NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
Purdue Northwest
Ali Alavizadeh
April 26,2022

Team Introduction

Ryan Milly

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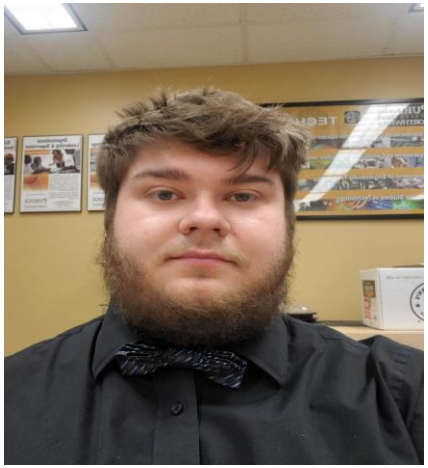
Kevin Davis



Patrick Olenik

Advisor: Ali Alavizadeh

Problem Statement and Objective

Design a vehicle that moves using hydraulics and human power.

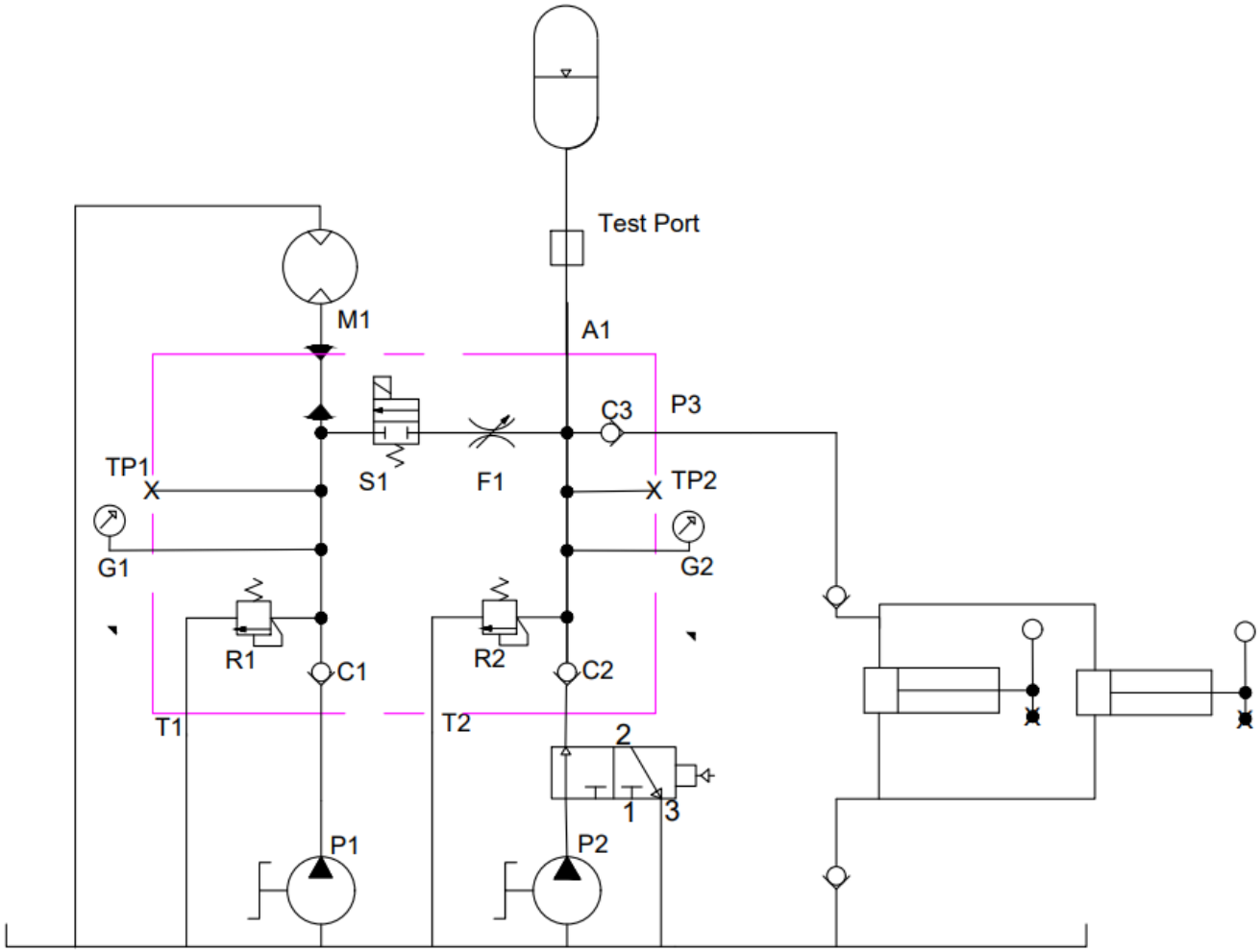
- Construct to weigh under 210 Pounds
- Gear to maximize speed
- Build to be safely operated

