NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

Final Review
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04/19/22

MURRAY STATE UNIVERSITY

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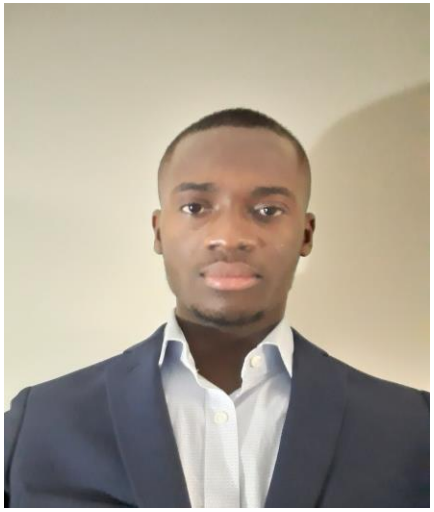

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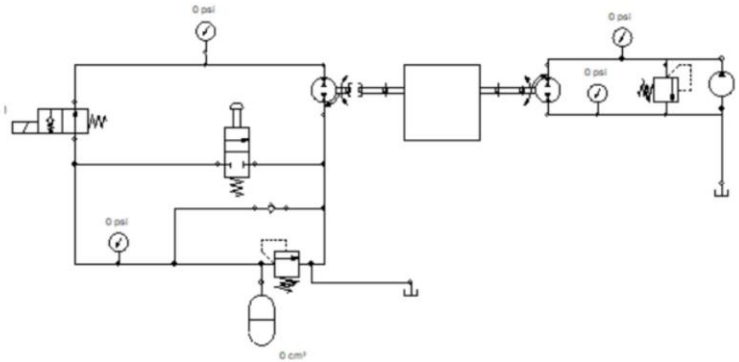
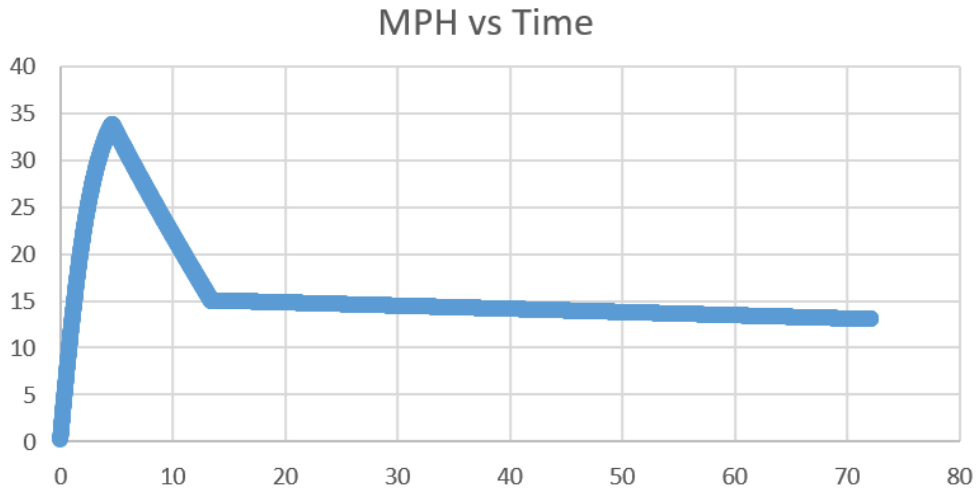
Midway Review

- Design Objectives
  - Prebuilt Frame
  - Automated Shifting
  - Implement Pneumatics for controls
  - Improved Clutch Design
- Vehicle Design
  - Tadpole Styled Recumbent Trike
  - 90% Prebuilt
- Fluid Power Circuit Design
  - Continued Simplification and Saftey-centered design



Midway Review

- Selection of Hardware
  - Marzocchi Alm1a-R-9-E2 for Human Input Pump
  - Marzocchi Alp1a- d-7 for Human Input Motor
  - Hydroleduc M 5 for Accumulator Pump/Motor
- Results and Analysis



Vehicle Construction

- Pre-built and Modified Frame
  - 90% pre-assembled
  - Modified the back wheel to allow for dual power input and output
  - Modified sprocket system
- Steel Mounting
  - Plate underneath rider for hydraulic components
  - Frame behind rider for reservoir and electronic mounting
- Wiring
  - Wiring was planned to route through the hollow tube Frame seating

Vehicle Construction

- Baker transmission
  - A baker 5 speed transmission with a custom reverse box is used for power transmission of the accumulator
  - Use of additive manufacturing and machining were implemented to allow the use of sprockets in areas where needed
- Pneumatics
  - Air actuators are used for shifting gears and engaging regeneration via control solenoids

Vehicle Testing

- Hardware was tested on bicycle trainer
  - Vehicle charging and accumulator release
  - Electronic controls and shifting
- Software was adapted and altered to offer more versatile control manually
  - Riders have complete control over shifting both transmission and cassette disc
  - Current bike is configured to allow for the vehicle to be manually tuned to riders specifications
- Tested to discharge and propel vehicle at speeds exceeding 15 MPH

Vehicle Testing

- Programming
  - Designed for simple wiring and central storage
  - Allows for proper shifting of transmission via timed pulsing of pneumatic DCVs
  - Automatic shifting during accumulator discharge
    - Shifting based on RPM
    - RPM measured using an optical sensor and prism reflector

Final Vehicle

- Discharged vehicle can exceed 15 MPH
- Vehicle Weight ≈ 200lbs
- Charging circuit works reliably
- All proper shielding has been installed
- Pressure relief valves set to cracking pressure of 3000 PSI
- Craftsmanship has been inspected by industry professionals

Lessons Learned

- Pre-made frames offer their own difficulties
- Initial design should be inspected thrice over
- Overzealous design leads to difficult work
- Diversity of skills is required
- Professional appearance should not be neglected
- Clear communication is required
- Account for needed tools
- Centralize planning
- Organize and document all work
- Minimize multiple purchases and make them as soon as possible
- Meet as often as needed