

Dylan Hudson
Chris Unger

SCADA Project Report

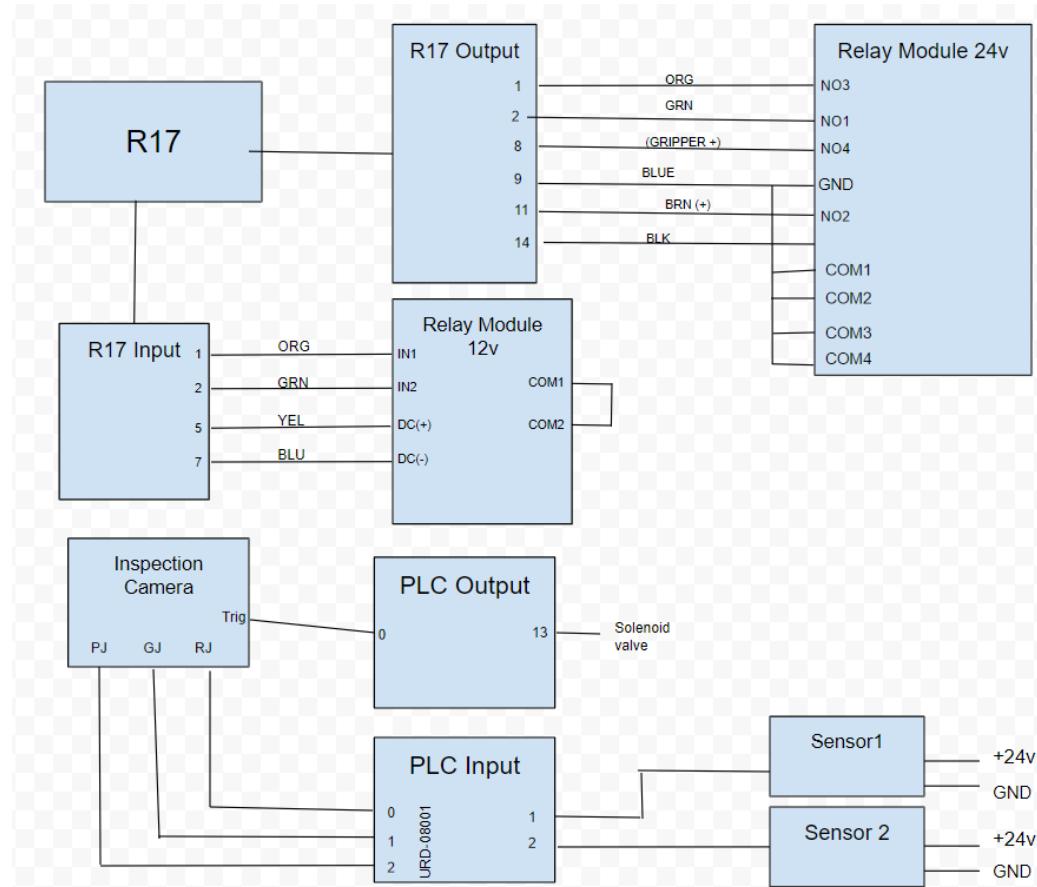
1. Starting Date: 1-15-21
2. Project Safety:
 - a. Wear PPE in proper locations.
 - b. Power needs to be off when dealing with electrical equipment.
 - c. “No horseplaying” in the Lab area at ALL times.
 - d. Proper Supervision in Lab and when turning ON the power.
 - e. Everyone including students, visitors, faculty will follow ALL safety rules and Industrial standards when in Lab and report any unsafe behavior and/or actions to proper personnel (instructor).
 - f. Task guidelines will be in line with the instructions from the instructor.
3. Project Planning Documentation:
 - a. Project Overview:
 - i. Creating and designing an automated colored block sorting station using an inspection camera, two sensors that detect a block/object, and a conveyor belt.
 - b. Project Scope:
 1. The R17 goes into its home position awaiting a task. There is a chute containing blocks of many colors. A pneumatic cylinder pushes a block onto the conveyor belt where it is detected by the first proximity sensor. This is used by the PLC to trigger the inspection camera to detect what color the block is, the data is sent and stored by the PLC. The PLC waits until the block continues along to the second proximity sensor, which the motion activates the R17 arm to pick the block up. When the block reaches the second proximity sensor, the PLC sends a command to the R17 triggering the correct subroutine for the block color. The R17 uses a suction cup endeffector to pick the block up and move it to its designated bin. After this task has been accomplished the R17 returns to its home position awaiting its next task. In the event a block color is not valid, it is pushed off the conveyor belt into a discard like bin, and ignored by the R17.