Summary Of Midway Review

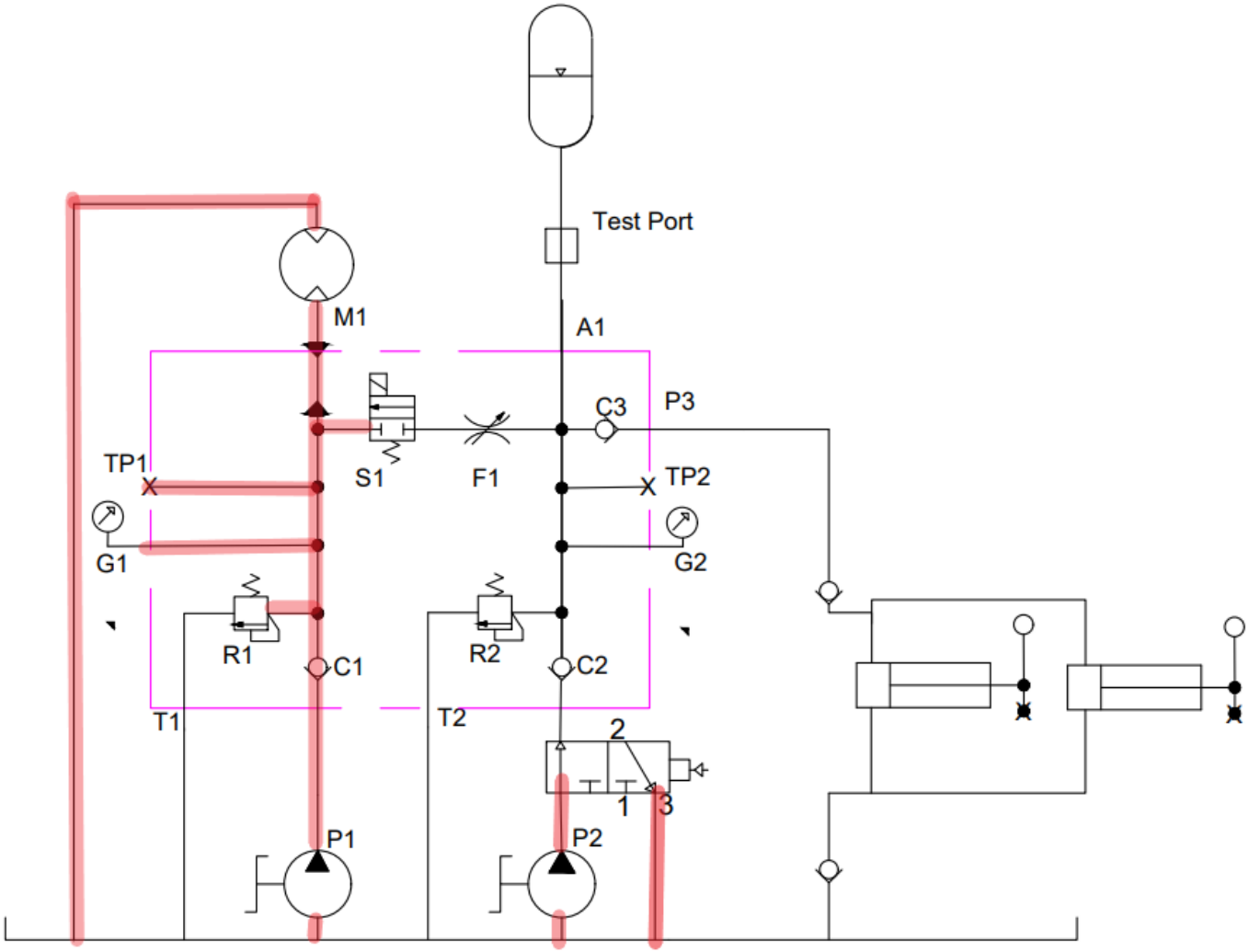
- **Vehicle Design**
  - Vehicle design was mostly new using plans from the previous year
- **Fluid power circuit design**
  - See following Slides
- **Selection of hardware**
  - Hardware from previous year was assessed and other components were required.
  - New Hoses were made approximately 30 feet of hose
  - Approximately 20 feet of 4130 Chromoly was used.
  - New pumps and motors were sourced

- **Results and Incorporation of Analyses**
  - Frame was modified and extended
  - Structural components were stress tested and analyzed for stress.

