NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION

Purdue University - WL
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Team Intro

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Outline

- Problem Statement & Objectives
- Progress Since Midway Review
- Vehicle Construction
- Vehicle Testing
- Encountered Technical and Electrical Challenges
- Lessons Learned
- Final Implemented Design

Problem Statement

Objective:

- Create a human powered vehicle that transmits power hydraulically and is capable of recovering and storing energy

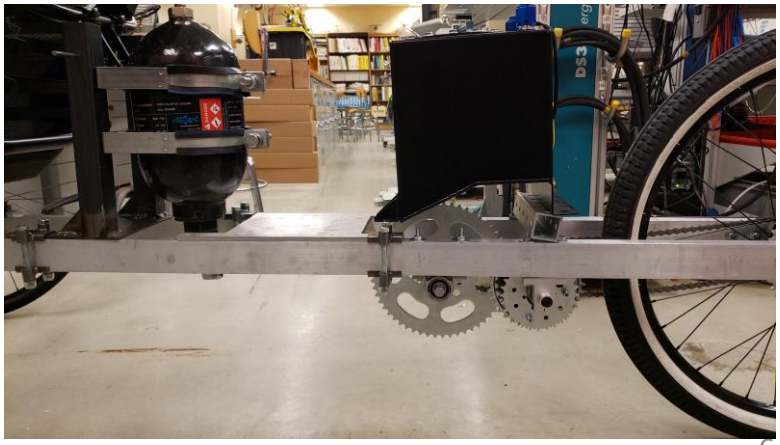
Challenges:

- Sprint
- Efficiency
- Endurance

Pre-Midway Review

CAD of Frame	FEA Completed
	BOM for frame
Hydraulic System	Completed Schematic
	Simulated
	Gear Ratio Calculations
	Pump Motor Sizing

Vehicle Construction
Mechanical System



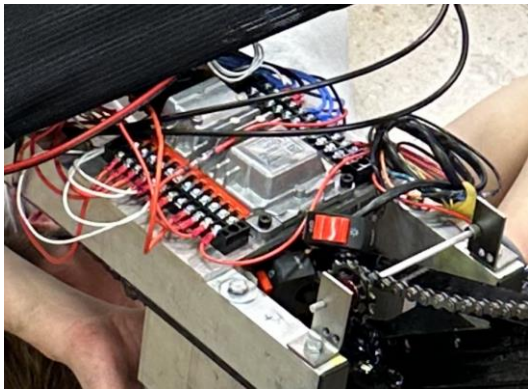
Vehicle Construction
Hydraulic System

Vehicle Construction
Electronics

HMI - eX705

- Current Speed
- Hydraulic Pressure
  - Motor
  - Accumulator
  - Low-Pressure Alarms
- HMI Mounting Arm