- c. Project Plan:
 - i. The first **MAIN** goal is to have everything up and running, certainly not having COVID interfere with our plans like the previous group.
 - ii. Get the pneumatic cylinder operating to push the block with the right amount of force.
 - iii. Make sure the proximity sensors can detect objects in front of them.
 - iv. Configure the inspection camera and get it to communicate with the PLC.
 - v. PLC needs to drive the VFD.
 - vi. Relays need to be operational.
 - vii. Program the R17 and get the Suctioning attachment to pick up the blocks.
- d. Timeline:
 - i. January 22- Received Project Instructions/Requirements. Started writing up the Scada Project Report. Instructor explained the rundown of the project in the Robotic Lab area.
 - ii. January 29 - Remove all wiring associated with the R12 since we are only focusing on the R17. Inspect the R17 connections and drawed a wiring diagram showing how the inputs and outputs are to be connected.
Repaired the output connector for the R17.
 - iii. February 5- Screwed in the terminal strip onto the board. We connected the camera cables to the terminal strip on to the board. Connected the output wires for the R17 to the relay. Marked the precise location of the remote I/O in the box. Created a R17 I/O Wiring Diagram. Screwed and mounted the box onto the board. Started drafting up Guard Rail for the conveyor belt.
 - iv. February 12- Took off the box to make it easier for us to wire more wires up. Put alien tape on to the inside terminal strip and connect to the box. Wired up both sensors 1 and 2, the piston 1 and 2, the pneumatic valve cable to the inside terminal strip. Rewired the camera input cable. Connected a cable from Modbus (input and output ports) to the inside terminal strip. Connected a second cable from the relay to remote I/O.
 - v. February 19- Added another terminal strip and added positive/ GND wires to the new terminal. Organize all wires to fit perfectly in the box. Added a cable to Allen Bradley PowerFlex 4M to Allen Bradley Power Supply. Added two fuses in the box and wired them up. We jumpered the positive and ground wires on the new terminal to send out to the other components. Wired up Relay 2 (12v) to Modbus. Started wiring up main power and ground from Modbus to the new terminal strip.
 - vi. February 26- Finished all the wiring. Jumper a cable for the terminal strip for power. Jumper a cable for Modbus pins. Connected Allen Bradley Power Supply to fuses. Changed idea of Guard Rail.

- vii. March 5- Added an IP address to Modbus. Added two missing GND wires. Checked and made everything work including sensors, inspection camera, and piston. Started programming to have the conveyor belt and the error system.
- viii. March 12- Cable/wire organization. Fix camera and change settings plus added new IP Address. Hooked up shoot photo sensor. More programming.
- ix. March 19- Programming and added delay to the photo of blocks on camera. Mounted second glass holder and sensor 2. Added cable between camera to Allen Bradley switch. Configured judgement parameter in camera for color recognition. Started process for linking PC to camera. Suction cup process by Brian/Lynn duo. Need to link color judgments to the three outputs on camera.
- x. March 31- Organize R17 wires/cables. Turn ON arm and test it. Reviewed Interfacing with the Outside World sheet. Reviewed I/O for R17.
- xi. April 2- Fixed I/O wires/ cables for R17. Organized wires after the fixes. Added I/O to PLC programming. Tested communication from I/O to PLC.
- xii. April 7- Hooked up pneumatic valve to suction cup. More configuring camera, mainly judgement display from camera to modbus. Camera up and running.
- xiii. April 9-Corrected camera judgement and camera configuring. Hooked up missing 12v relay to power arm and suction cup. Fixed piston to clear shot.
- xiv. April 14- Fixed wiring to match PLC and Robwin software to communicate. Updating hand drawn wiring diagram. Start arm Programming. Created first route for pickup and place block.
- xv. April 16- Fixed new wire problem. Fixed time when stopping on the second sensor. Checked and adjusted judgments for camera. Checked the first route.
- xvi. April 21&23- Finalizing Robot program and finishing all three routes. Updated judgements for new sets of boxes from Lynn. Began writing the Roboforth program. Was able to get the red route linked to PB 6 and the green route linked to PB 7. PLC was able to control these.
- xvii. April 23- Adjusting the routes to incorporate the new storage bins for the blocks. Add to the program the ability to remove the invalid color blocks. Work more on the final wiring diagram. Edit the PLC program so it will begin automatically till all the blocks are gone. Adjust both routes, red and green, to accommodate new bins. Added an alarm to notify everyone that no block in shoot. Project now be in auto mode running with one button.