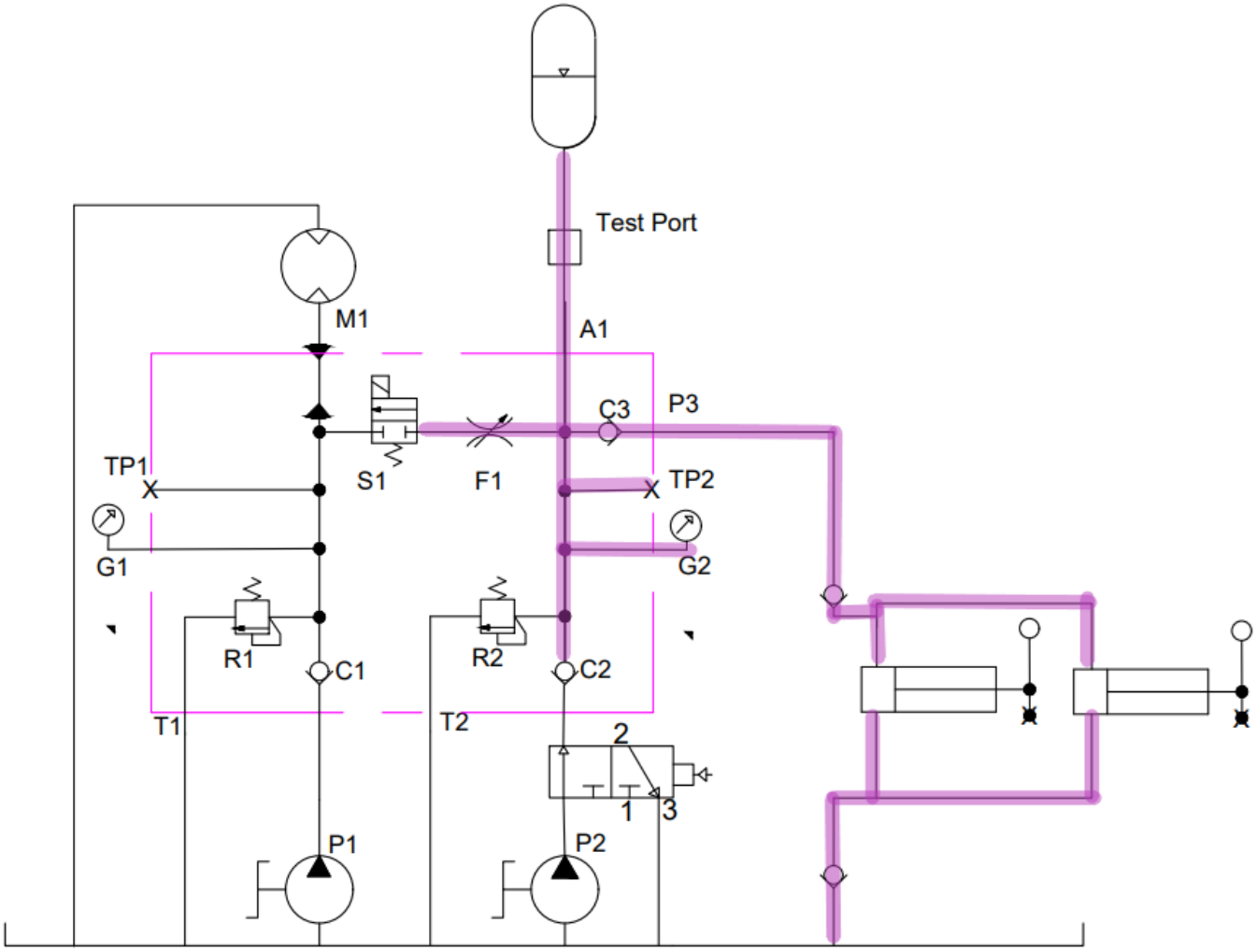
Hydraulic Circuit



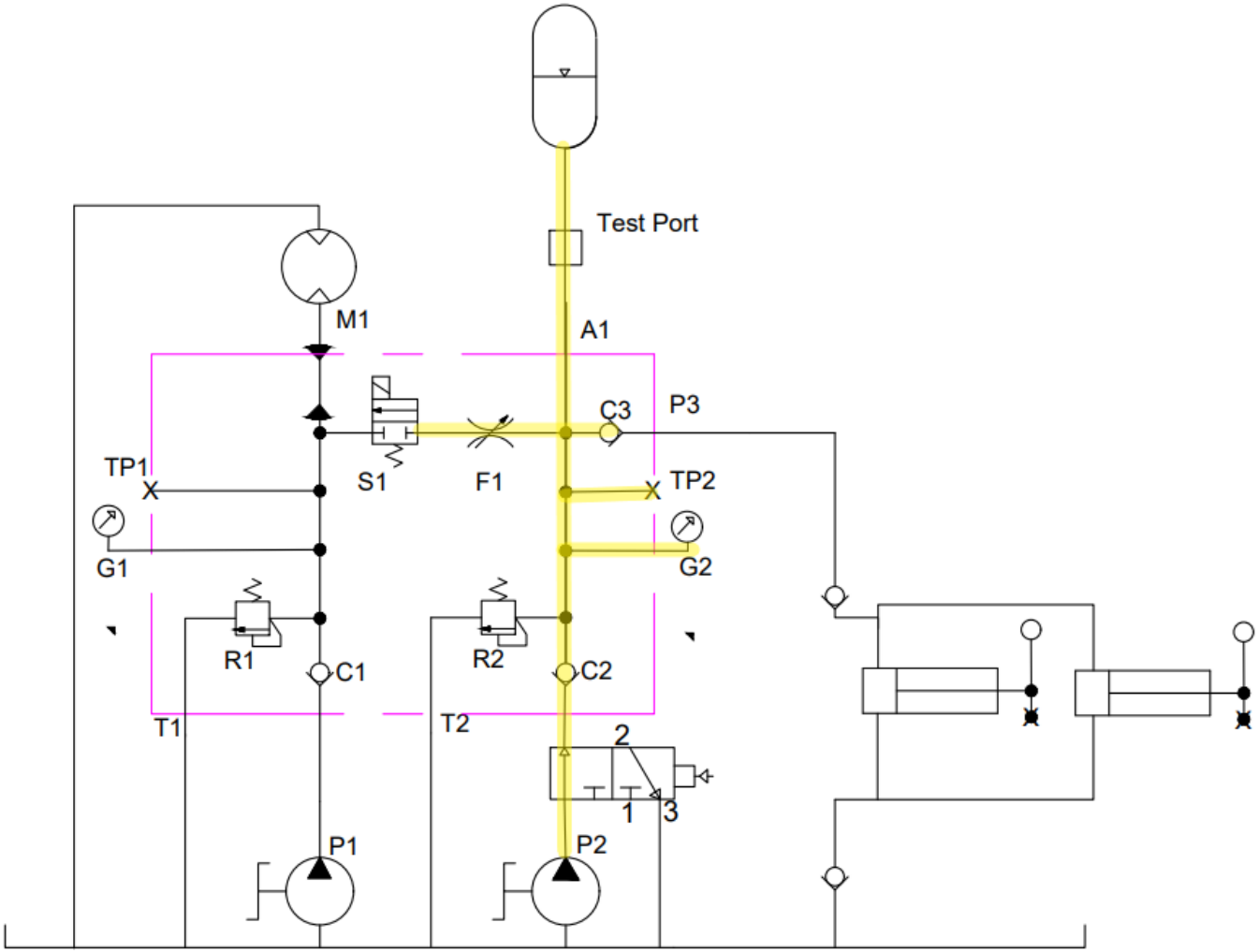
Drive Circuit



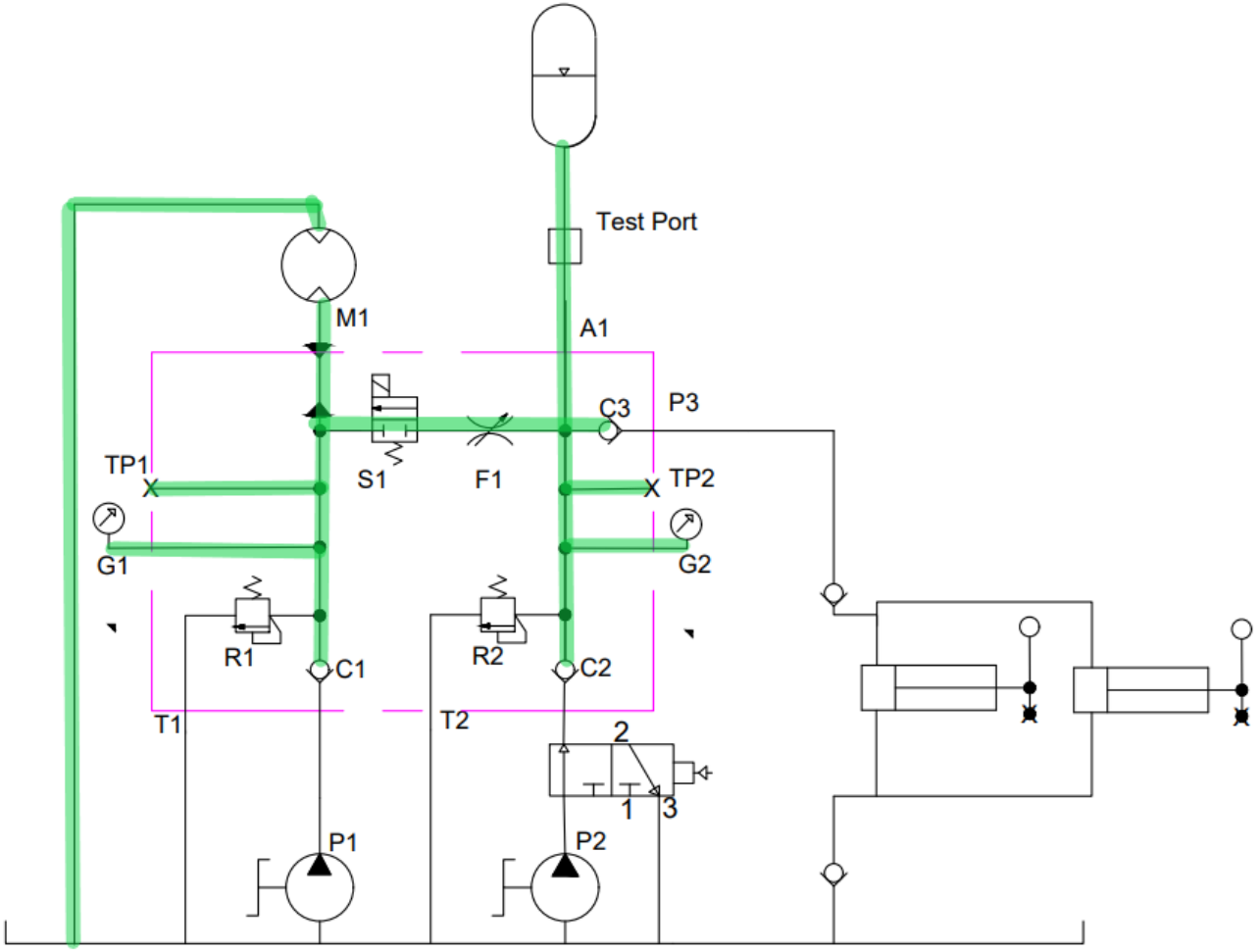
Pressurizing Accumulator



