NFPA
Education and
Technology
Foundation

FINAL PRESENTATION &
DESIGN REVIEW
University of Cincinnati
Dr. Muthar Al-Ubaidi
April 15th, 2026

Team Introductions

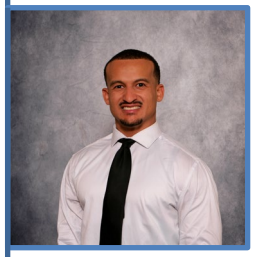
- Amelia Roney
- Cole Weaver
- Mason Roy
- Sam Kohls
- Nicholas Brito
- Favour Kongyu
- Muthar Al-Ubaidi (Advisor)

Amelia Roney
MET 2026,
Minor
Robotics and
Automation

Cole Weaver
MET 2026,
Minor
Robotics and
Automation

Mason Roy
MET 2026
RIAS 2026

Sam
Kohls
MET 2026

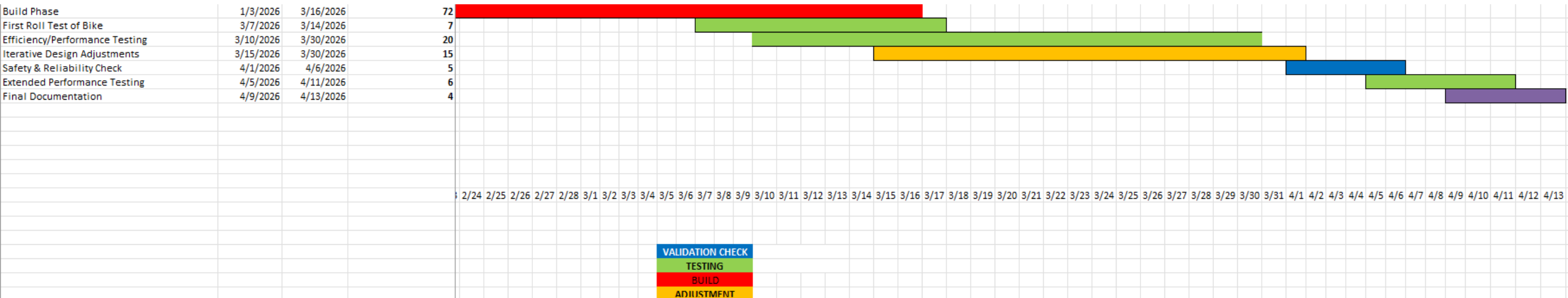


Nicholas Brito
MET 2026,
Minor
Robotics and
Automation

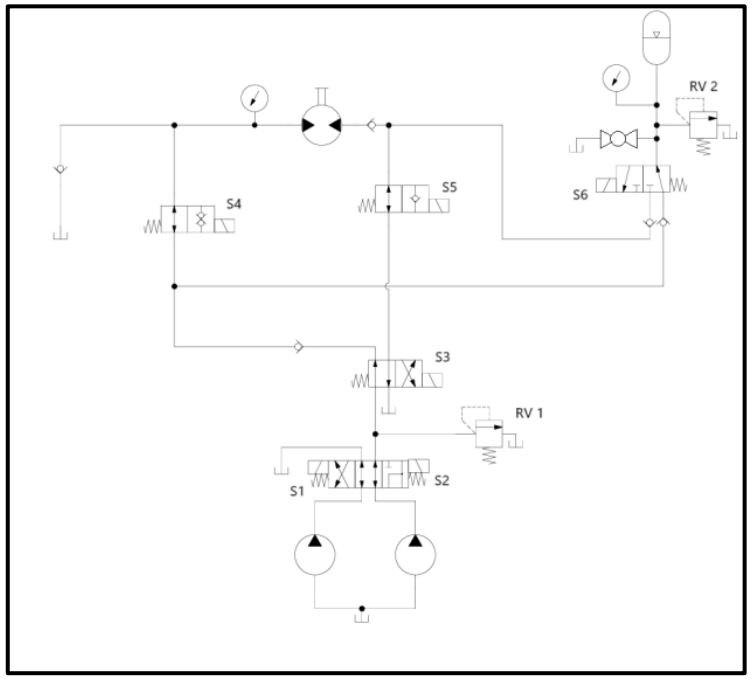
Favour
Kongyu
MET 2026

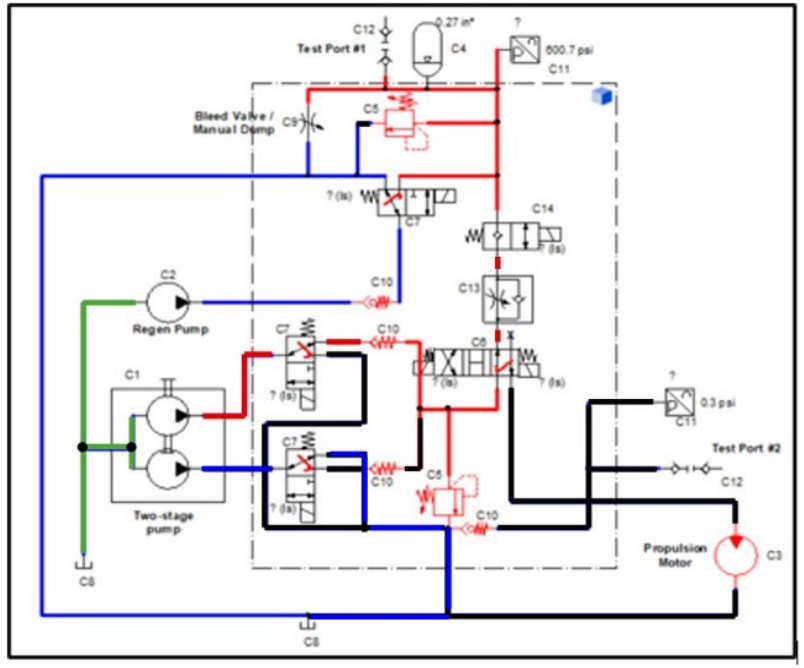
Vehicle Construction

- Utilized the university machine shop to complete all necessary work in-house
- Proactively addressed setbacks as they occurred
- Maintained communication of progress, completed tasks, and open action items via weekly team and sub-team meetings
- Build → Test → Fix → Validate → Document



Previous Year's vs Current Circuit





Improvements

Added Manifold

