

MXET 400 LAB UPGRADE

Updated: Sep 28, 2021

Written by D Malawey

Relevance of PLC integration:

WHY:

PLC systems are highly relevant in industry

PLC use different communication protocols and higher voltages than embedded systems.

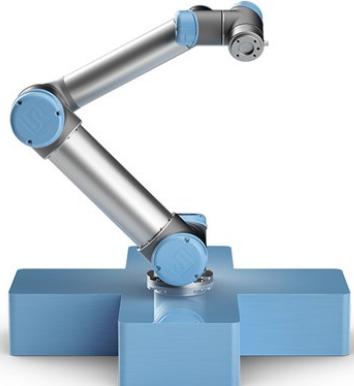
MXET students can gain their first PLC exposure in MXET400, Fall 2021

HOW:

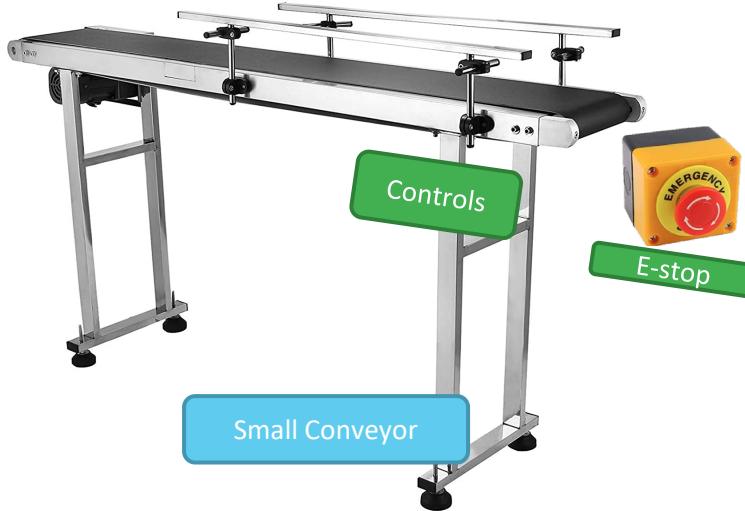
Students should gain these outcomes:

- Connect a sensor to modify PLC behavior
- Observe a PLC system operating a conveyor belt
- Receive diagrams & resources for further learning

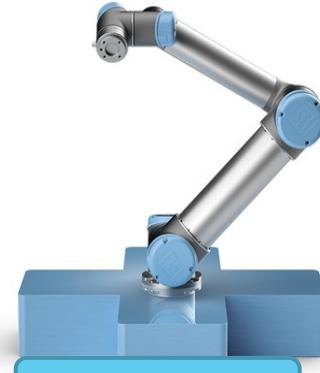
MXET 400 Equipment



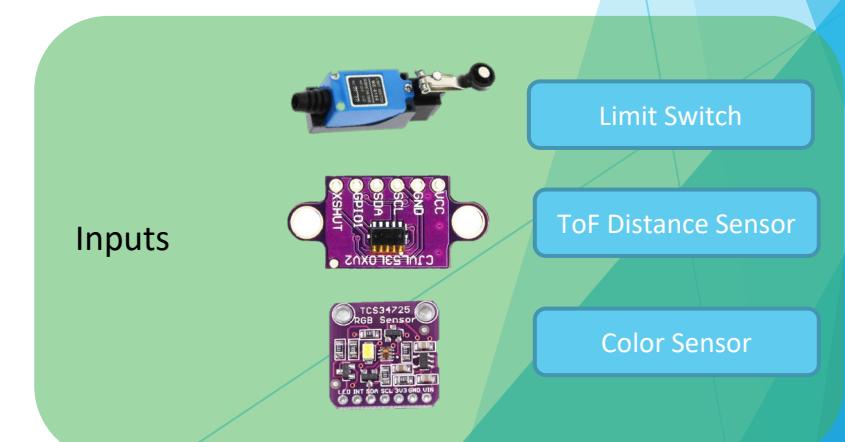
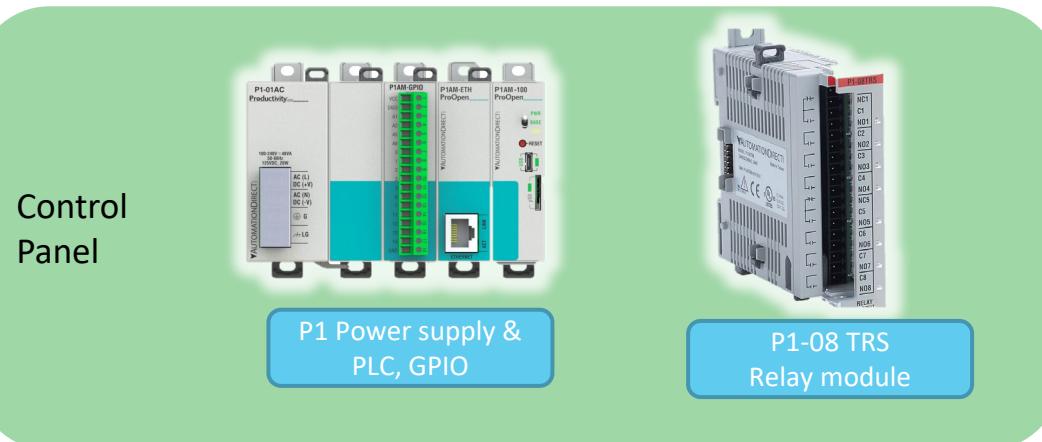
UR3-e



