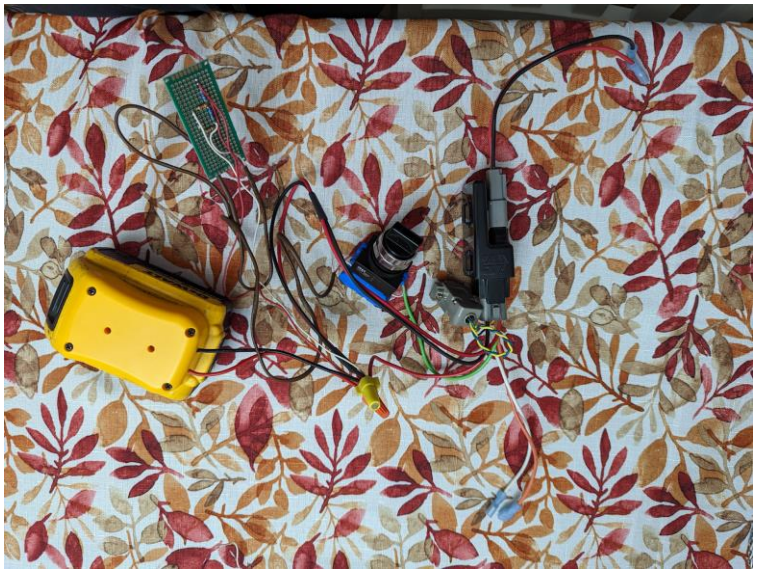
Final frame was constructed out of a combination of 4130 chrome-moly steel (used for structurally critical components) and A36 steel (supports and bearings)

Mounts to hold the components of the hydraulic circuit were made from sheet metal



The prototype frame, actual frame, sheet metal mounts, as well as the front gear were all fabricated and welded at Firefly Automatix

The reservoir was constructed from sheet metal mounts, and pipe fittings were screwed in order to connect the appropriate hoses.



The electronic control system was constructed from a selector switch, DeWalt battery, and controllers in order to operate the two solenoid valves

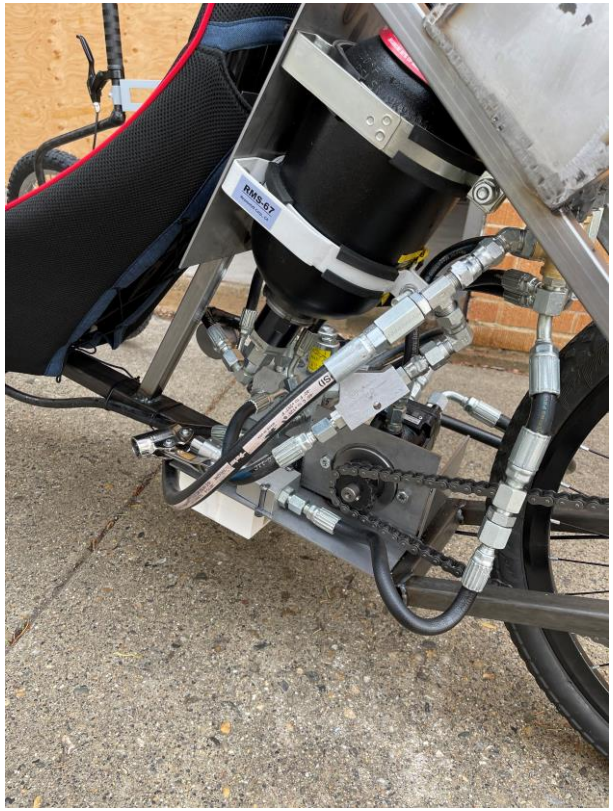
Vehicle Testing

Problems Encountered - Solution

- *Hydraulic fluid leaks* – replaced pipe fittings, tightened lock nuts
- *Motor difficult to start* – run it continuously (on accumulator charge) and push start
- *Difficult to pedal the bike* – reduced front gear ratio from 8:1 to 3:1
- *Difficult to get torque on back wheel* – increased back gear ratio from 3:1 to 4:1

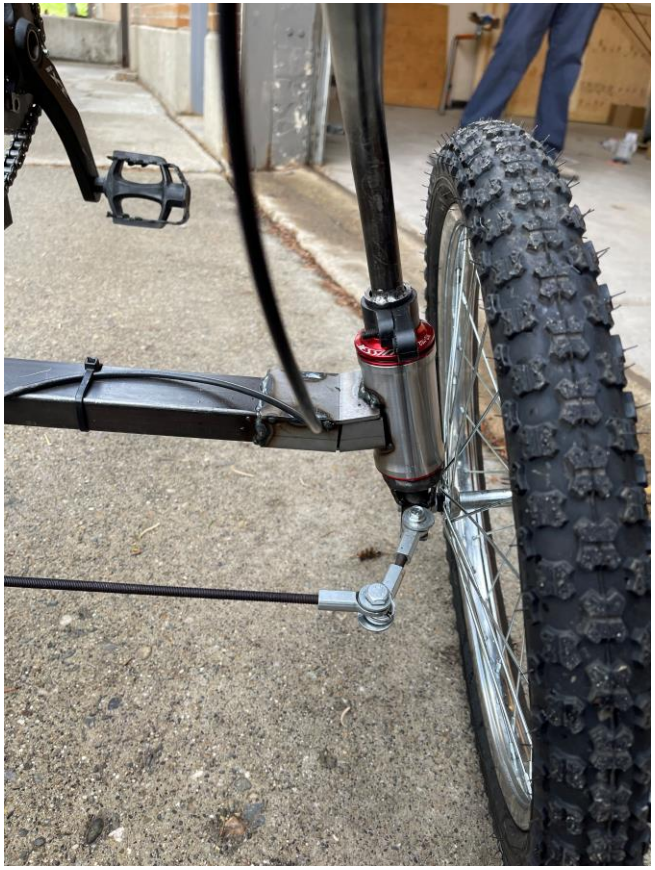
Final Vehicle

Full Vehicle



NFPA Fluid Power Vehicle Challenge

Rear (closeup)



Front (closeup)

Lessons Learned

- Utilize a used gear motor, to reduce stiffness

- Involve industry mentors primarily at the hydraulic circuit design phase

- Make sure to use the previous year's vehicle as a starting point to learn about hydraulics.

- Make major design decisions quickly and focus on specific areas to optimize.

- Keep track of budget as items are purchased

- Utilize a new back wheel with a longer back axle

Acknowledgements

- Ernie Parker
- Mitch Nelson
- Firefly Automatix
- NFPA & NFPA Vehicle Challenge Sponsors
- Travis Schmidt and David Ruxton

Questions?