Added Dump Valve to safely empty accumulator

Added a Regen Pump

Cleaned up overall bike to make design more visually appealing

Vehicle Testing & Results

Best Operational Settings for each Race & Testing Scores

Efficiency:

- Bladder Pre-Charge: 1000 PSI
- Max PSIA: 1200 PSI
- Average Distance: 640 ft
- Gear: 3
- **Overall Efficiency Score: 28.5%**

Sprint:

- Bladder Pre-Charge: 1000 PSI
- Max PSI: 2200 PSI
- Set Distance: 300 ft
- Operational Setting: Direct Drive Low, Discharge Accumulator @ 100 ft
- Gear: 3
- **Time: 28 seconds**

Endurance:

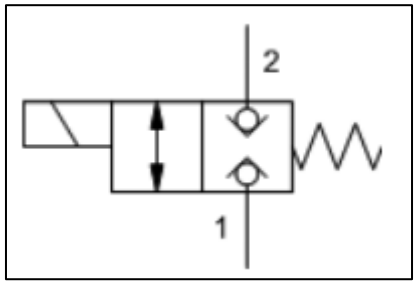
- Bladder Pre-Charge: 1000 PSI
- Max PSIA: 2500 PSI
- Gear: Use between 3,4, and 5
- Operational Setting: Use between Direct Drive Low, Medium, and High
- **Average Number of Laps: 25**

Regenerative Breaking Demonstration:

- Bladder Pre-Charge: 1000 PSI
- Set Distance: 200 ft
- Gear: 3
- **Average Discharge Distance: 63 ft**

Regen Braking Concept/Circuit

- Double blocking valve – DTBF XCN
- Regen engaged at 10 mph
- Charges accumulator from 0 to 1100psi