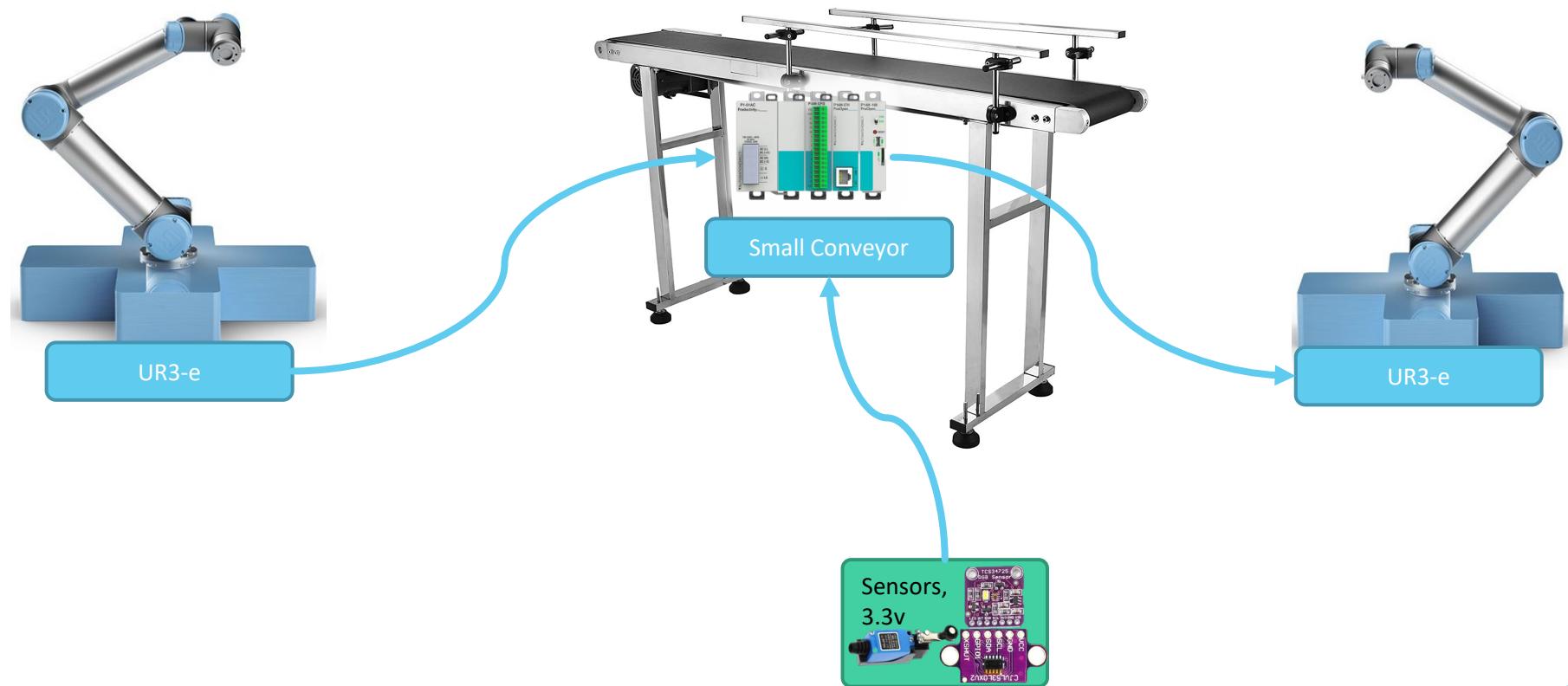
Small Conveyor



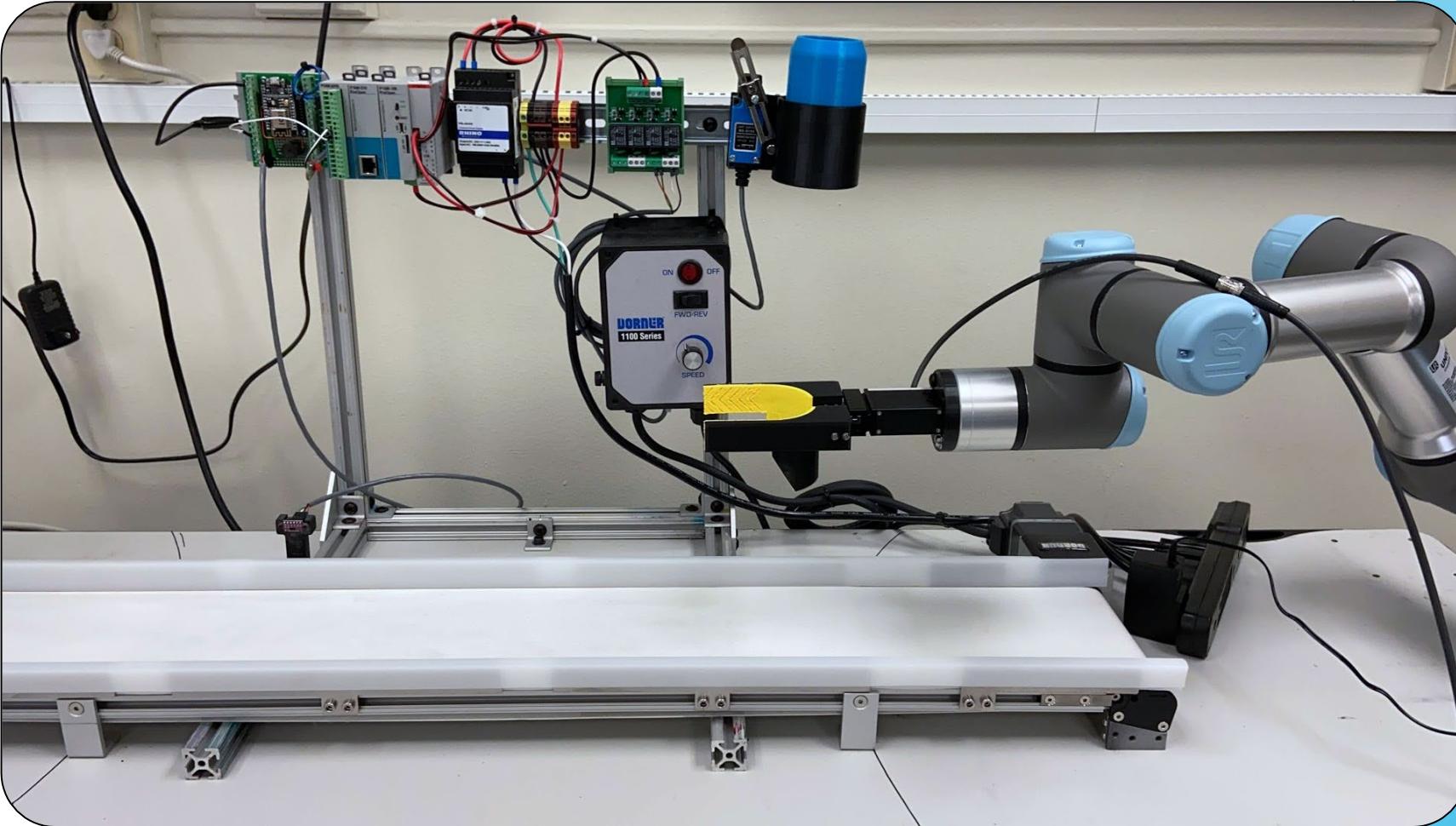
UR3-e



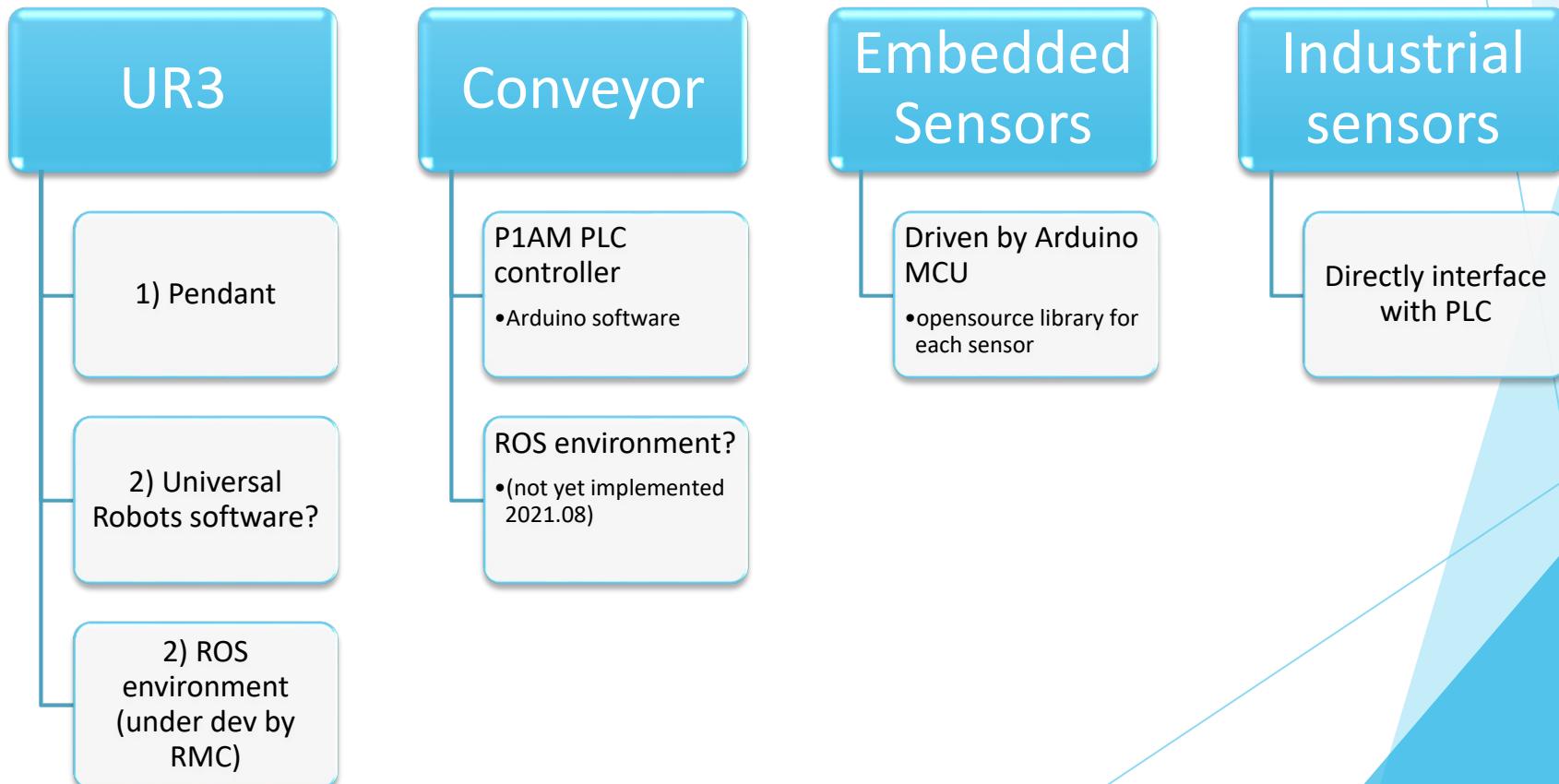
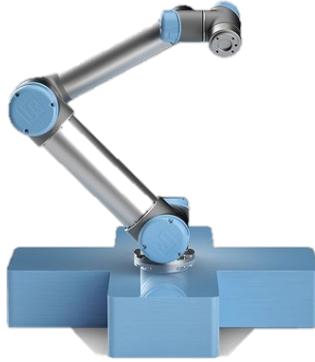
Process Signals



