Team 26.5

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Mentors: Dr. Jose Garcia-Bravo, Purdue Fluid Power Club
Professor Fred Berry

Customer Background

The Purdue Fluid Power Club is sponsored by the National Fluid Power Association to participate in the Fluid Power Vehicle Challenge. The FPVC gives students the opportunity to design and implement a hydraulic/mechanical/electrical system to compete against other universities.

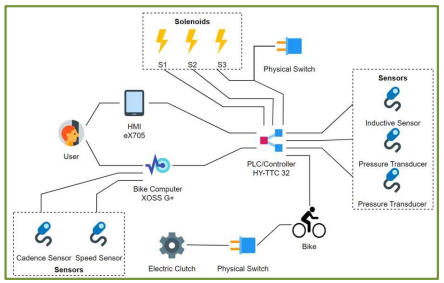
Problem Statement / Scope of Work

Create an efficient electronics control system for managing solenoid valves and sensors on a Fluid Power Vehicle.

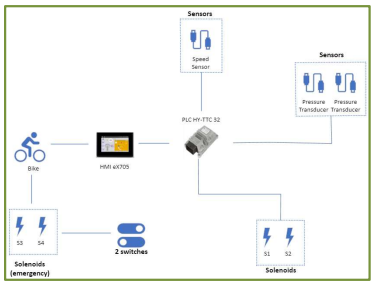
Requirements

Req #	Design Rationale	Design Targets	Validation	Rationale
1	Actuate two solenoid valves.	Solenoids allow for necessary mode changes.	Each mode will be tested, ensuring hydraulic function.	Criteria was given to us by Dr. Jose Garcia-Bravo and the FPC.
2	Controller battery no more than 24V.	Electronics not able to use more than 24V.	Multimeter used to check battery output.	Criteria was given to us by Dr. Jose Garcia-Bravo and the FPC.
3	Read speed/ pressure sensors.	Rider knows bike speed, accumulator and motor pressure.	Tested using physical pressure gauges.	Criteria was given to us by Dr. Jose Garcia-Bravo and the FPC

Experimentation and Concepts



2021-2022 FPC Final Electrical Design

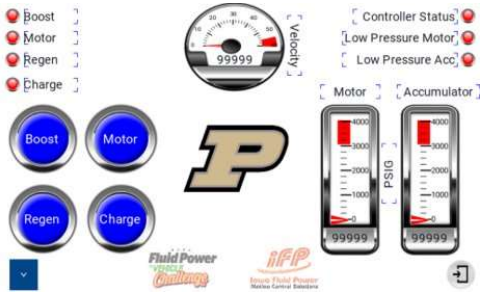


2022-2023 FPC Final Electrical Design

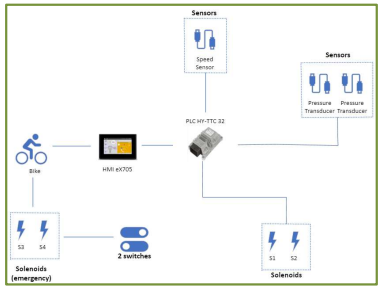
Changes From 2021-2022 Electrical Design to Now:

- Solenoid valves controlled using toggle switches now rather than the HMI, allows for functionality of bike even in case of PLC failure.
- Removal of electric clutch, XOSS G+ bike computer. These were unnecessary components for the new design.
- New Hydraulic circuit only requires two solenoids, rather than three.

Final Design



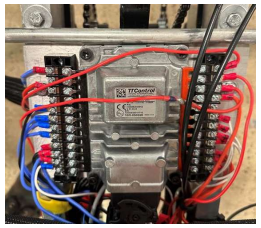
PLC Design



Circuit Design

Speed Sensor

Competition



PLC Wiring

Failure Mode and Effect Analysis

Key Process Step	Failure Modes	Failure Effects	S E V	Potential Causes	O C C	Current Controls	D E T	Action Taken
Programmable Logic Controller	Communication loss	Cannot control system	8	Insufficient power	4	Refer user manuals, compile code in chunks	3	PLC tested regularly and placed securely
HMI Display	No data displayed	User unable to monitor data	3	Insufficient power, improper PLC connection	4	Refer user manuals and industry expert	3	Fixed tag connections
Electrical Wiring	Communication loss	Unstable operation	3	Cables too short or overheat	3	Ensure physical connectivity while in motion	2	Connections soldered, longer cables used
Components Mounting		Wobbly or unstable structure	3	Uneven surface, weight undistributed	3	Check structural integrity and surface area	3	Cable mounting plate created and tie-wrap used to secure cables

Testing

Step	Test	Details	Outcome
1	Power Test	The Power supply outputs 24 Volts to supply power to the PLC, HMI, and solenoid plugs	All components are suitably powered with no issues.
2	Connectivity Test	The PLC and the HMI communicate with each other to transfer data.	Connection was established between the two devices.
3	HMI Tag Test	Buttons send tag signals to the PLC, and receive tag signals from the PLC.	Upon actuation, buttons control tags and send and receive bits to and from the PLC.
4	Pressure and Speed Test	The pressure transducers and magnetic sensor transmit values to the HMI.	Pressure and speed values update as the bike runs on the HMI.
5	Page Test	Circuit diagrams display on HMI with button inputs.	Each mode shows the relevant circuit display.