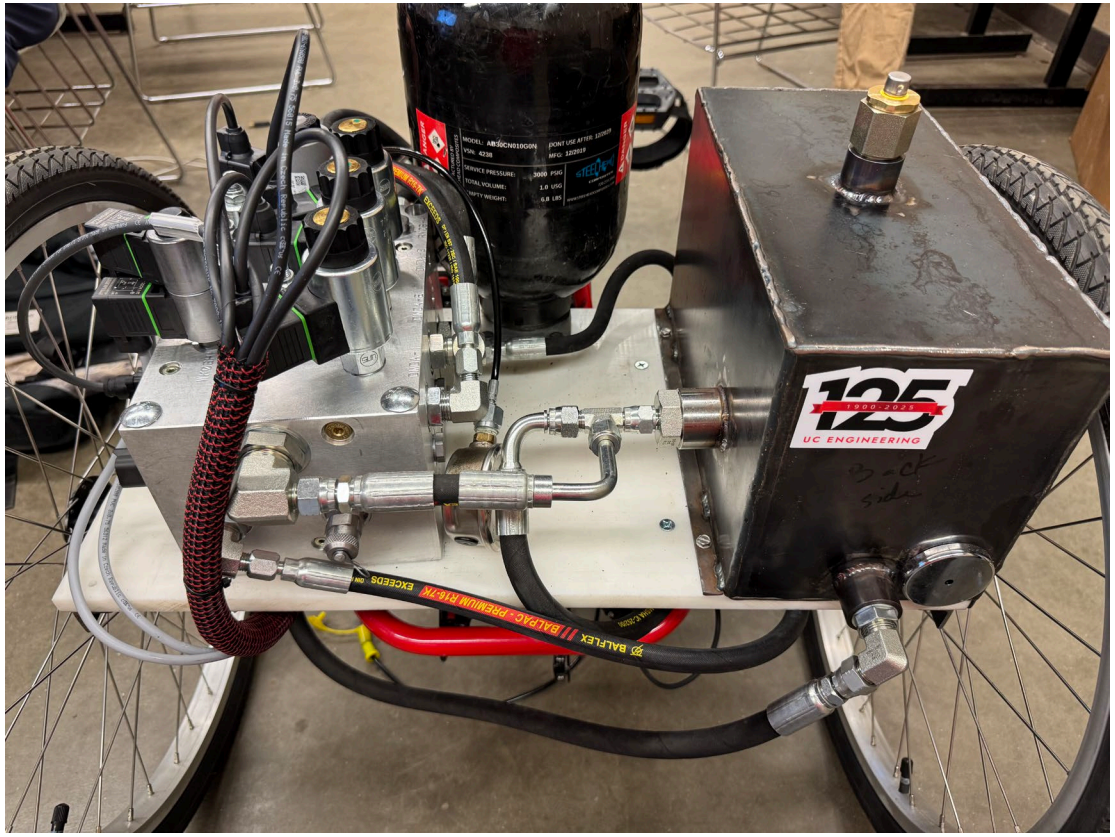


Frame Design

- Tricycle design chosen for balance, space, and cost
- Delrin plate support 100lbs
- Underside of plate shelters wires, pumps, and gears. This protects the rider and components, while adding to visual appeal
- Larger seat for rider comfort
- Custom chain cover to protect rider
- Straps on pedals to prevent foot slipping while pedaling

Hydraulics

- Manifold
  - 5 solenoid operated valves for efficient mode switching
  - 2 pressure reliefs, 1 dump for safety considerations
  - 1 throttle valve to tweak accumulator discharge flow
- 9 BALFLEX Hoses max 6500psi
- 3000 psi max pressure reliefs
- 2.2 gallons tank to accommodate inlet/outlet height
  - Breather to prevent suction in system