Demo setup 08.06



Software



PLC Components

Power supply, 24v

Relays, 24v

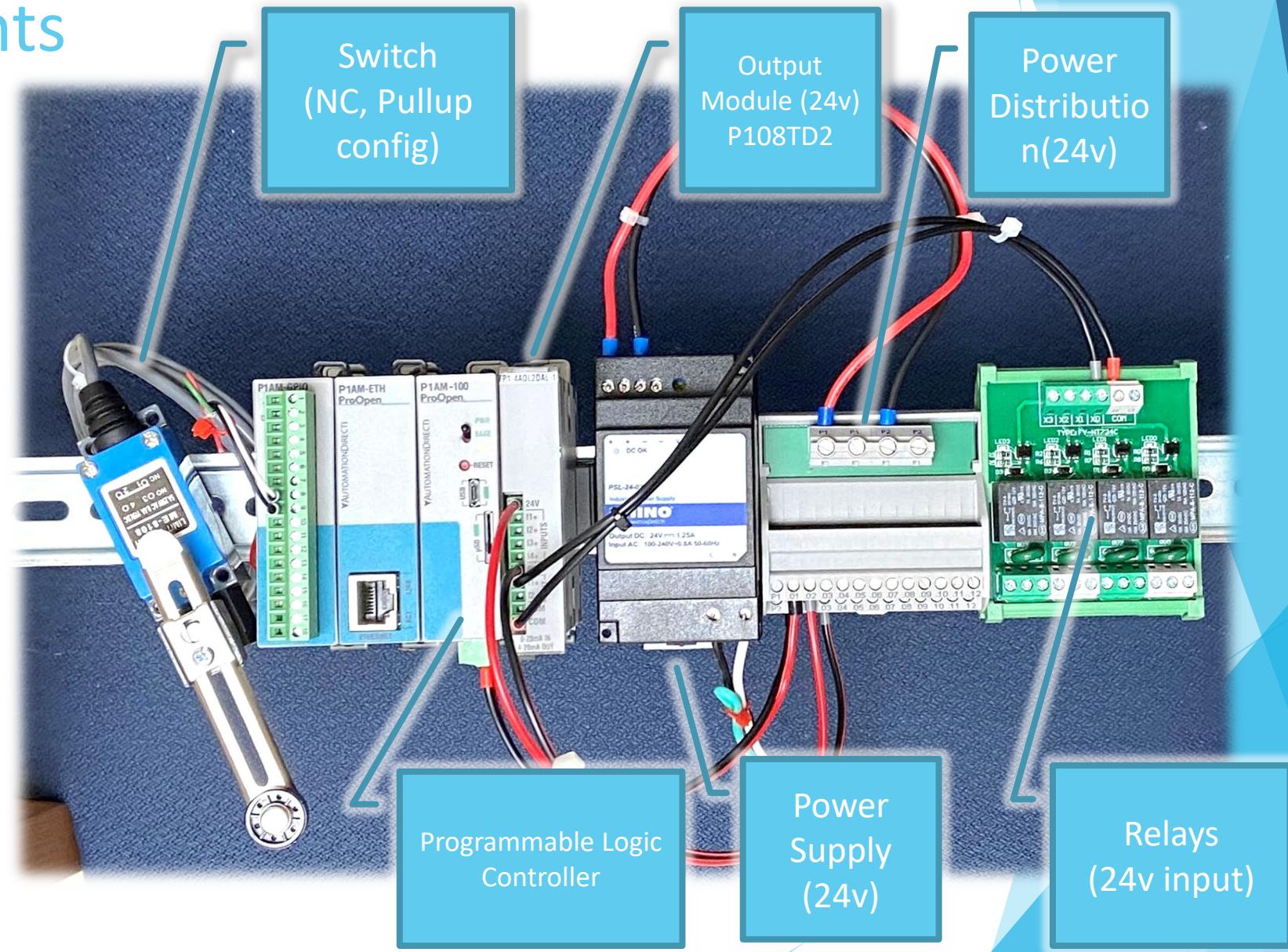
Mechanical switch

PLC

- TTL module
- Industrial 24v module

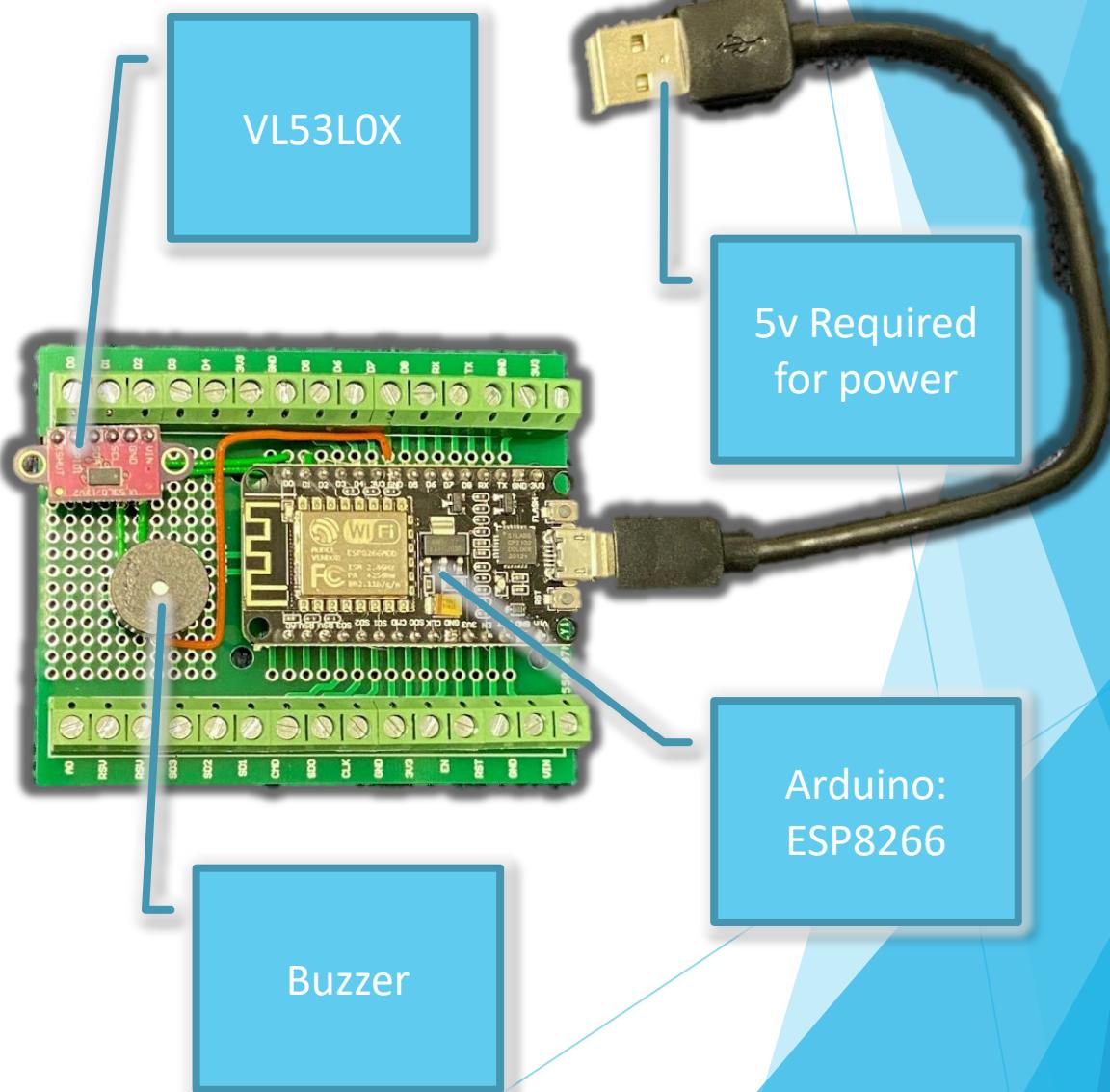
Input

- Mechanical switch

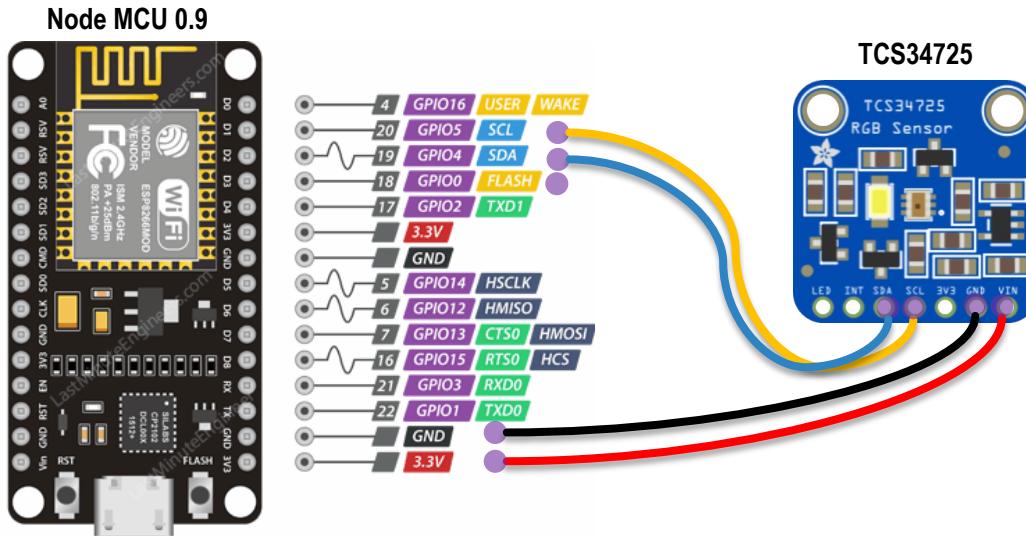


Distance Sensor

- ▶ Goal: Students reconfigure the distance sensor to determine the behavior of robots and conveyor, in course project.
- ▶ Sensor: VL53L0X
- ▶ Accuracy: tested to be +/- 5mm or better
- ▶ Buzzer connected for threshold distance
 - ▶ 20cm or less
 - ▶ Audible output for troubleshooting
- ▶ Digital output pin of ECU to indicate object detected, along with buzzer.



