Department of MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

PLC Lab Trainer

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Background

Programmable Logic Controllers (PLC's) are widely used in industrial applications to automate and control various processes. The University of Utah's new industrial automation course will teach students the foundations of PLC control in manufacturing processes. This project focuses on engineering a PLC training platform where students will learn control of the most common field devices found in industry without conforming to brand specific methodologies.

Trainer Platform

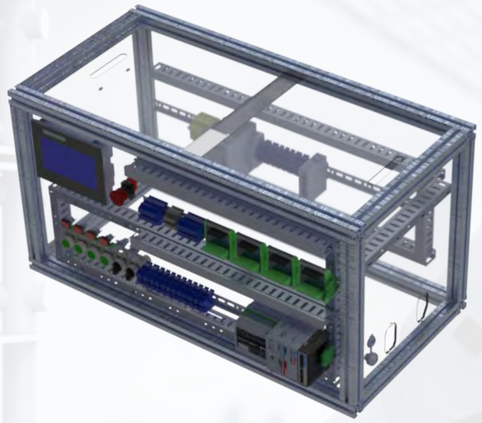


Figure 1: 3D rendering of PLC Trainer Platform.

Purpose

The trainer platform is designed to teach fundamental use of the PLC. The platform safely supplies power, access, and controls to the PLC and expansion modules.

Design

The trainer form factor features an aluminum 8020 frame with transparent acrylic panels to allow students to visualize the internal components. Input/output devices such as buttons, switches, potentiometers, and LEDs are included on the front panel for a variety of different controls. A human machine interface has also been included as it is a common device used in industrial applications. The back panel isolates high power components from users and safely distributes power through fuses and terminals.

Industry Standards Achieved

NFPA 70 – General Electrical Installation
NFPA 79 – Electrical for Industrial Machinery
OSHA Electrical

Module A: Wind Tunnel

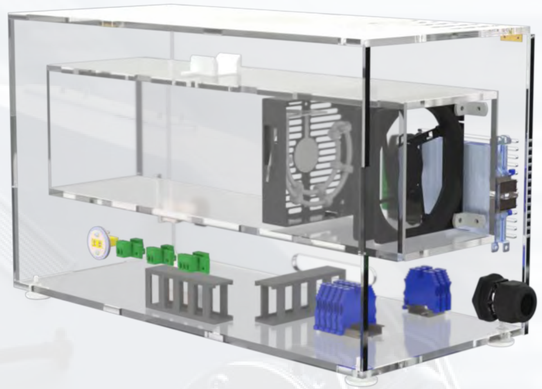
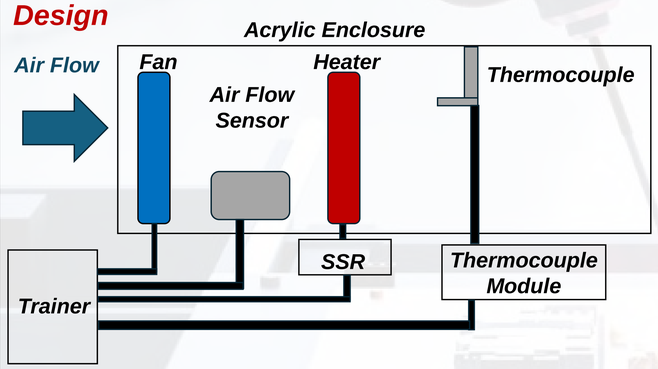


Figure 2: 3D rendering of Wind Tunnel Module.

Purpose

Showcase the analog sensing and control capabilities of the PLC.
Analog input devices: *Hot Wire Anemometer, Type-K Thermocouple*
Analog output devices: *24 Volt DC Fan, 800W Heating Element*

Design



Specifications Achieved

Air Speed Range	0-5 m/s
Maximum Air Temperature	80°C
Flow Sensor Accuracy	±5%
Thermocouple Accuracy	±2%

Module B: Pneumatic Piston

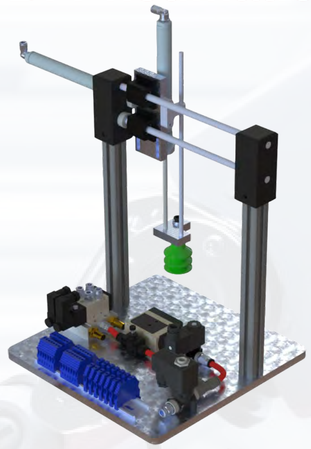
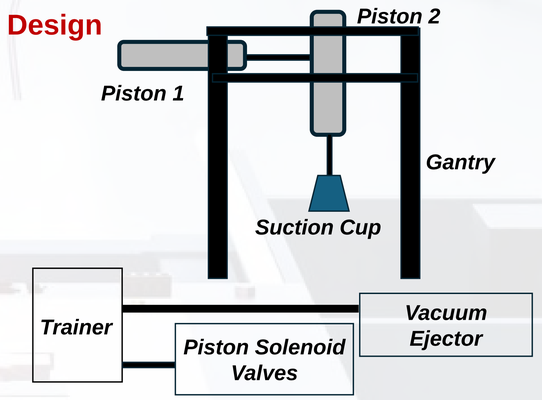


Figure 3: 3D rendering of Pneumatic Cylinder.

Purpose

Showcase the digital sensing and control capabilities of the PLC.
Digital input devices: Position Switch
Digital output devices: Double Action Pneumatic Cylinders, Solenoid Valves, Vacuum Ejector

Design



Specifications Achieved

Piston 1 X-Translation	5 inches
Piston 2 Y-Translation	6 inches
Suction Cup Vacuum Capability	31.12 lbs.

Module C: VFD/Motor

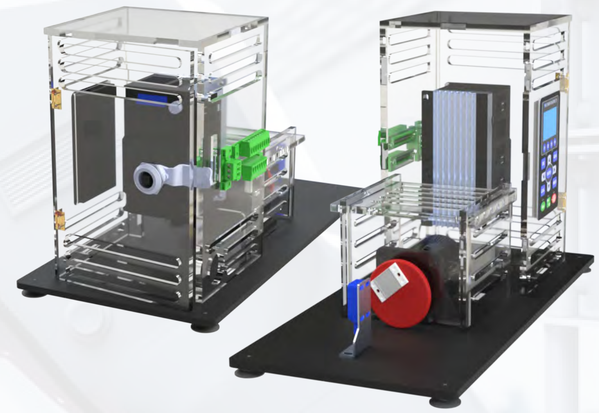
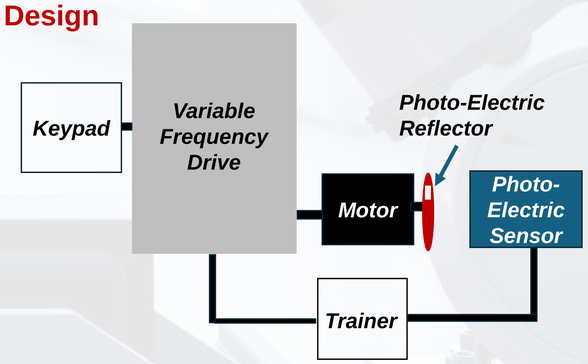


Figure 4: 3D rendering of the VFD side (left) and the motor side (right) of the module.

Purpose

Showcase communication protocols and motor control using PLCs.
Communication devices: Variable Frequency Drive (VFD), Keypad Extension
Control Devices: Induction Motor, Photo-Electric Sensor

Design



Communication/Control Pathways

Serial Communication : RS485 Modbus
Analog I/O
Digital I/O