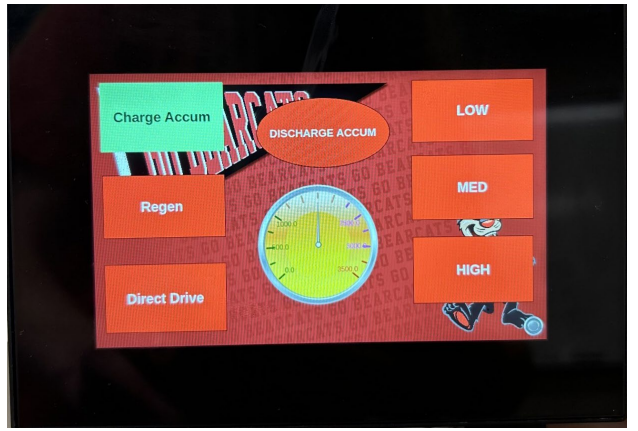


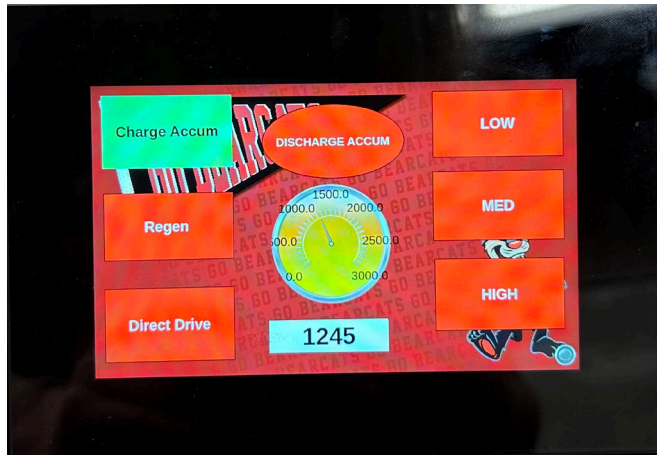
Power Transmission

- Dual Pump to crank arm
- Modified tensioner keeps chain tension and ensures smooth shifting under load
- 7-speed cassette enables real-time performance tuning, allowing quick shifts between high torque and high speed
- Cassette includes freewheel that prevents back-driving of the pump, reducing drag and improving coasting efficiency

Controls

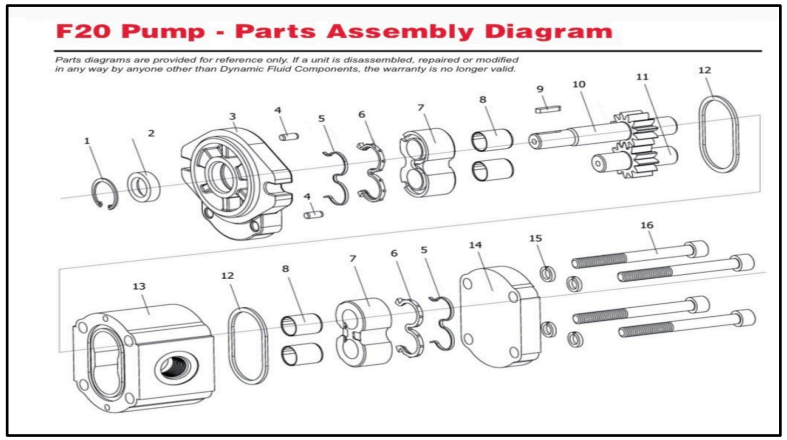
- **Important aspects of control system: button latching, communication between PLC and HMI, digital pressure gauge, integer readout**
- Modes added to cover all competition needs
- Pressed buttons change color, indicating to the rider what mode is active
- HMI screen allows the rider to rest their hand on the handlebars or side of HMI mount and click a button
- Started with a pressure gauge read out, but then added an integer readout, as this was easier for the operator to see.
- Added Cable sleeves to eliminate wires being pulled
- Wagos used to perform wiring connections





Lessons Learned

- Coded a trigger (one shot) function in the HMI to switch system states and latching to indicate modes for rider.
- Pumps can be used as motors, but pump internals need to be reworked to ensure the seal is on the low-pressure side.



Improvement Ideas

- Update the circuit design to include an option to isolate fluid directly to the motor

QUESTIONS ?