Color Sensor Circuit



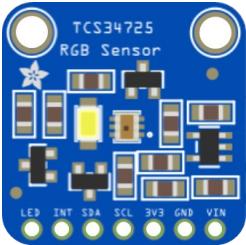
TCS34725 connects on regular i2c bus.

Recommended Library:
Adafruit_TCS34725

Verify your RGB colors at:
W3schools.com

- ▶ Color sensor tested, but not integrated into conveyor system (2021.09)

Color Sensor Integration



Example values from test:
Red can: 192, 31, 31 (rgb)
Blue can: 30, 90, 120 (rgb)

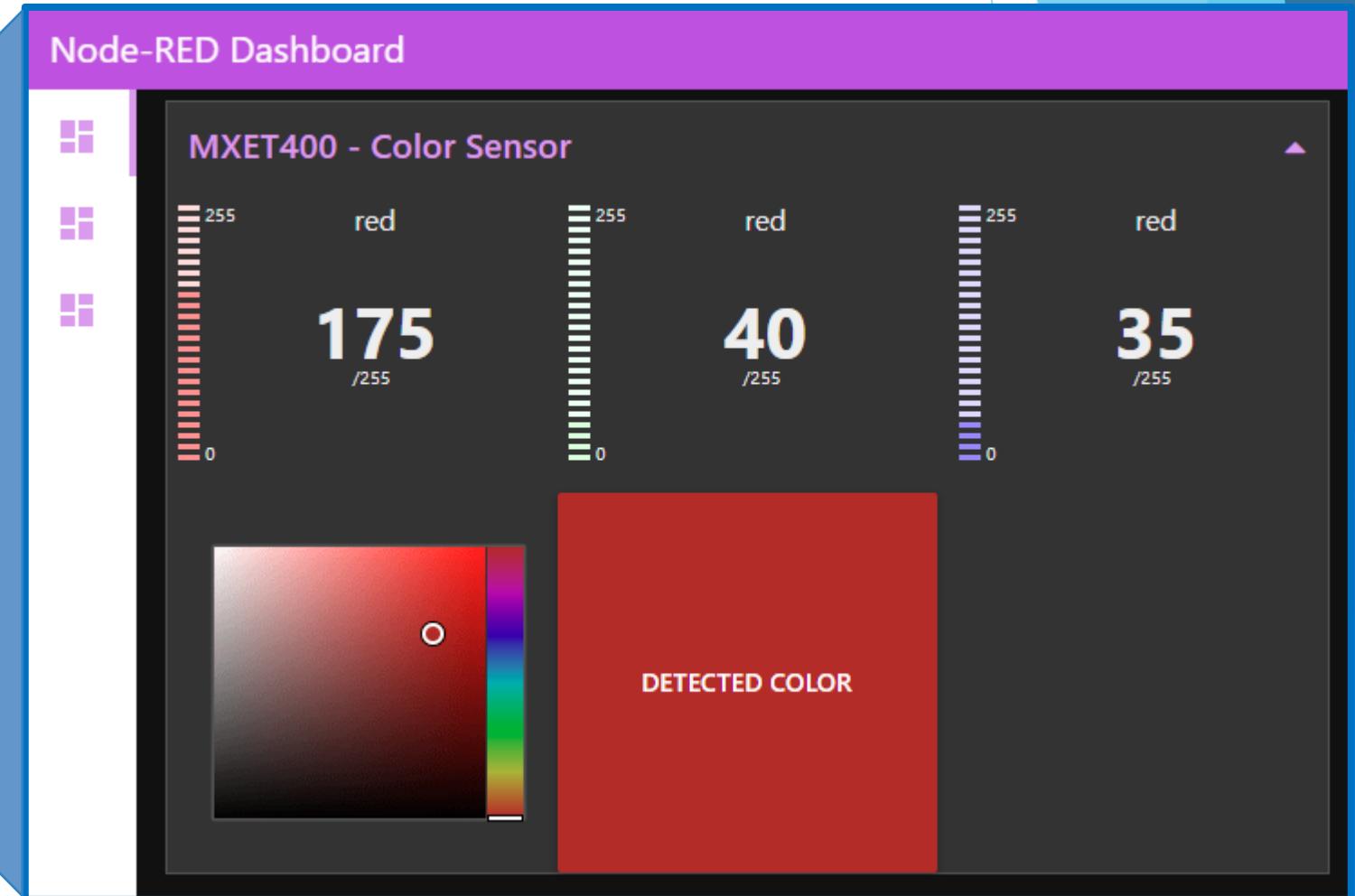
TCS34725 Tested on 3D printed “soda cans”



- ▶ Color values will vary based on lighting conditions, settings on the sensor (such as integration time), shadows, and positioning of the sensor with respect to object.

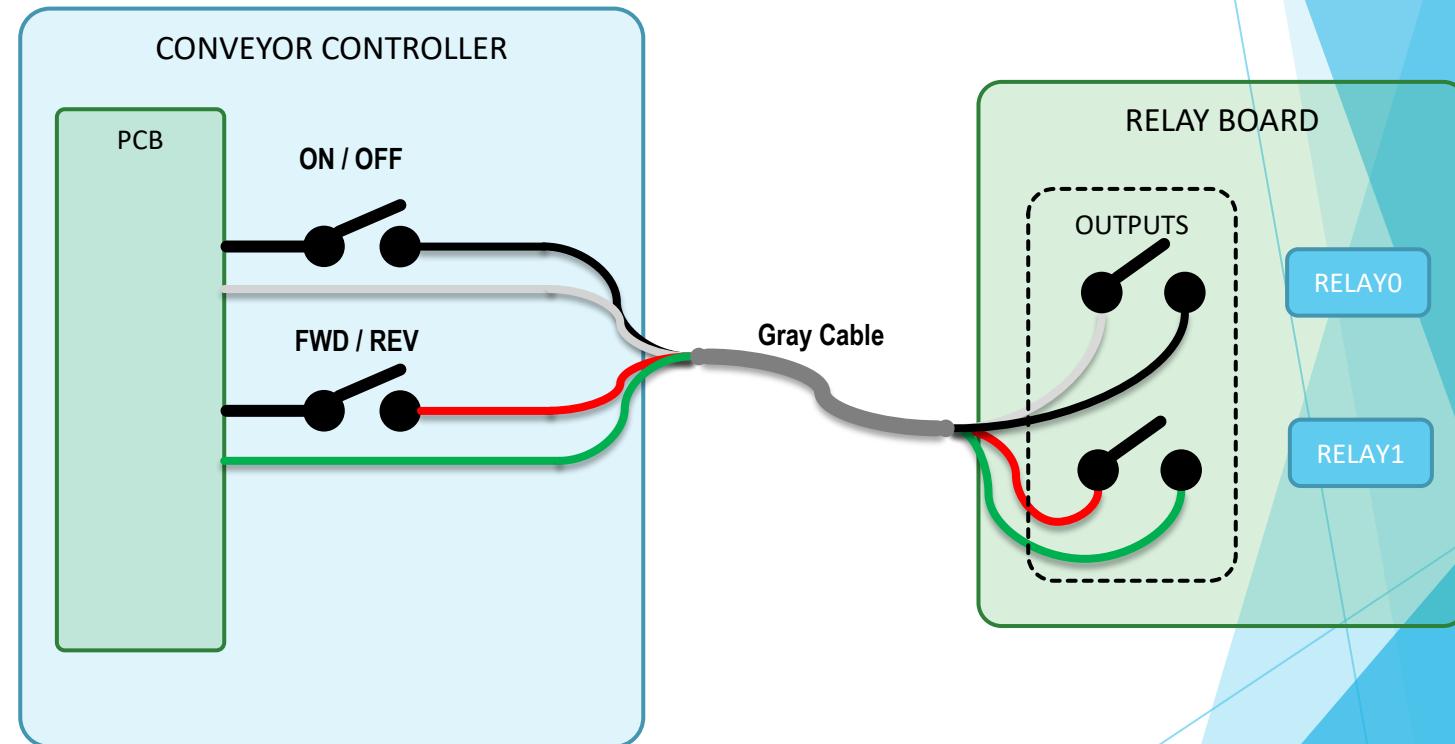
Color Sensor Feedback

- ▶ This nodeRed dashboard receives RGB values from the color sensor and displays the readings.