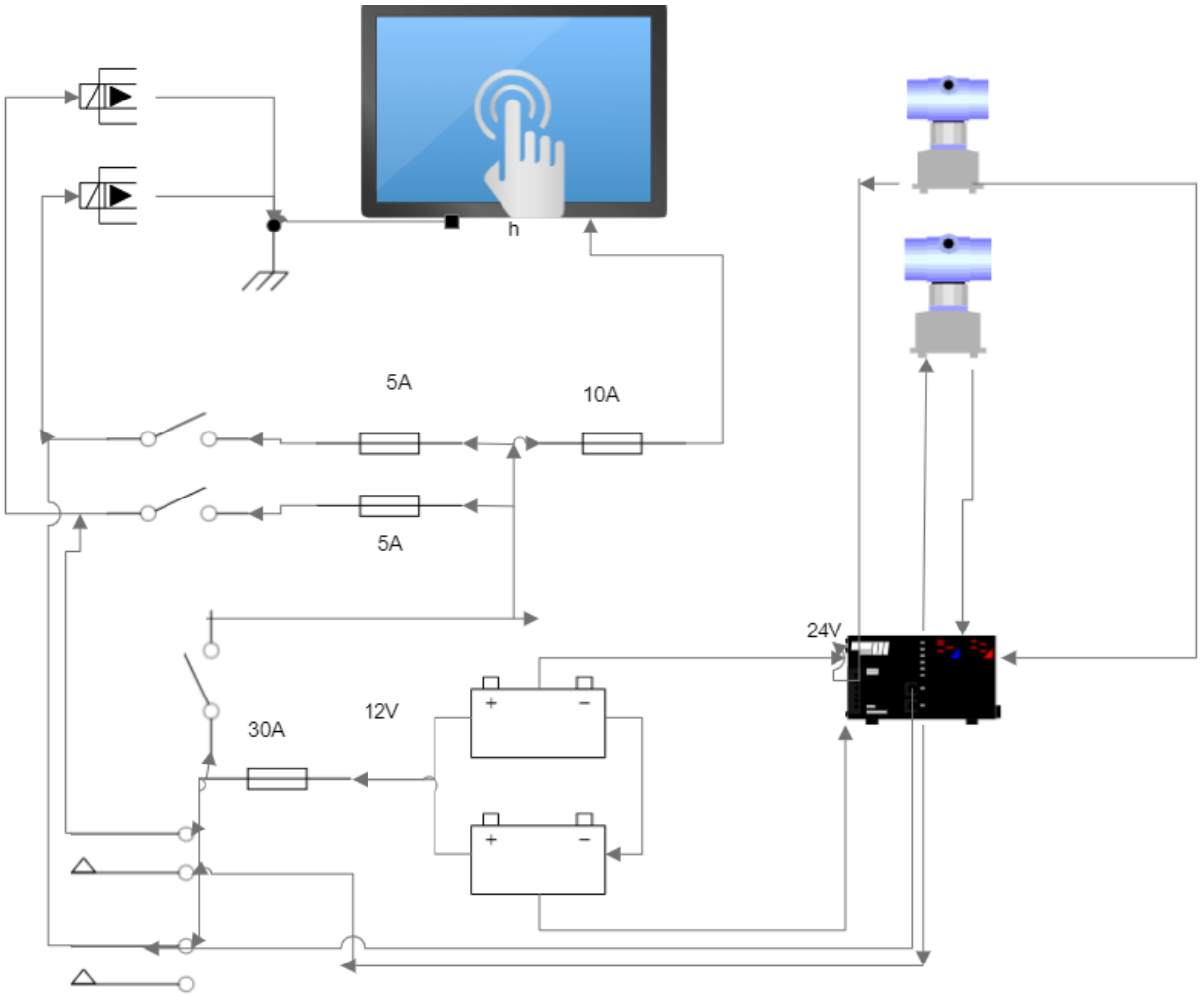
Regenerative Braking



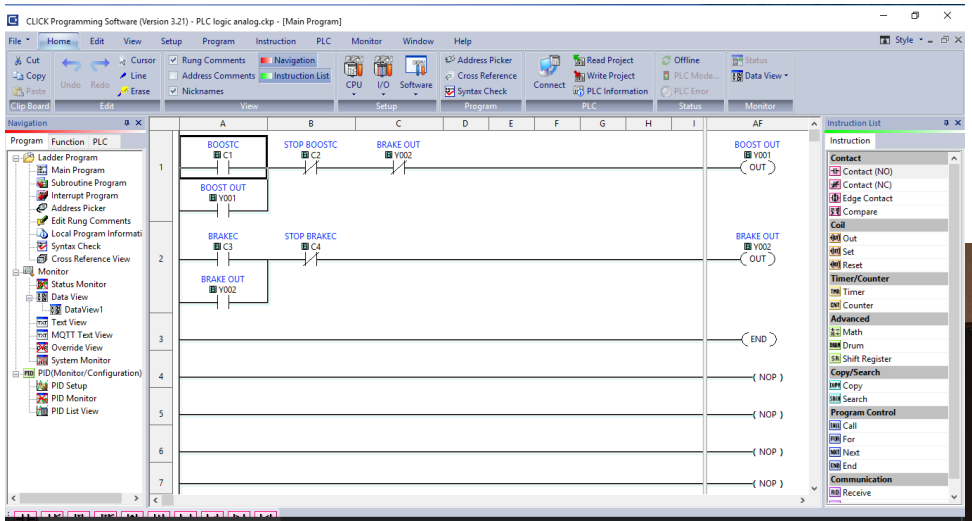
Accumulator Power

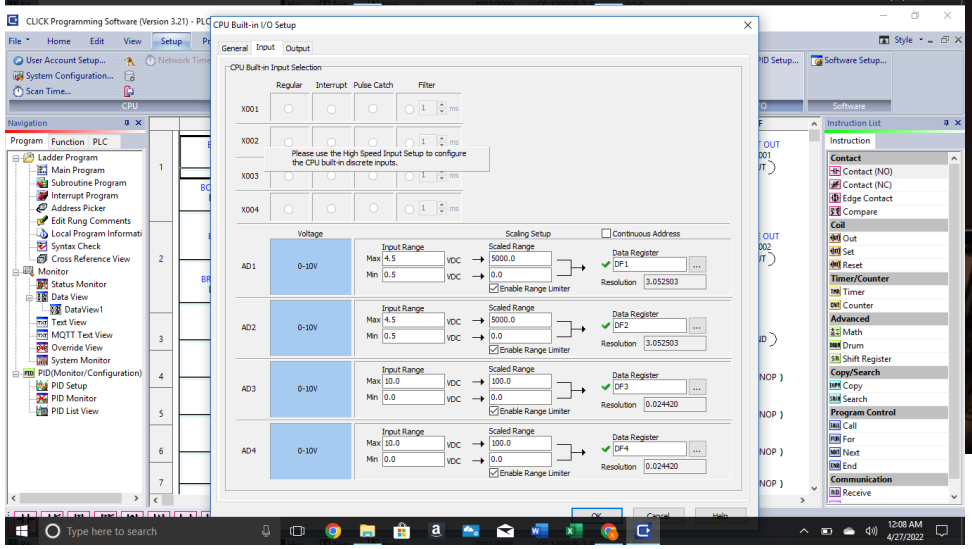


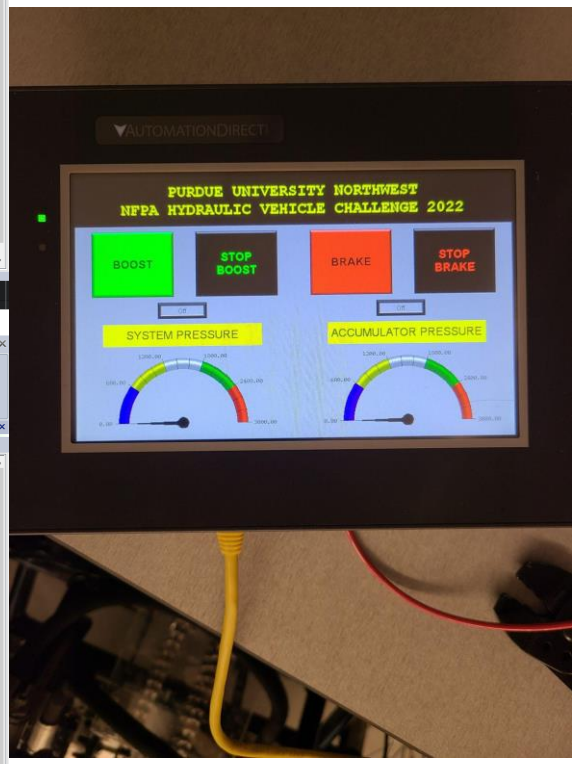
Wiring Diagram



PLC Program


CLICK Programming Software (Version 3.21) - PLC logic analog.ckp - [Main Program]
BOOSTC C1
STOP BOOSTC C2
BRAKE OUT Y002
BOOST OUT Y001
BRAKEC C3
STOP BRAKEC C4
BRAKE OUT Y002
END
NOP
NOP
NOP
NOP


CLICK Programming Software (Version 3.21) - PLC
CPU Built-in I/O Setup
General
Input
Output
CPU Built-in Input Selection
Regular
Interrupt
Pulse Catch
Filter
X001
X002
X003
X004
Please use the High Speed Input Setup to configure the CPU built-in discrete inputs.
Voltage
Scaling Setup
Continuous Address
AD1
AD2
AD3
AD4
0-10V
Input Range
Scaled Range
Data Register
Resolution
Enable Range Limiter
OK
Cancel
Help