- xviii. April 28- Added documentation for PLC programming. Ran into a problem where it will not run program.
- xix. April 30- Finalizing everything. Fix the program issue from the 28th.
- xx. May 5- Found a mystery bug that was fixed when resetting robot console box. Reason is unknown. Added more photos to report.

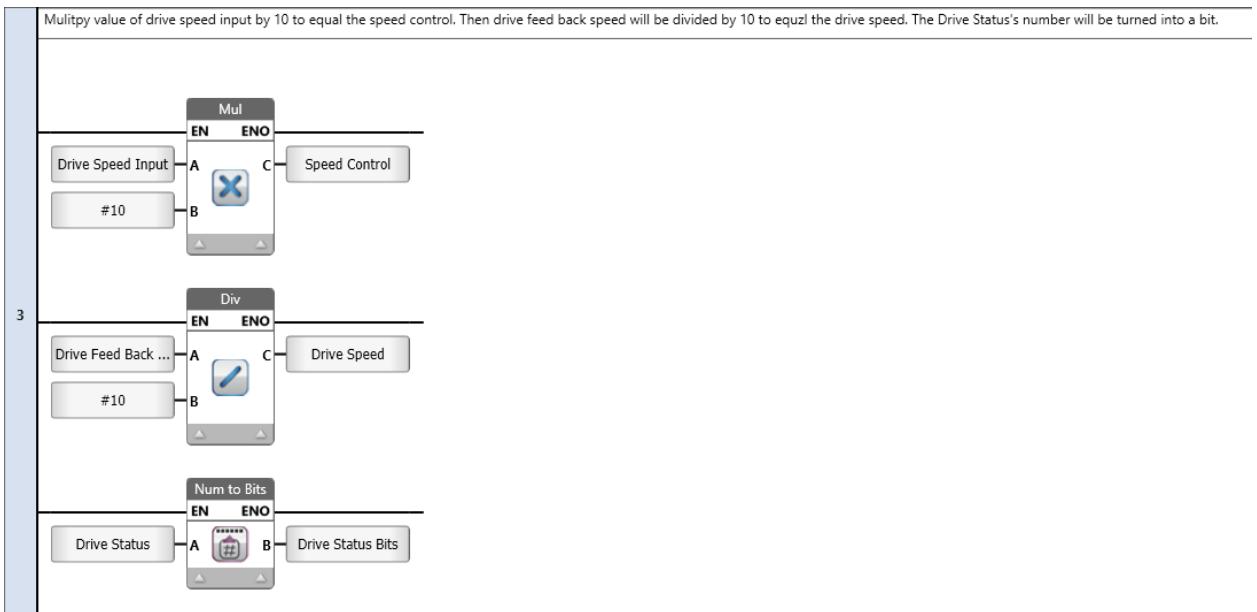
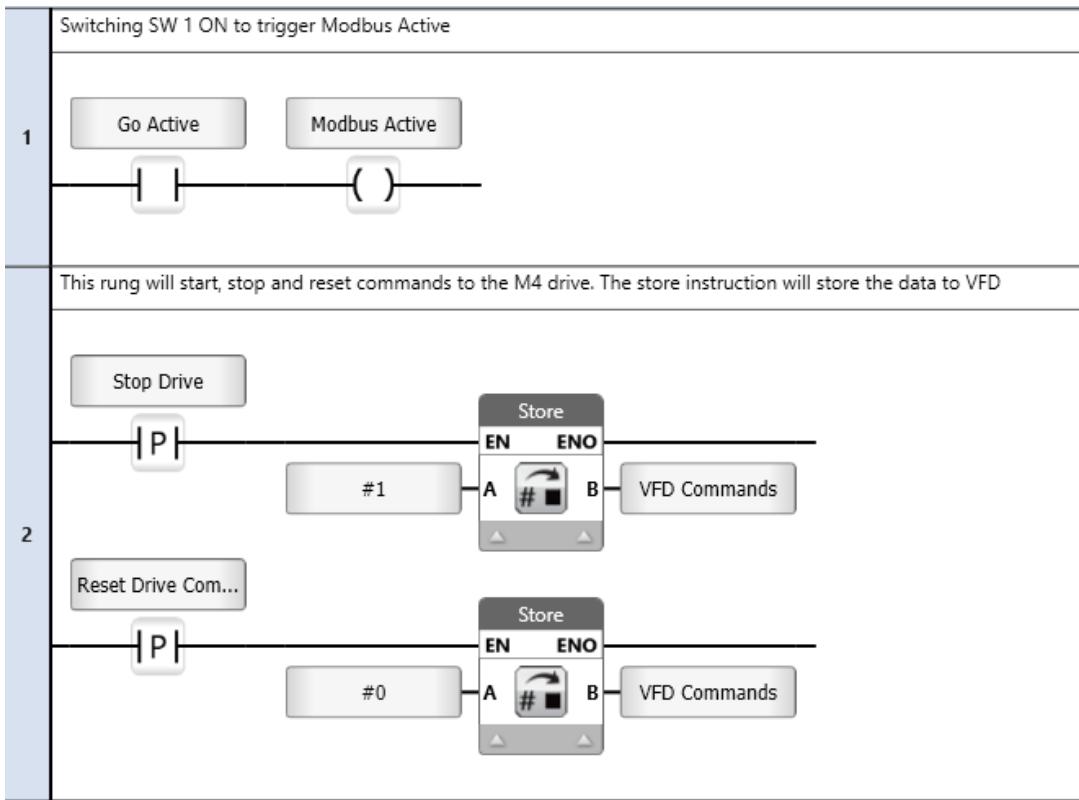
e. Wiring Diagram:

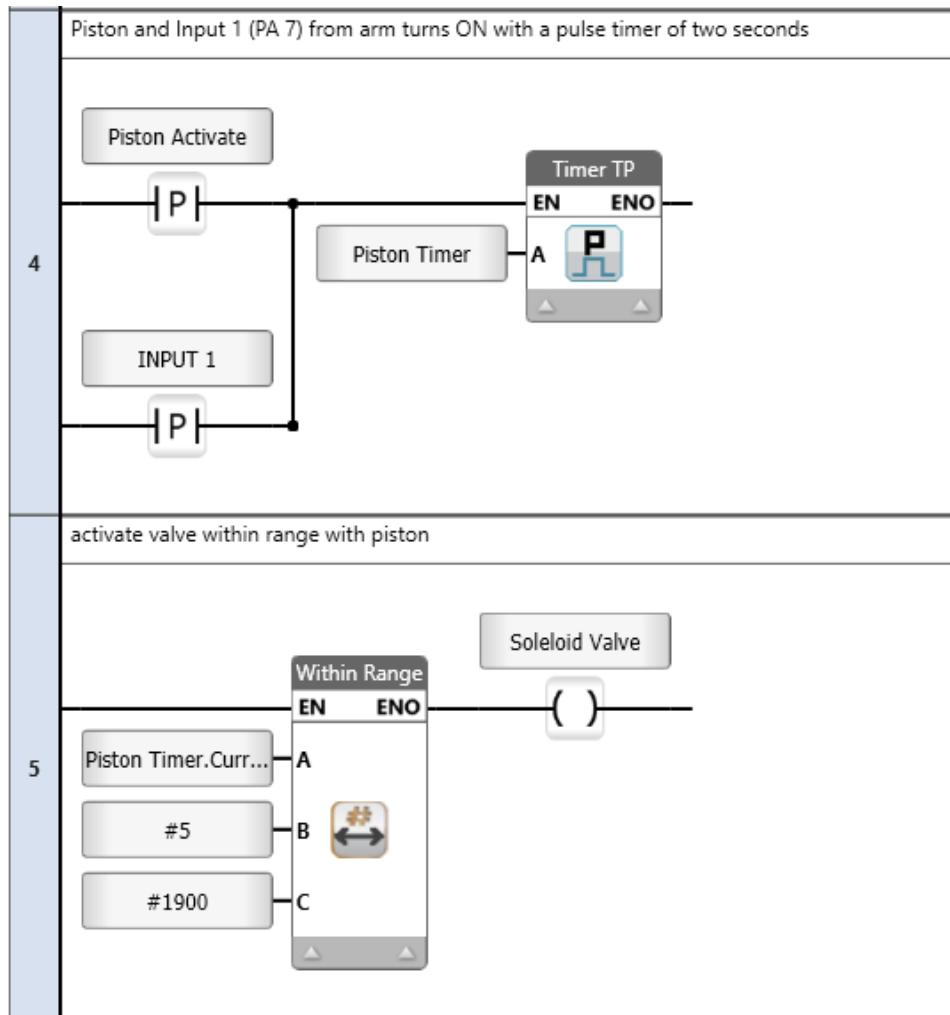