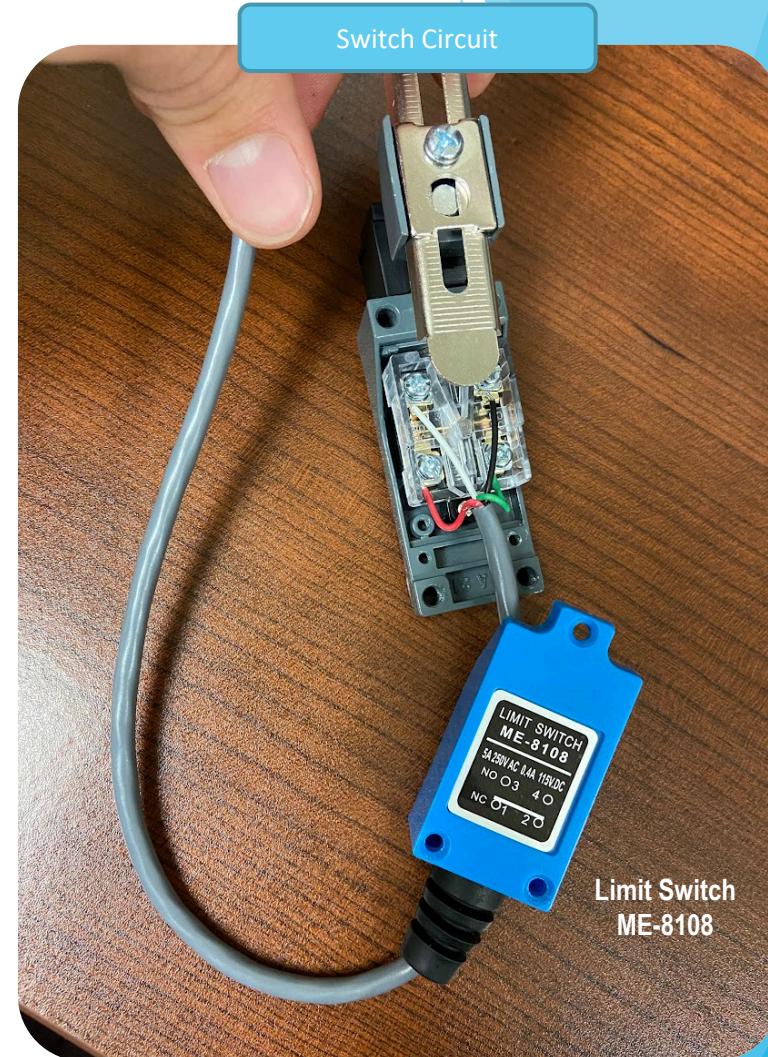
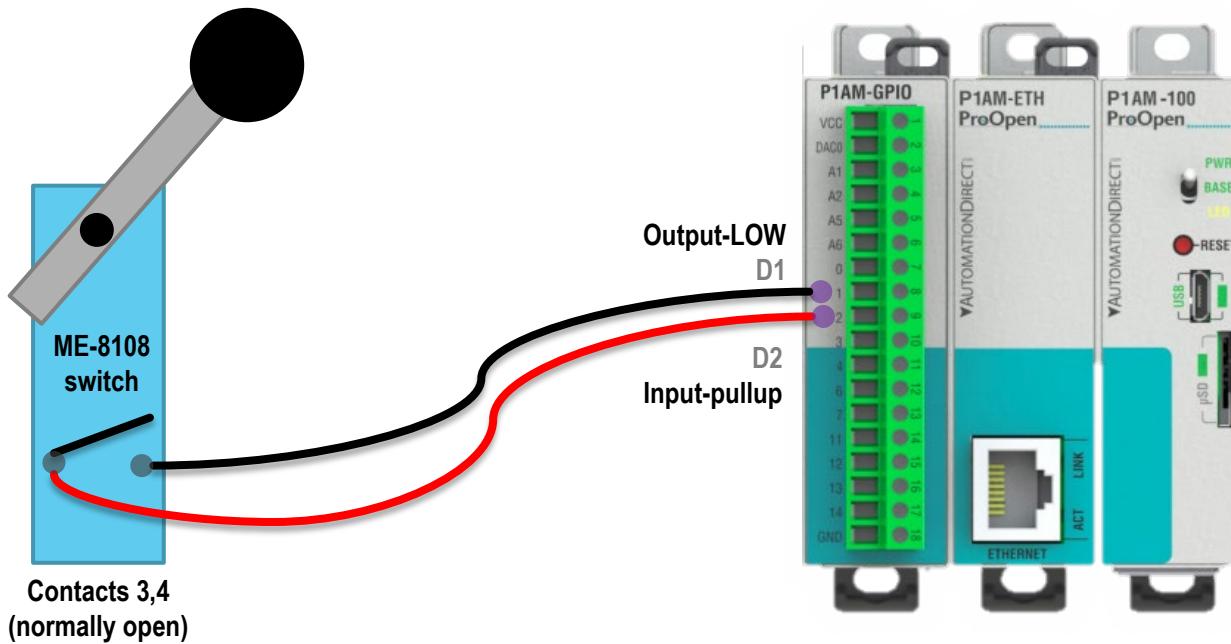
Conveyor – External Control Mod

- ▶ Relays control ON/OFF and FWD/REV
- ▶ Safety Note: ON/OFF carries 110vAC
- ▶ All wires in 1 gray cable
 - ▶ Will label the cable & tie into relays of PLC unit
 - ▶ Cable runs from Relay module to 24v output Module of PLC

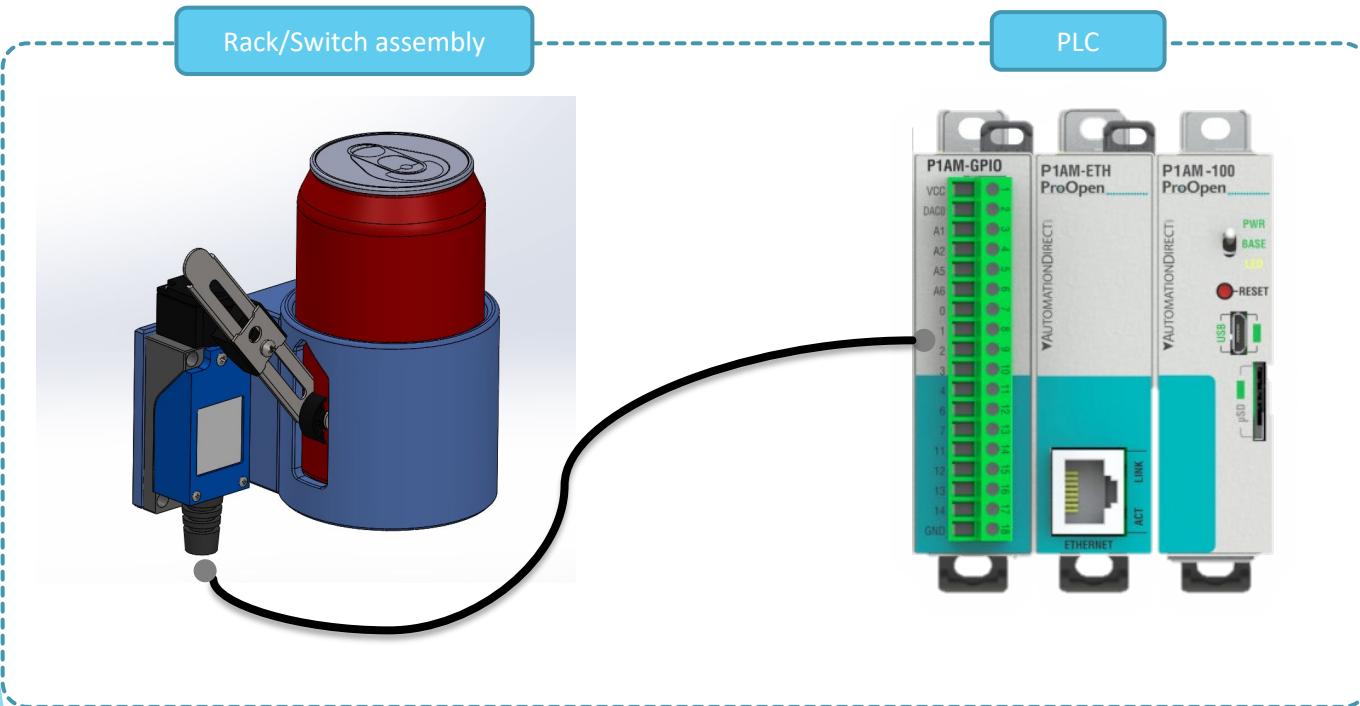


Limit Switch Circuit

- When switch is actuated, input D2 goes LOW



Limit Switch Integration



Configuration:

- The switch indicates if the can is loaded.
- PLC output to D1 is set to 0v, while D2 input is in pullup mode

