Department of MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

NFPA Fluid Power Vehicle Challenge

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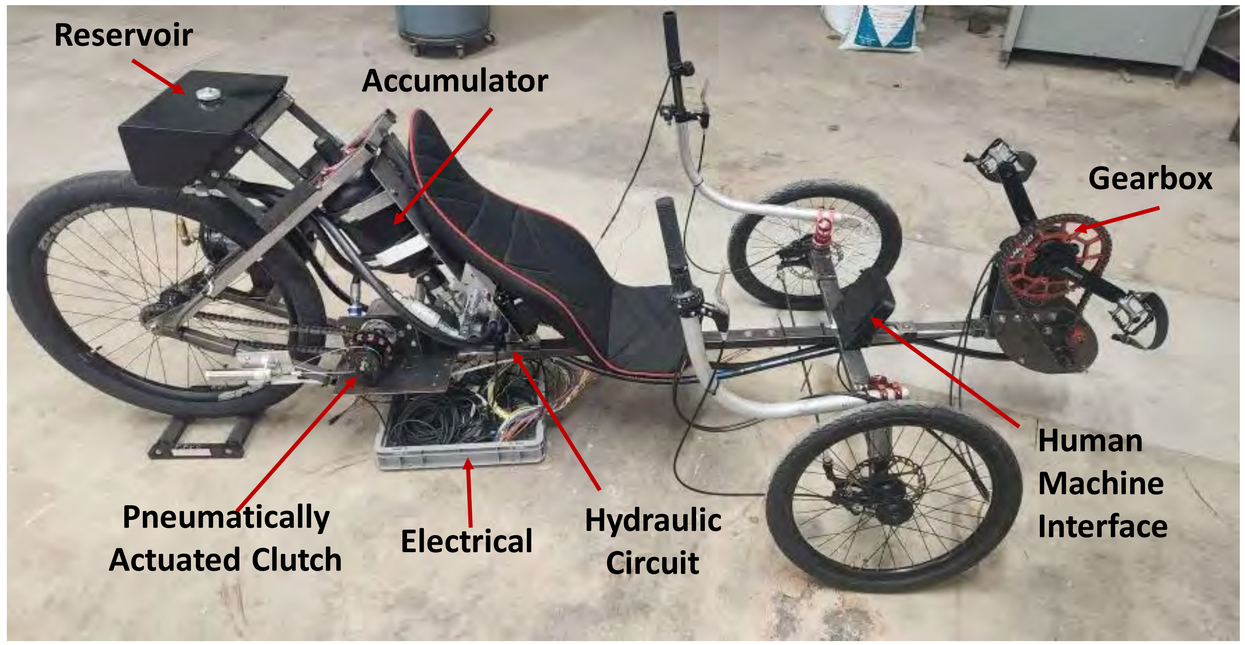
NFPA Fluid Power Vehicle Challenge

Competition Description

The NFPA (National Fluid Power Association) holds an annual competition for university teams in which teams build a human-powered, fluid-driven vehicle. Instead of the pedals turning a regular bike's back wheel these vehicles have hydraulic components (usually a motor, pump, manifold, and accumulator). Teams from various schools come together at the end of the year to compete in a variety of competition challenges. The purpose of the competition is to expose students to the fluid power industry and provide an opportunity for a hands-on engineering experience.



Drive Modes

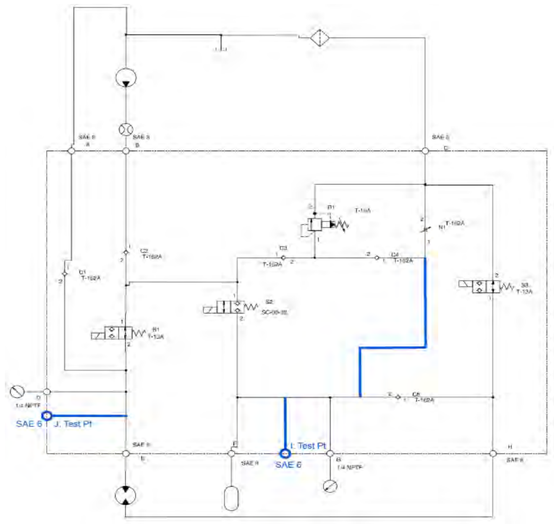
The vehicle has four modes for the various competition objectives, Direct Drive, Regenerative Mode, Boost Mode, and Charge Mode

Upgrades from Prior Design

- We kept the frame from last year but redesigned the entire hydraulic circuit using a new pump, motor, manifold, and clutch.
- We extended the pedals and made them adjustable to fit multiple riders.
- We added a clutch to allow the vehicle to coast freely when regeneration is not needed.
- We installed a PLC based control system to replace the existing Arduino system.

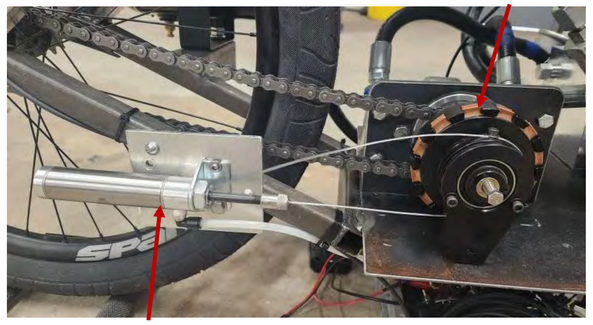
Hydraulic Circuit

The most critical part of the vehicle is the drive system which consists of a hydraulic pump, motor, accumulator, and manifold. The manifold uses 3 solenoids to change where fluid flows in the system which changes the drive mode. The accumulator stores pressure using a bladder filled with pressurized nitrogen. The pump and motor convert rotational motion to fluid pressure and then fluid pressure back to rotational motion.



Clutch System

The clutch allows the rider to engage and disengage the motor and either gain speed going down hills (disengaged) or use the friction to charge our accumulator (engaged).



Performance

The bike has a top speed of 8 mph in direct drive mode and 25 mph with accumulator boost. Using accumulator pressure alone the bike can coast more than 500ft. At full speed in direct drive the bike can come to a complete stop in less than 20 feet. One improvement that could be made is decreasing the force required for direct drive.