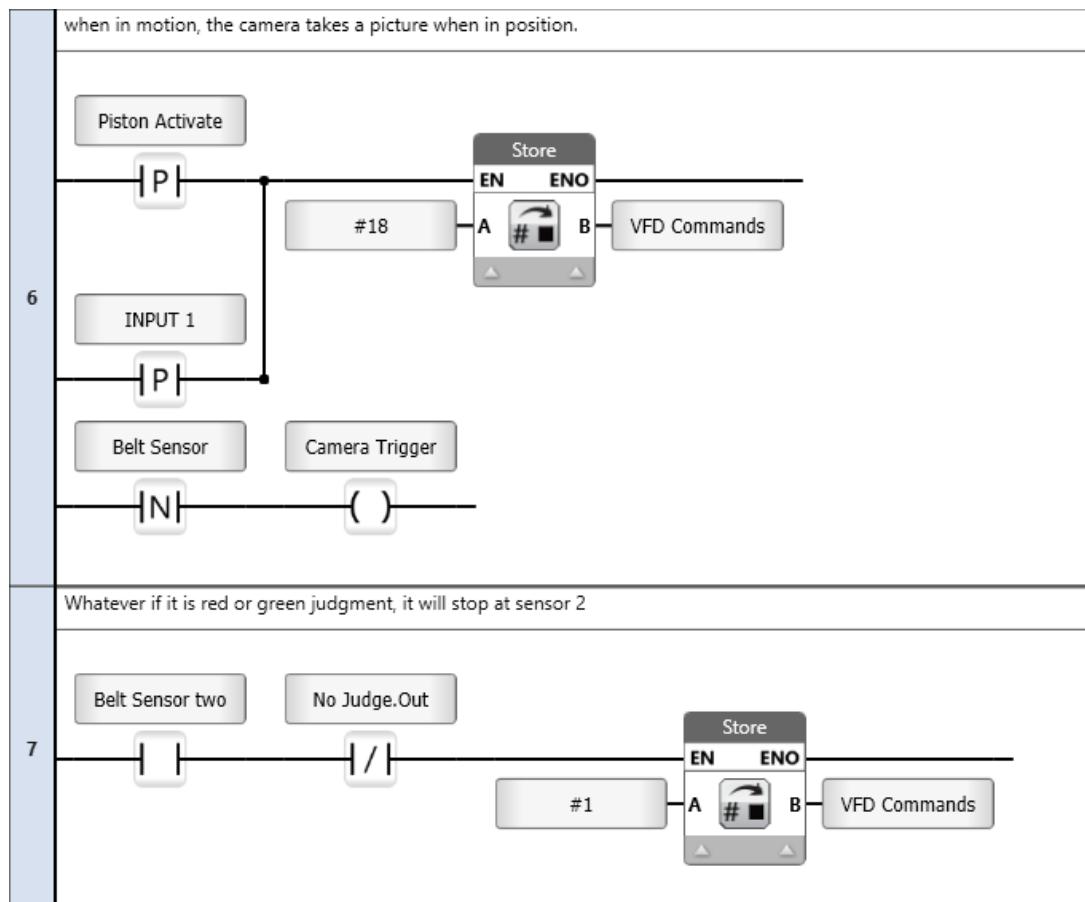
4. Networks:

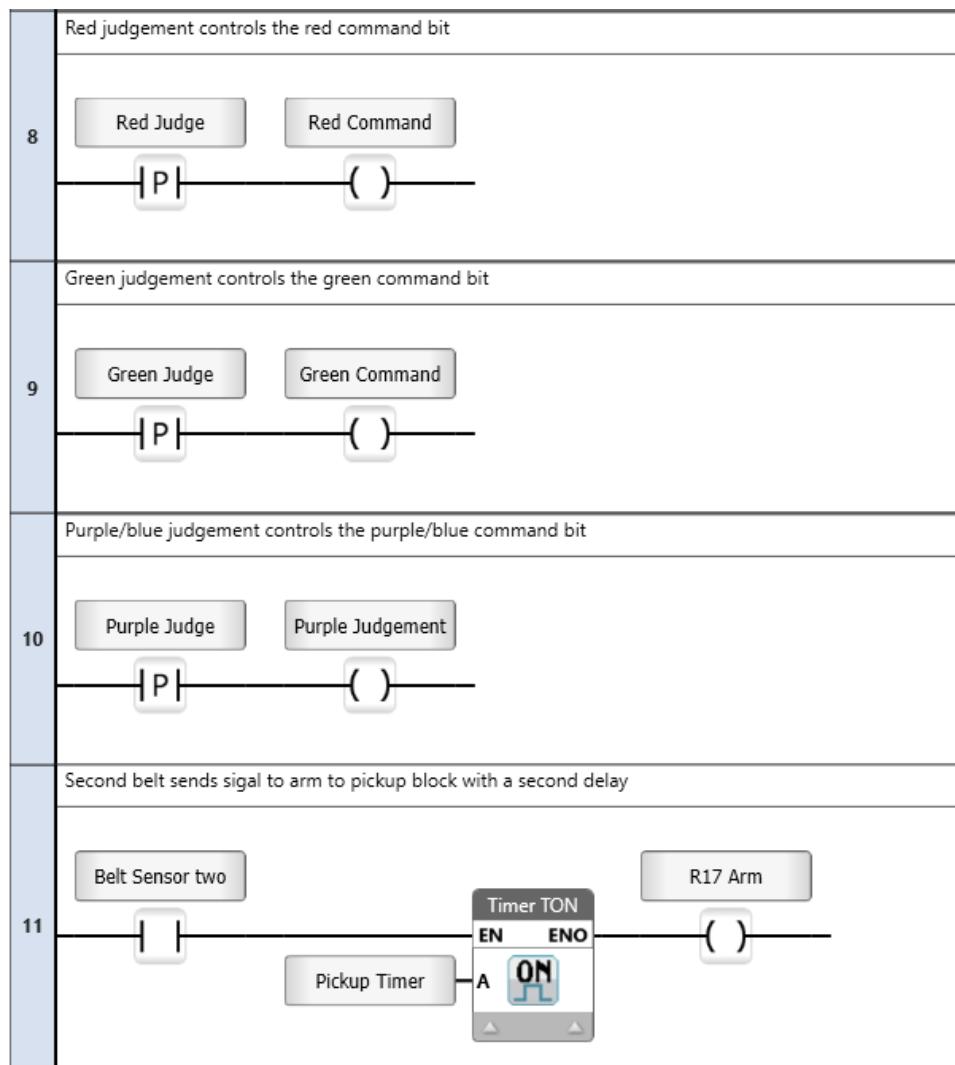
- a. February 26- Dylan and Chris received/learned how to set up the MAC address for Modbus when we started to configure the IP address.