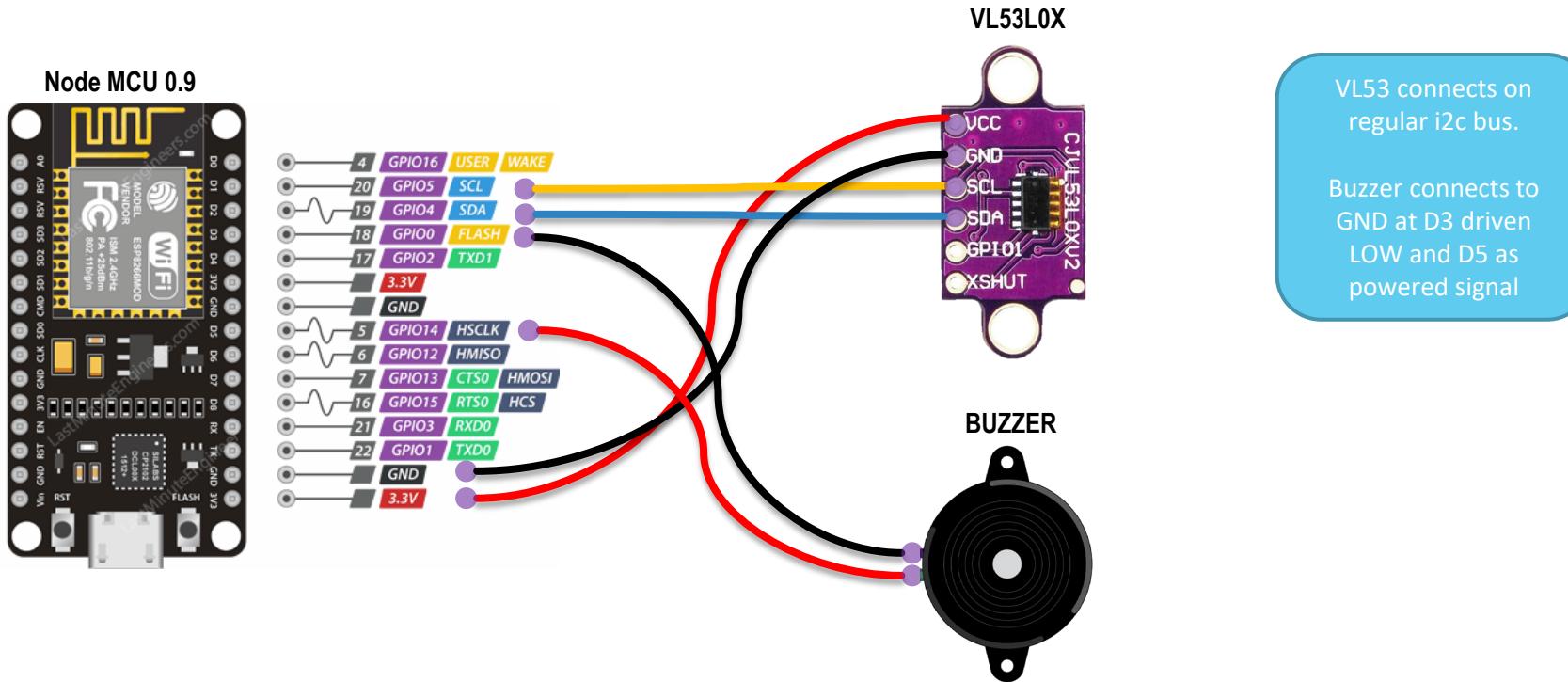
Can is placed in the rack

- Flag: RACK IS FULL = true
- the switch is “activated”
- Terminal in switch is CLOSED

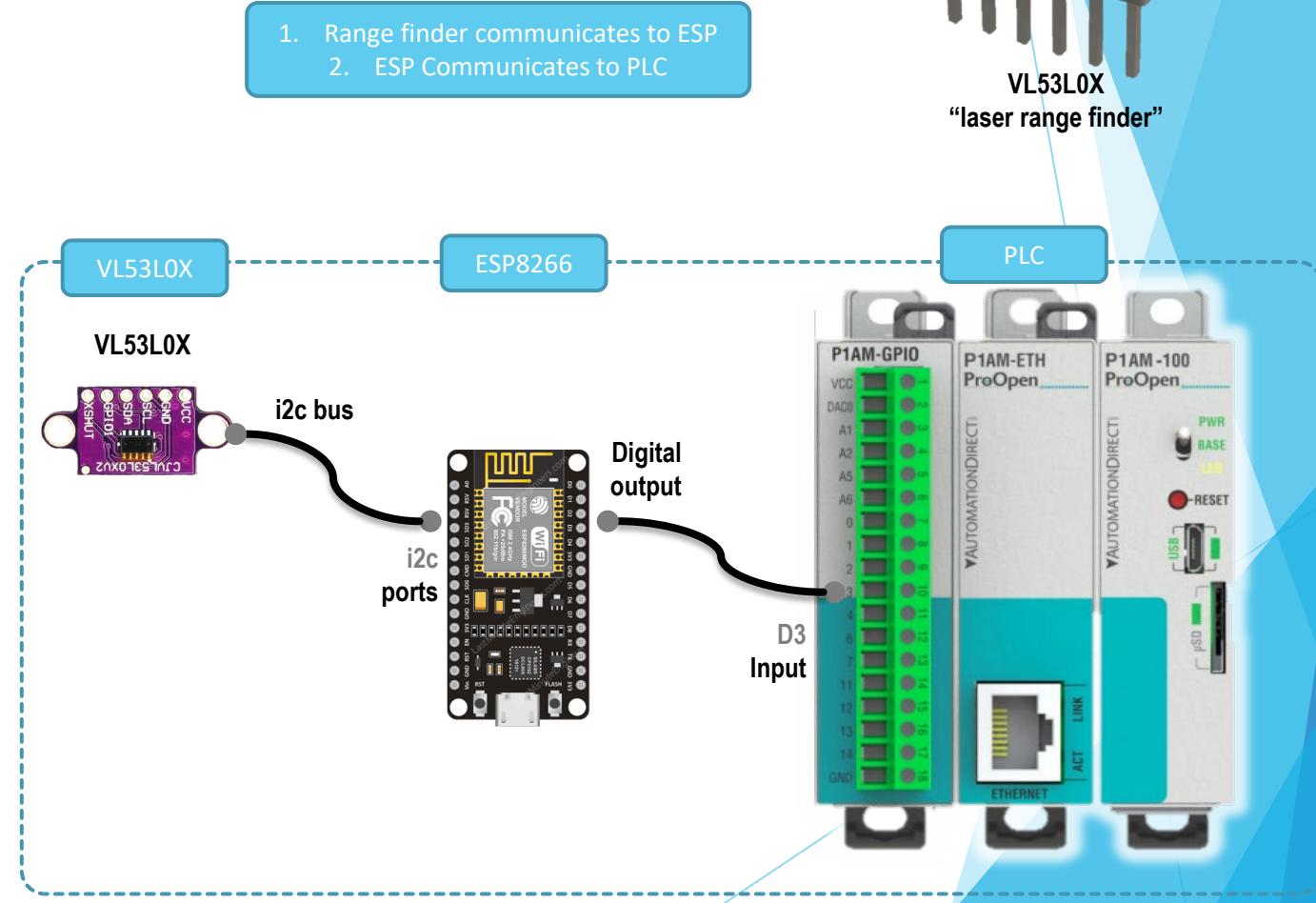
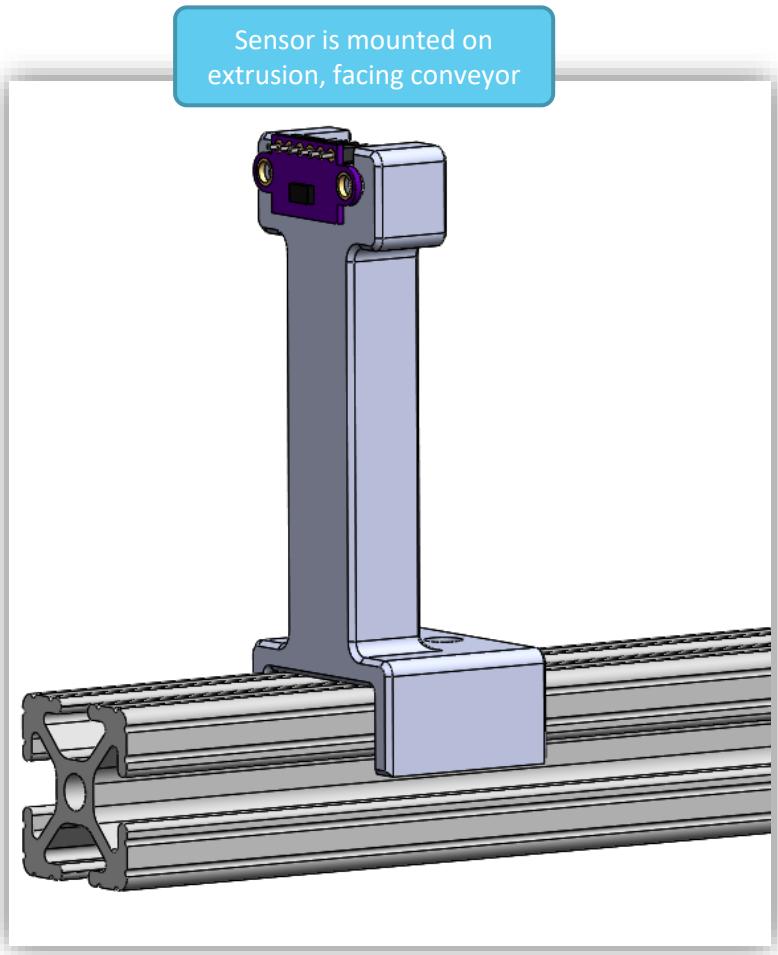
Can is removed from rack