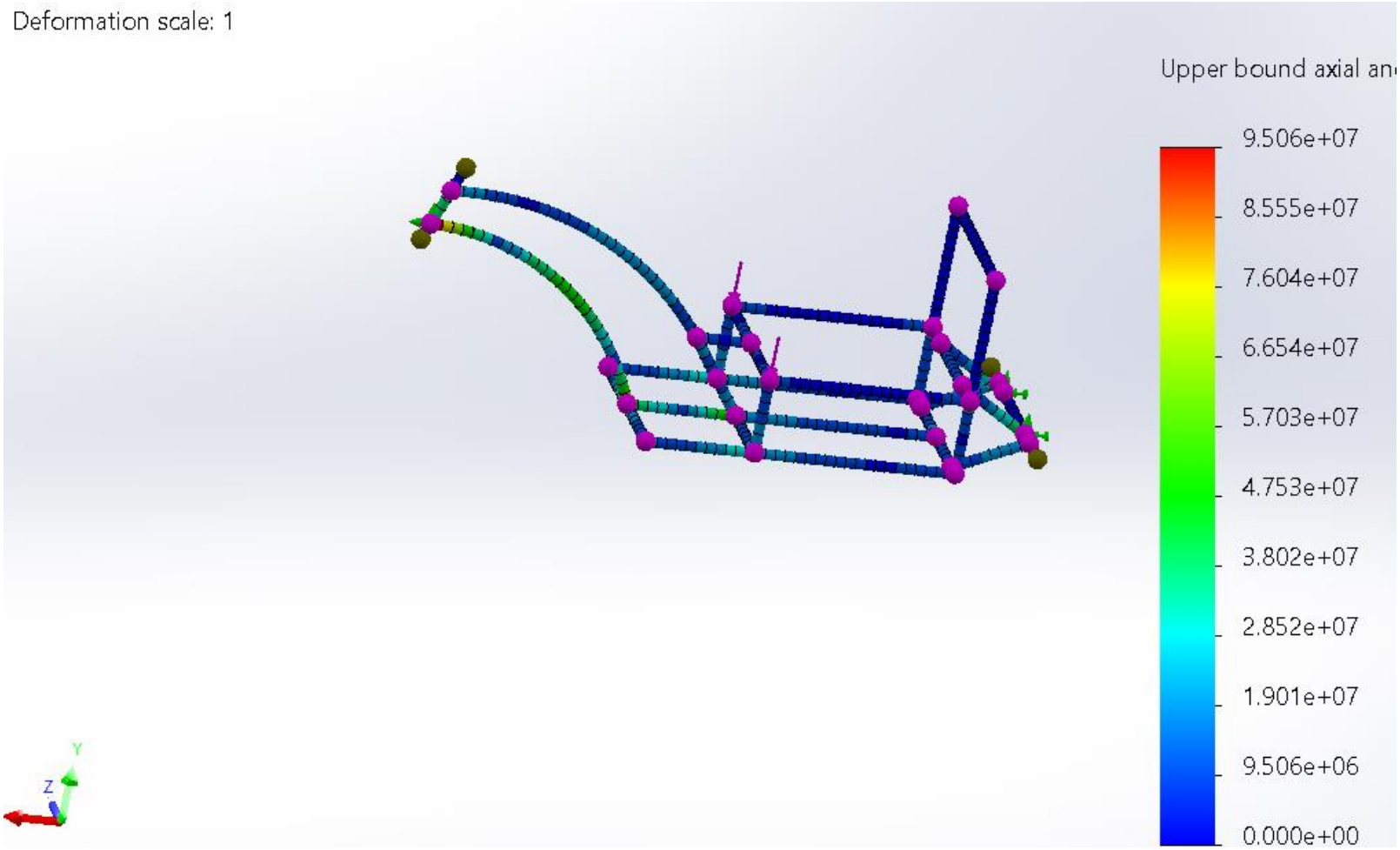

AUTOMATIONDIRECT
PURDUE UNIVERSITY NORTHWEST
NFPA HYDRAULIC VEHICLE CHALLENGE 2022
BOOST
STOP BOOST
BRAKE
STOP BRAKE
SYSTEM PRESSURE
ACCUMULATOR PRESSURE

Vehicle Construction

Vehicle construction was completed on time.

- Frame was constructed and welded by the team.
- Reservoir was plasma cut and welded by team with help of school shop
- Pump and motor mounting brackets were used from last year's team.

FEA STRESS ANALYSIS



Vehicle Testing

- Vehicle testing began April 4th.
- Problems incurred during testing
  - Leaking connections
  - Lose chains
  - Lose bolts
- Fine Tuning
  - Double checked fittings and fasteners
  - Added tension to chains
  - Changed gear ratio
  - Changed chain type and size

Final Vehicle

- Frame made of 4130 Chromoly Pipe
- Comfortable for one rider and ergonomic to pedal.

Racing Prep

- Sprint
  - Seems fast but is slow to start
- Efficiency
  - Stores energy for a while
- Endurance
  - Managed 5 plus laps around our parking lot

Lessons Learned

- Nothing stays on schedule
- How much time that a task is estimated to take double it.
- Lead times are very important and not always correct.
- Parts availability was difficult.
- Knowledge is power.

Thank You