5. SCADA (PLC) Programming:

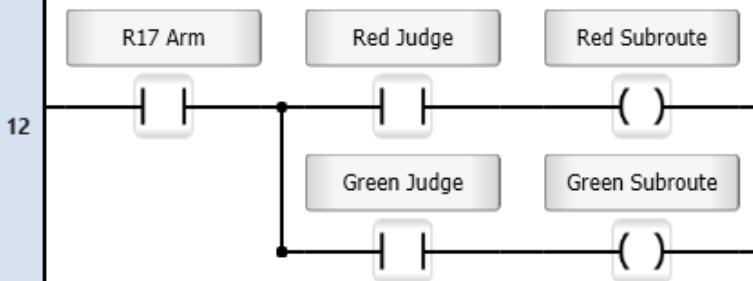




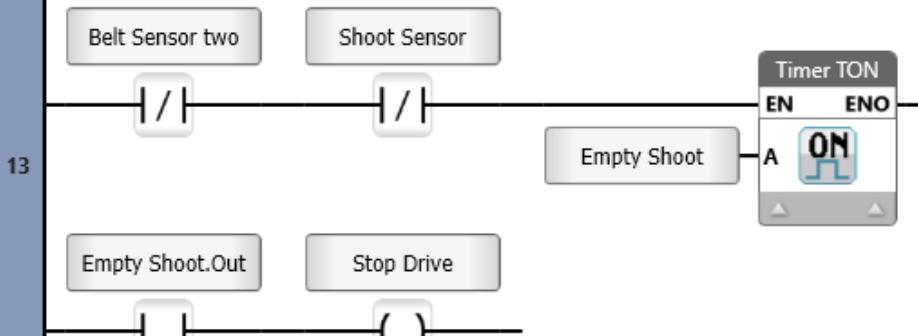




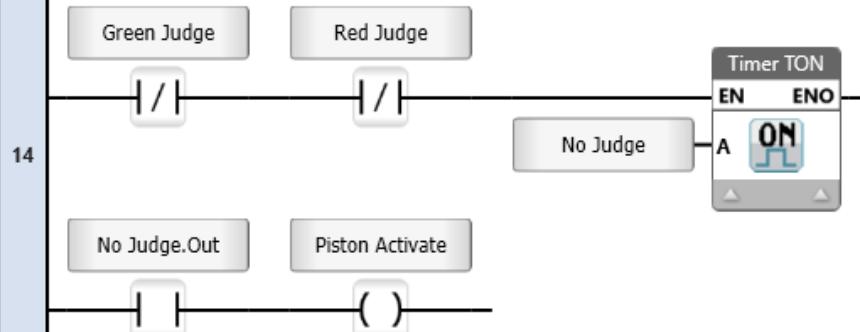
Arm has two subroutines to activate by the judgement from camera



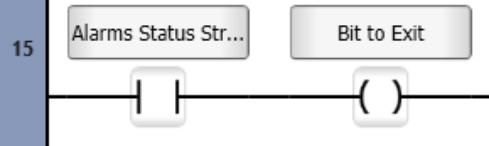
when no blocks are left in shoot, the conveyor belt will stop in five seconds



If there is no judgement, waits for 5 secs, then continue on to kick block off belt.



Alarm goes off ends robot program.



6. Robotic Programming:

Two windows showing robotic path planning routes:

Route RED_PATH

Line	Waist	Shoulder	Elbow	Hand	Wrist	Yaw
1	HOME	0				
2	5769	-8775	-10274	-1064	-1054	0
3	5679	-11706	-9781	-753	-743	0
4	GRIP	0				
5	5769	-8775	-10274	-1064	-1054	0
6	7339	-6343	-11414	-1064	-1054	0
7	17116	-9463	-8251	-1676	-2347	0
8	UNGRI.	0				
9	0	0	0	0	0	0

Route GRN_PATH

Line	Waist	Shoulder	Elbow	Hand	Wrist	Yaw
1	HOME	0				
2	5769	-8775	-10274	-1064	-1054	0
3	5679	-11706	-9781	-753	-743	0
4	GRIP	0				
5	5769	-8775	-10274	-1064	-1054	0
6	2114	-2678	-11414	-1064	-1054	0
7	-4706	684	-9987	-1064	-1054	0
8	-11615	684	-9987	-1064	-1054	0
9	-16986	-7682	-9008	-1663	-1653	0
10	-16986	-10898	-8482	-1283	-1273	0
11	UNGRI.	0				
12	-16986	-7682	-9008	-1663	-1653	0
13	0	0	0	0	0	0