- Flag: RACK_FULL = false
- The switch is “not activated”
- Terminal in switch is OPEN

Distance Sensor Circuit

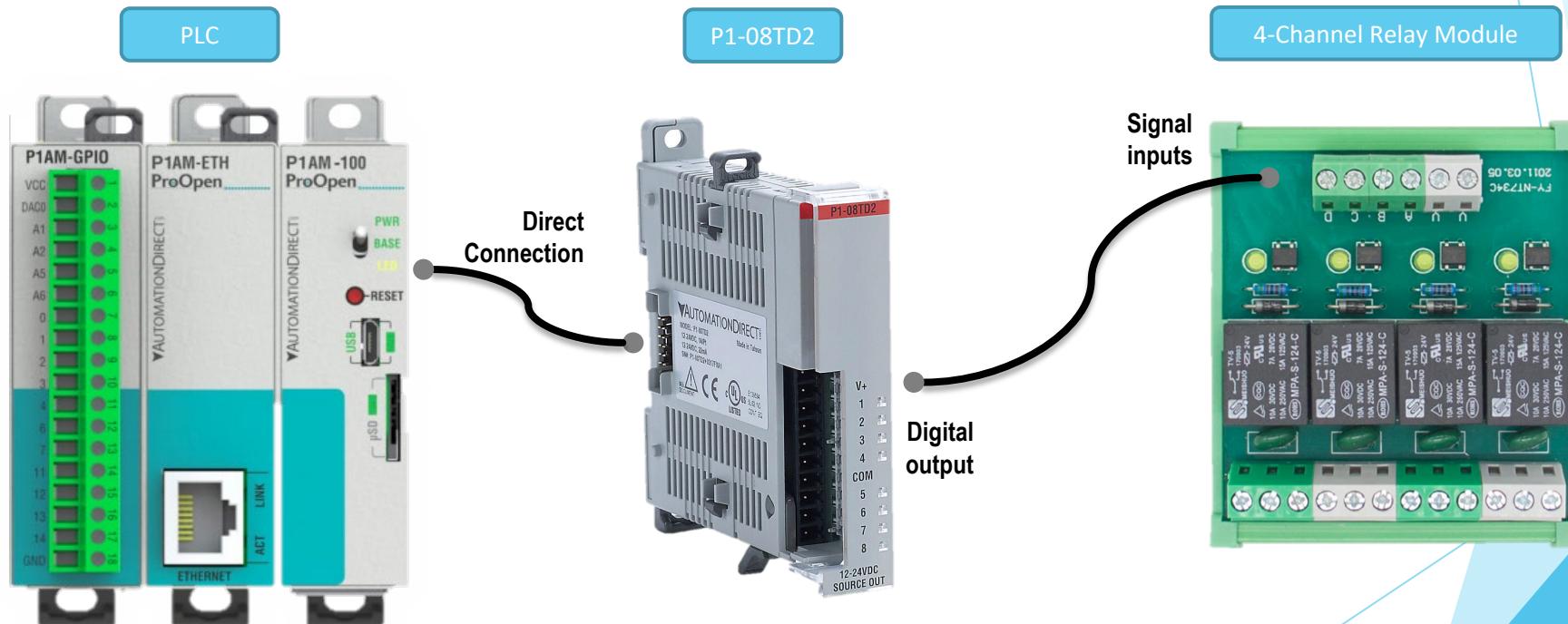


Distance Sensor Integration (VL53L0X)

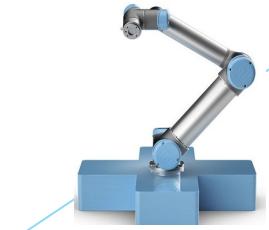
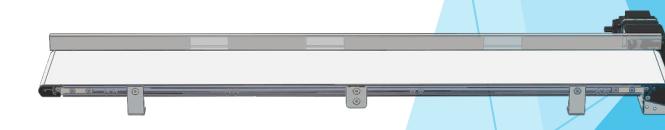
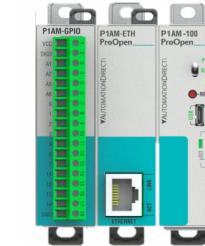


Relay Integration (VL53L0X)

