Team 3

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Intelligent Process Control Cart

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Customer Background

- Endress+Hauser
  - Leading supplier of industrial measurement instruments
  - $2.4 billion in global revenues in 2022

Problem Statement

- Sensor data not easily accessible, requires full integration
- Goal: Real-time measurement value reading & documentation development
- Industry 4.0 requirement: Automatic and user-friendly data acquisition

Requirements

Req. #	DESIGN REQUIREMENTS	DESIGN TARGETS RATIONALE
1	Each IPCC component (sensor, valve, heater) powers on, communicates with the PLC, and functions as intended.	This is critical for E+H to demonstrate functionality and Purdue professors to develop labs. [1]
2	All 120V circuitry must reside within the plastic enclosure.	The 120V power poses a fire hazard to end users, so it should be put inside the safety cabinent. [10]
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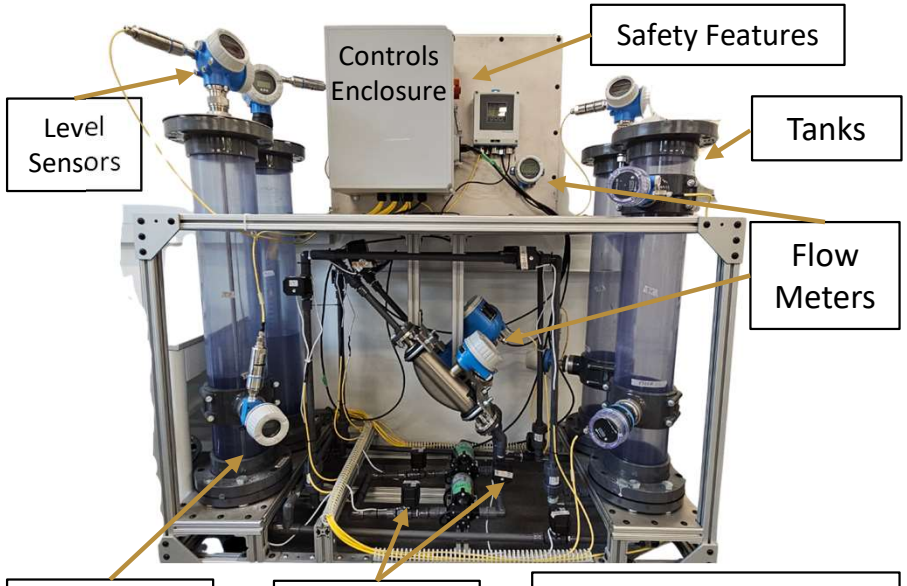
4	The machine must include an E-Stop.	The exposed nature of the wiring poses a significant safety risk, so power to the IPCC should be strictly controlled [11]
5	The machine must include a lock out tag out.	The exposed nature of the wiring poses a significant safety risk, so power to the IPCC should be strictly controlled [11]
6	The IPCC must be capable of demonstrating features such as level control, mixing of fluids, and other user-inputable process control functions.	E+H has demonstrated interest in showing this functionality to their cleints. Additionally, Purdue has expressed interest in teaching its students about process control.
7	The team must provide both documentation on the IPCC's operations and setup as well as any software produced for the aforementioned feature demonstrations.	Any future use of the IPCC technology, including future capstone teams, will require knowledge of the IPCC to get started.

Cart Design



Learning Tools

IPCC Handbook

Goal: Document all knowledge required to continue development and operations of the cart

Four Primary Sections:

- IPCC Overview
- Student Operations Manual
- Development Guide
- Maintenance and Troubleshooting

IPCC-GPT

Goal: Provide easy access to knowledge without hassle

- Built a Natural Language Processing interface leveraging OpenAI API
- Used to provide a Chat experience to users for the IPCC
- Able to index relevant videos and text about the operations and answer questions

FMEA Summary

Possible Failure	Priority Score
Overwritten Code	Medium
Pump Failure (Dry Pump)	Medium
Valve Failure	Low
Electrical Short-Circuit	Low
Sensor Miscommunication	Low

Problems Encountered

- Access Issues for Software
- Uncertainty of End User
  - Students vs. Profs
- Maintenance of IPCC
- Missing Components
  - Tank 4 Cap, Threading Adapters, etc.

Testing

- Programs are designed around sensors that measure level, temperature, and Flow-rate.
- These metrics are tied to alarms and other tags to track values from the sensors
- Based on the results we can determine functionality of pumps, valves, and the accuracy of other sensors
- Data is tracked via a historian(Ignition) to find any deviations that can indicate systemic failures or localized failures