

# Endress+Hauser IPCC with ChatGPT

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## Customer Background

Current learning tools on the market are either outdated or too complex for new students to grasp topics related to PLCs, valves, and hydraulics. With the support of Endress+Hauser's Learning Cart and the components provided, we are proposing an innovative solution that enhances students' learning experience through hands-on labs while also providing Endress+Hauser's tech support team with a more efficient method to troubleshoot customer issues.

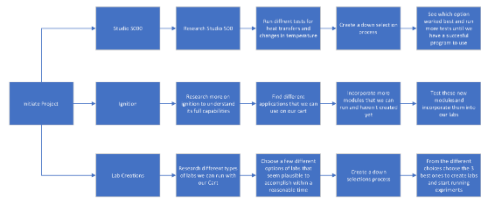
## Problem Statement

The aim of this project is to create custom process control and PLC labs for Purdue students to follow through and create an AI learning language model that aids the students through these labs and be more accustomed to coding in PLCs and learning about valves and hydraulics.

## Requirements

Table 1: Requirements Matrix

REQ #	DESIGN REQUIREMENTS	DESIGN TARGETS	VALIDATION
<b>RATIONALE</b>			
1	The team will incorporate Chat GPT. It will be able to answer various questions on the cart.	Functionality	It will be given test questions. It must answer these appropriately and correctly.
Endress+Hauser wants the cart to be more versatile. Nicole mentioned this in our meeting on 1/22/24.			
2	The team will perform an engineering analysis.	Survey	Client approval, safety on the cart is improved and functions properly. It will be tested by pushing the e-stop.
Endress+Hauser wants more data on the cart. Fred mentioned this in our meeting on 1/22/24.			
3	The team will find new applications for the cart. This will include more labs.	Survey	Client approval, approval from Professor Richards who teaches the controls courses
Endress+Hauser wants the cart to be used for more things. Nicole mentioned this in our meeting on 1/22/24.			



## Experimentation and Concepts

print name (first last): \_\_\_\_\_  
 course: \_\_\_\_\_  
 lab date (month/day): \_\_\_\_\_

### I/O Check

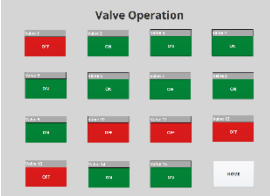
**Objectives**  
This lab will teach you very useful skills and troubleshooting techniques used in industry. An I/O check involves checking for expected outputs when certain inputs are given. You will be able to follow the procedures below to complete this lab. After this lab, you will be better at troubleshooting controls systems and understand the connection between machines, PLC, and the panel view.

### Approach and Results

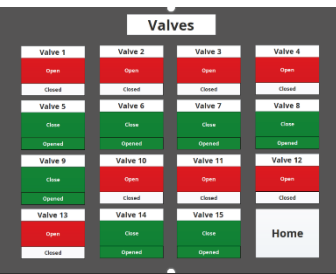
- Start the Intelligent Process Control Cart (IPCC).
- Log into the Intronix by going to localhost:8080 and open 'VponesClient Launcher on the desktop. Open 'BasicCart' and stay on the IPCC Home for now.
- Next, open Studio 5000 on the computer. You will need to upload the current project on the PLC to the computer. Once you have the program open, then you will be able to begin the lab.
- Go to Ignition and assign to the Valve Operation screen. Verify or click on the Valve 3 toggle so 'Valve 3 is ON' (Open) on this screen.
- Is the status correct? Yes ( ) No ( )
  - Repeat step 4 if you selected No.
- Go to the Outputs page on Studio 5000. You will find the output Valve 3 on rung 2. The inputs are on the left side of this rung. Look for Valve 3 PB. This corresponds with the toggle on Ignition that you just verified was ON.
- Is the normally open contact under Valve 3 PB highlighted in green? Yes ( ) No ( )
  - If yes, you just verified that the signal from Ignition went to the PLC and you are able to view it on Studio 5000.
  - If no, you will need to troubleshoot the connection between the PLC and Ignition. Check if the cart is on and plugged into the computer via the ethernet to USB adapter.
- Next, you need to read rung 2 to see if the output Valve 3 should be on. Write your response below.
  - Repeat step 4 if you selected No.
- You should have said: If Tank 2 Ready Transfer OR Tank 1 All Tank Refill OR Valve 3 PB is on then the output Valve 3 will turn on.
  - Should the output Valve 3 be on? Yes ( ) No ( )
  - Is the output Valve 3 on? Yes ( ) No ( )

We created four different lab manuals for the students. These consists of Heat Transfer Lab, I/O Check, ChatGPT intro Lab and Optimizing Water Transfer Lab, WE used a Down Selection Process to evaluate each of the labs and concluded with using I/O Check Lab and ChatGPT Intro Lab for the initial phase.

Process Description	Availability for completion	Student Learning objectives	Client 1 score	Client 2 score	Client 3 score	Local Score
I/O Check Lab	9	10	20	20	20	20
ChatGPT Lab	9	9	17	17	17	17
Optimizing Water Transfer Lab	9	9	9	9	9	9
Water Refill Transfer Lab	9	9	16	16	16	16
Heat Transfer Lab	9	9	16	16	16	16



## Final Design



## Testing

- You what level sensors are used in the IPCC
- IPCC Assistant: The Intelligent Process Control Cart (IPCC) at Purdue utilizes several types of level sensors, primarily provided by Endress+Hauser, for educational purposes in process control labs. Here are some of the level sensors used:

- LevelFlex Sensor** - This sensor measures the level of a liquid in a container by sending a high-frequency pulse down to the liquid and measuring the time it takes for the signal to bounce back. It is known for its durability and ability to operate under extreme conditions like high temperatures and pressures.
- Prosonic Sensor** - Similar to the LevelFlex, this is a "time of flight" sensor. It is used for measuring the level of liquids, pastes, and granular materials, and can also function for flow measurement in open channels and measuring weirs.
- MicroPilot FMR51** - This sensor is used for level measurement in harsh conditions, suitable for industries like oil and gas, and chemicals. It works well with liquids, pastes, and slurries, and offers high reliability and safety due to its gas-tight feedthrough and double ceramic coupling.
- MicroPilot FWR30** - A cloud-connected, battery-powered radar level sensor. It is designed for reliable level monitoring and can measure level changes in tanks, temperature variations, and even severe weather conditions.
- Liquiphant FTL51B** - A point level switch made by Endress+Hauser, which determines when a liquid reaches a specified, predetermined level in the tank, helping to prevent scenarios of running out or overflowing.

- You how to turn on the IPCC?
- IPCC Assistant: To turn on the Intelligent Process Control Cart (IPCC), you can follow these detailed steps:

- Ensure Safety and Preparation:**
  - Verify that the cart is properly connected to a power source.
  - Ensure that all safety measures are in place, such as checking that there are no loose wires or exposed electrical parts.
- Power On the Electrical Cabinet:**
  - Locate the red switch on the side of the electrical cabinet of the IPCC.
  - Flip the switch to the 'On' position to power up the cart.



The testing phase mainly consisted of developing the ChatGPT tool and finetuning it to ensure accuracy. This included feeding the knowledge center of the AI with lab manuals, previous group's lab report and sensor manual provided by Endress+Hauser.