1. P1AM controls the digital output module
2. Output module sends 0/24v signals to relay module



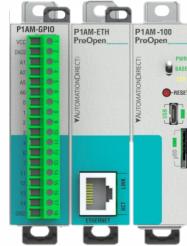
Demo1 Behavior



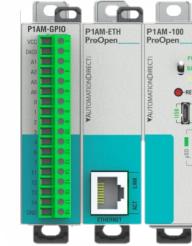
Demo1 Behavior



50 Hz



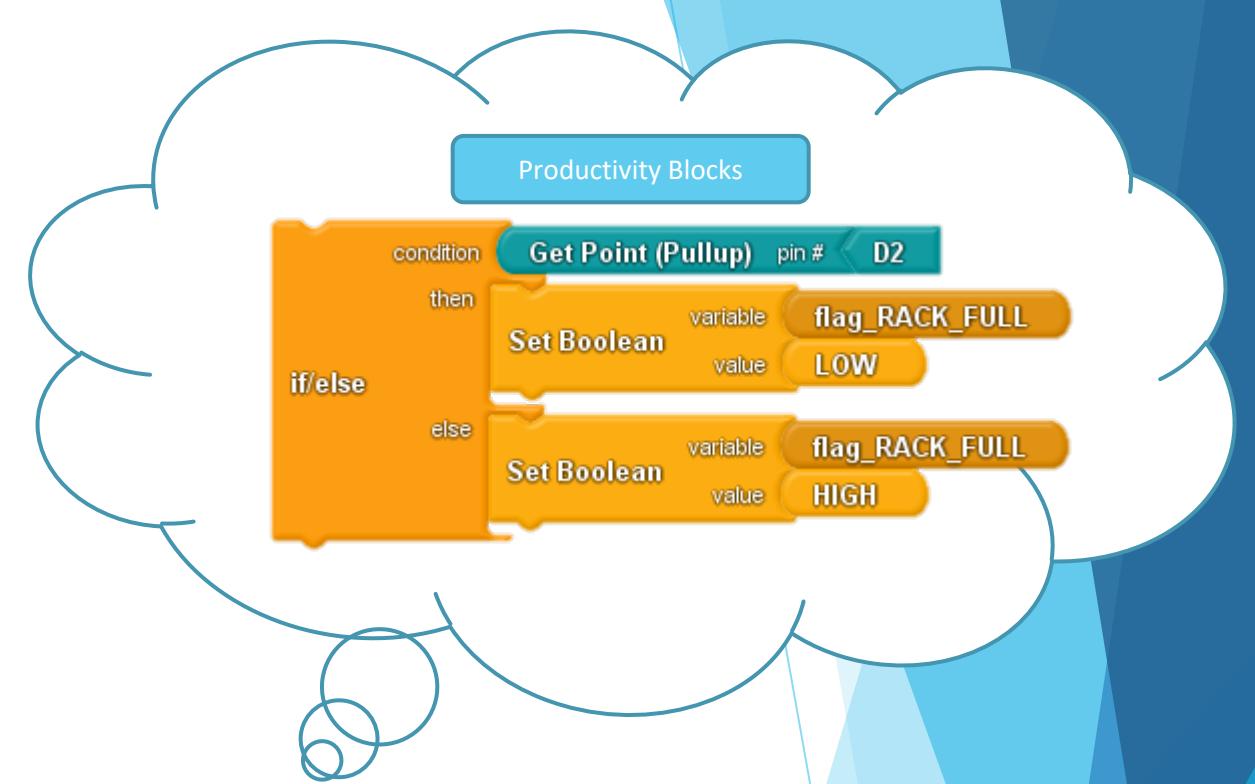
1000 Hz



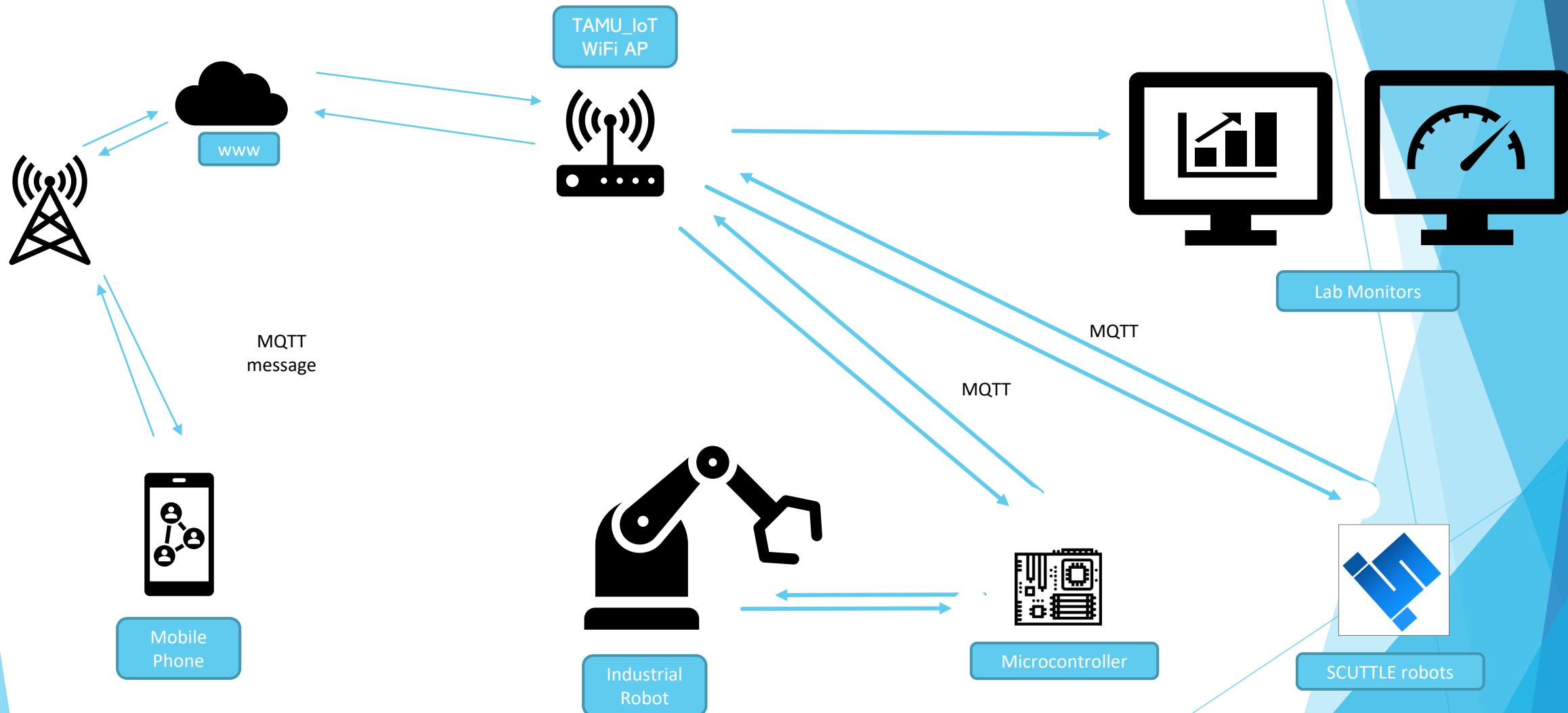
Logic Table, 2021.07 demo

- ▶ Two flags defined
 - ▶ RACK IS FULL (switch)
 - ▶ OBJECT IS NEAR (distance sensor)

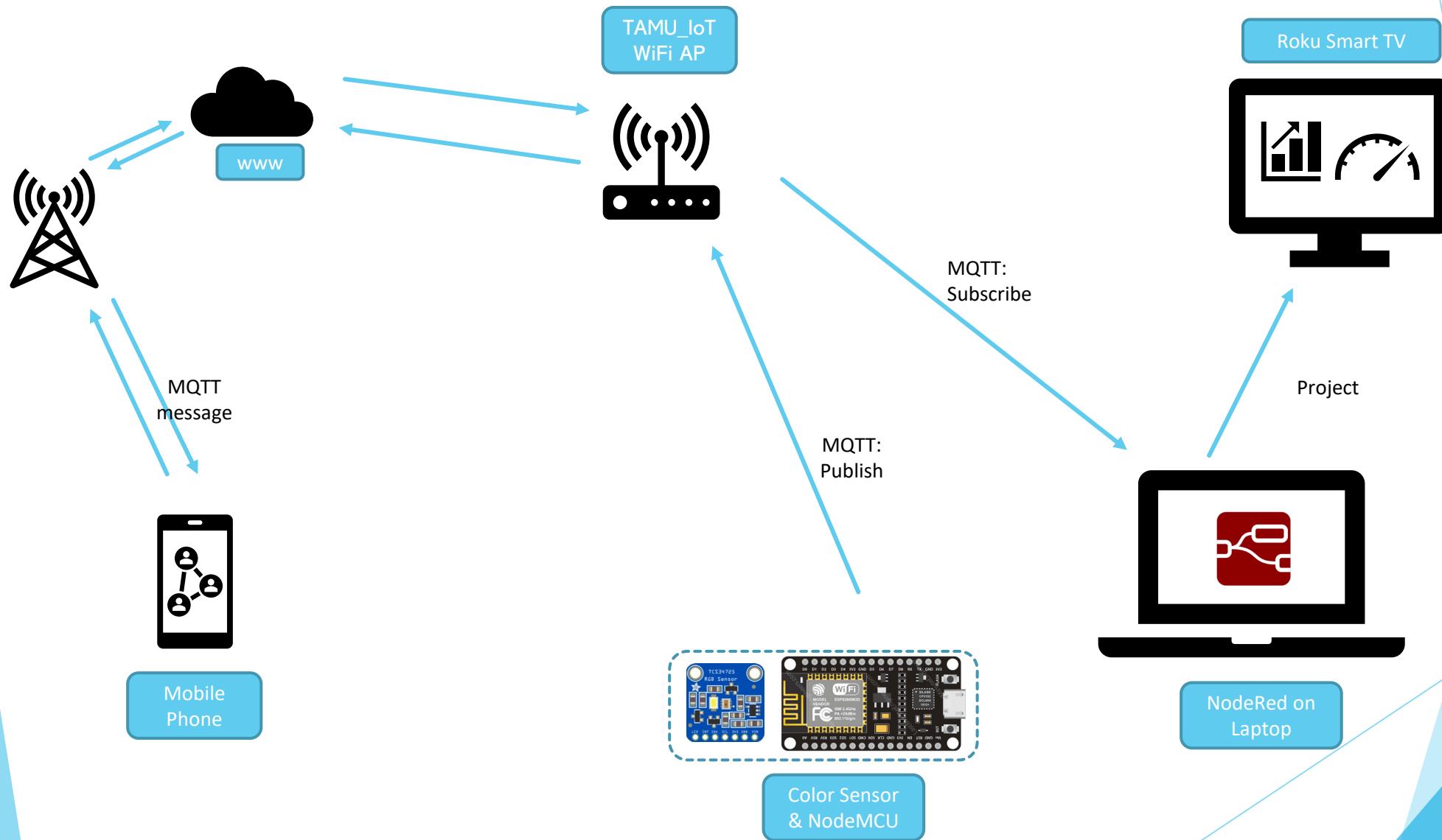
Conditions		Conveyor Actions		When will this occur
Rack is FULL	Object is NEAR	Direction = AWAY	Movement = GO	
0	0		1	object is traveling mid-conveyor
0	1	0	1	object reaches the end of conveyor
1	0	1	0	object sits in the rack
1	1		0	CANNOT OCCUR



Possible Linking of Devices

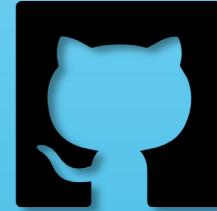


Color Sensor Demo with MQTT



ALL documentation about the demo:

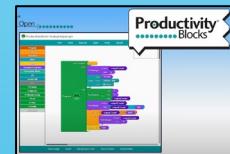
github



github.com/dmalawey/MXET-Conveyor-2021



Arduino code



PLC code



AutomationDirect:
manuals



This PDF

CAD MODELS

NodeRed alerts

- ▶ [Email node setup](#)
 - ▶ Gmail account [settings](#) to allow automated email
 - ▶ Use a [change node](#) to set a global variable
 - ▶ See [instructions](#) from gmail to configure settings
-
- ▶ Raspberry Pi Jam (group learning)
 - ▶ <https://projects.raspberrypi.org/en/jam/jam>
 - ▶ Example: traffic lights with python(command line)
 - ▶ <https://projects.raspberrypi.org/en/projects/traffic-lights-python>
 - ▶ Projects
 - ▶ Minimal additional hardware. Learn python.
 - ▶ Line-following robot
 - ▶ <https://projects.raspberrypi.org/en/projects/rpi-python-line-following>
 - ▶ Coder Dojo
 - ▶ <https://projects.raspberrypi.org/en/coderdojo>

Video Tutorial