HY-TTC 32



- Sensor data collection
- Input/ Output of all data for bike

- PLC mounting plate
  - Electrical Busses

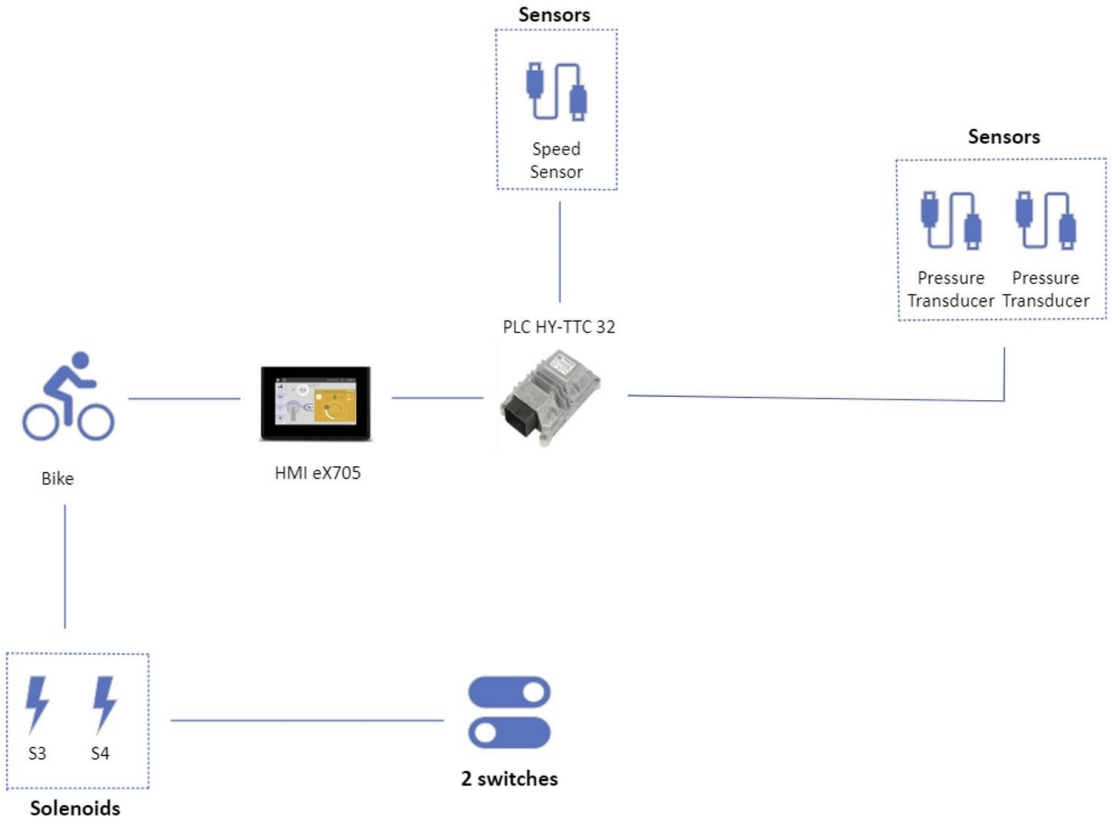
Handlebar Toggle Switch

- Directly wired to solenoids
- Basic ON/OFF switch

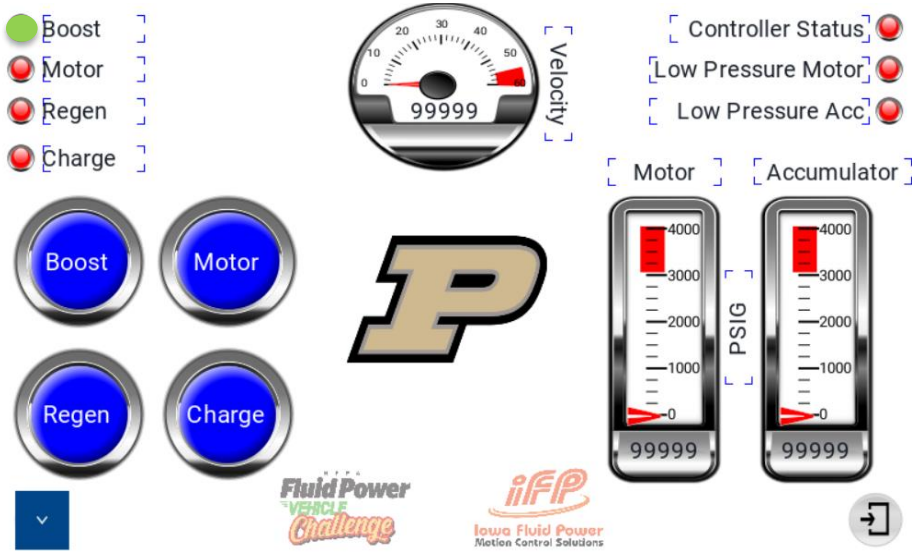
Vehicle Construction
Electronics

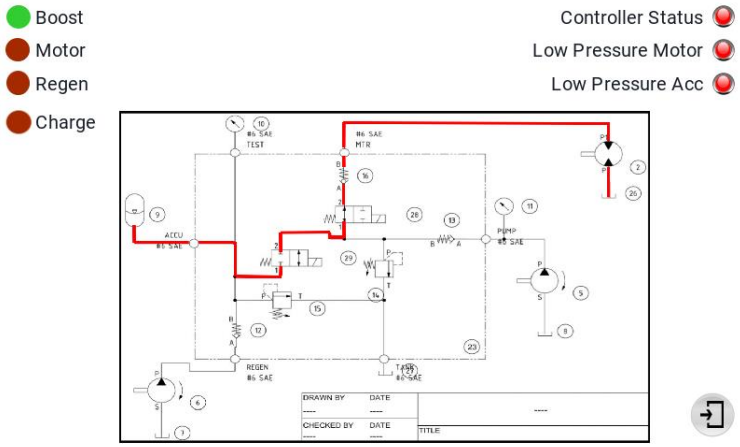
- PLC and HMI used to interface with the rider
- Manual Switches
- Pressure Transducers
- Magnetic Sensor

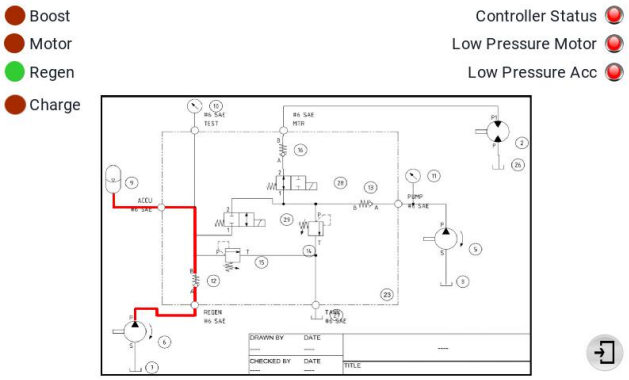
- HMI Software – Jmobile
- PLC Software – CodeSys

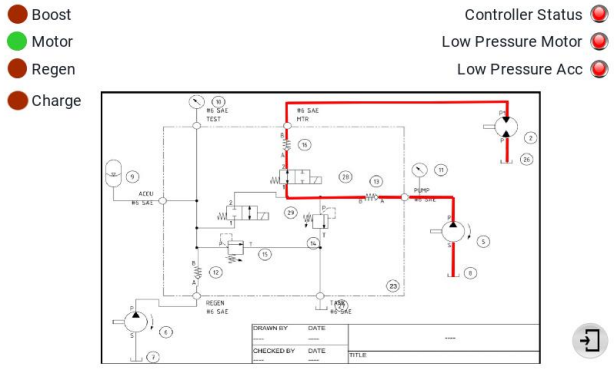


Vehicle Construction
Electronics









Vehicle Construction

Electronics

- Design Challenges:

Solenoid Connectors	Power supply 12V vs 24V
PLC coding difficulties	Inconsistencies between HMI and PLC code

Vehicle Testing

Wheel Camber

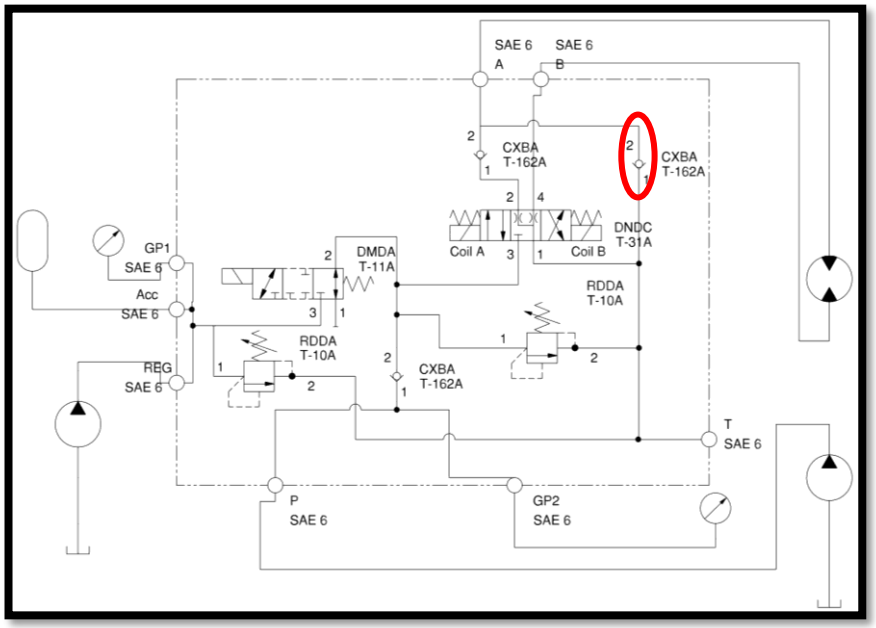
Bottom Bracket
Thread Direction

Vehicle Testing

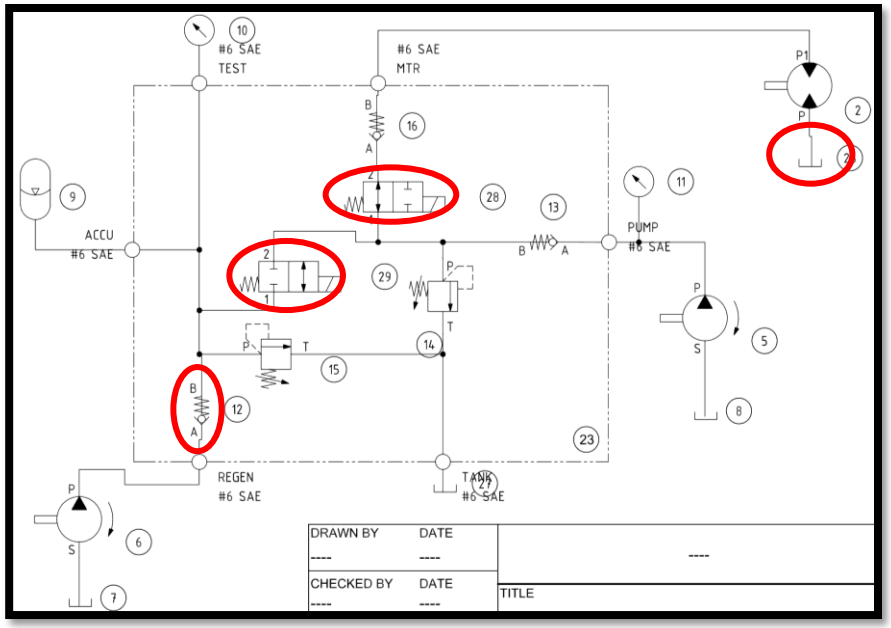
- Hydraulic system issues and solutions
  - Pumps were connected backwards leading to fluid flowing backwards in the system
    - Hard lines were remade to connect pumps properly
  - Motor stalled and would not run under load
    - Motor needed to be broken in under load and was run on a test bench

Old vs. New Circuit

OLD



NEW



- Cancel 1 check valve

- Add 1 check valve for regen pump
- Change direction valves to 2W2P
- Motor outlet directly to reservoir

Technical and Electrical Challenges

- Solenoid connectivity with hardware difficulties
- Power supply for solenoid valve had to be changed
- PLC actuation of solenoid valve challenges
- Accumulator difficult to charge
- Regen clutch

Lessons Learned

Short hardlines work!

Different gear ratios for different competitions

Having the bike work with no electronics

Final Implemented Design

Thank You!

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