BLOCK2.ED2

```
: RED
RED_PATH RUN
PA 7 ON
500 MSECS
PA 7 OFF
;

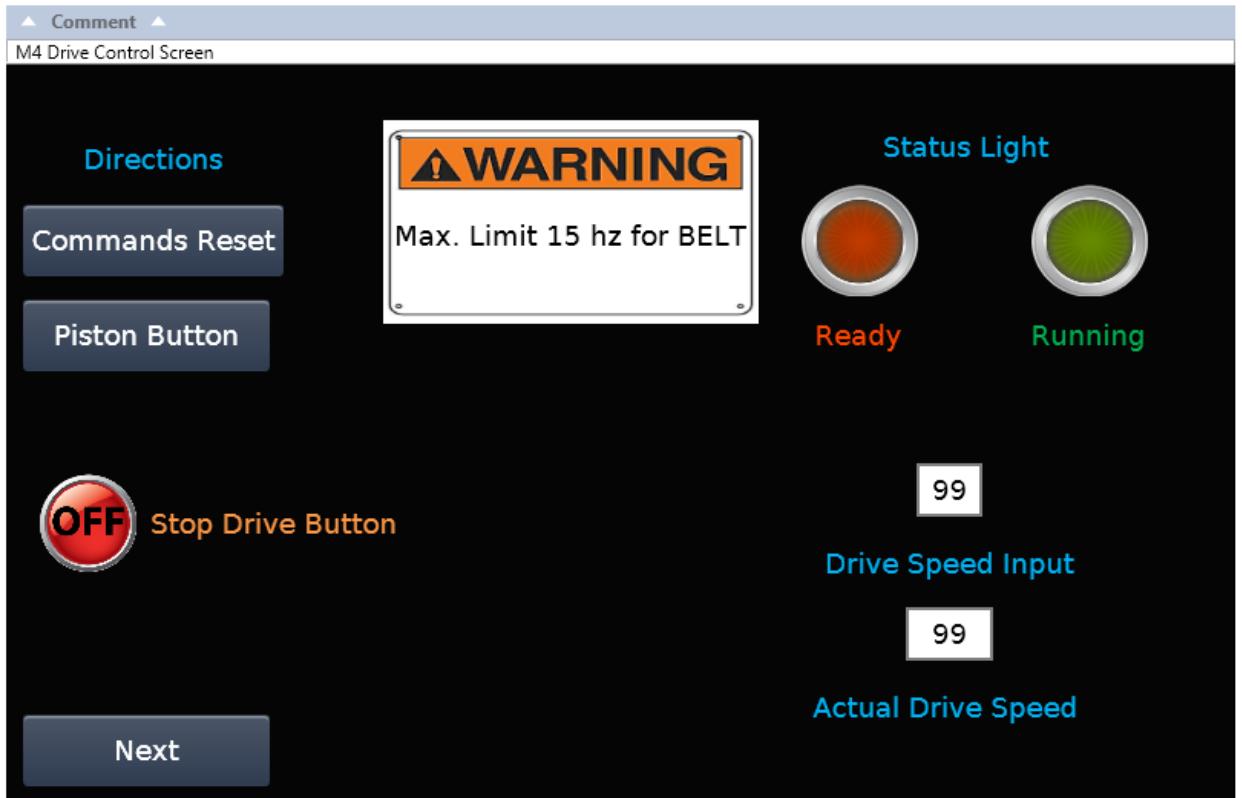
: GRN
GRN_PATH RUN
PA 7 ON
500 MSECS
PA 7 OFF
;

: TEST
BEGIN
    PB 6 BIT? 0= IF
    RED
ELSE
    PB 7 BIT? 0= IF
    GRN

THEN
THEN

PB 5 BIT? 0= UNTIL
;
```

7. HMI:



8. Teamwork:

- a. Chris attended all the classes, Dylan missed the first class due to waiting on COVID-19 test results. Chris filled Dylan in on what he missed. Dylan also missed the 28th due to a second vaccine that made him sick or not feel well.
- b. Chris and Dylan both did good effort on assigned tasks. They discussed what needed to be done and decided on whom would take care of which tasks that needed to be accomplished.
- c. Chris and Dylan both put in strong effort on their responsibilities.
- d. A time did not come where a member had to miss a class. It can be confidently stated that if one member was absent, the present one would notify the absent one on what was done in class, and what tasks were needed to be accomplished or any tasks were finished.
- e. All the members shared ideas through email or in person. Both respectfully would consider each other's inputs. If there was a disagreement on how something should be done, each member would explain their reasonings and they would discuss the options.
- f. The team members, Chris and Dylan, cooperate as a team with shared effort.

PROGRAM OUTLINE TO BE MODIFIED AND DELETED

Cylinder retract switch check to see if closed, Conveyor belt running.

Turn on the solenoid till cylinder extracted switch is closed, then turn off solenoid valve

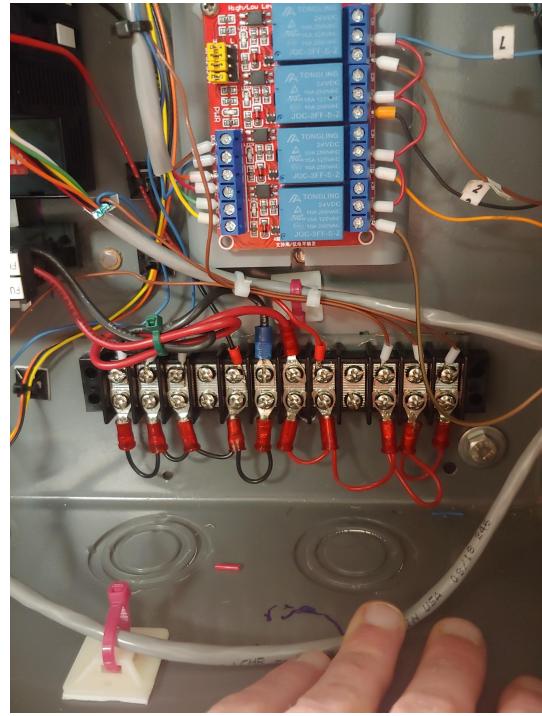
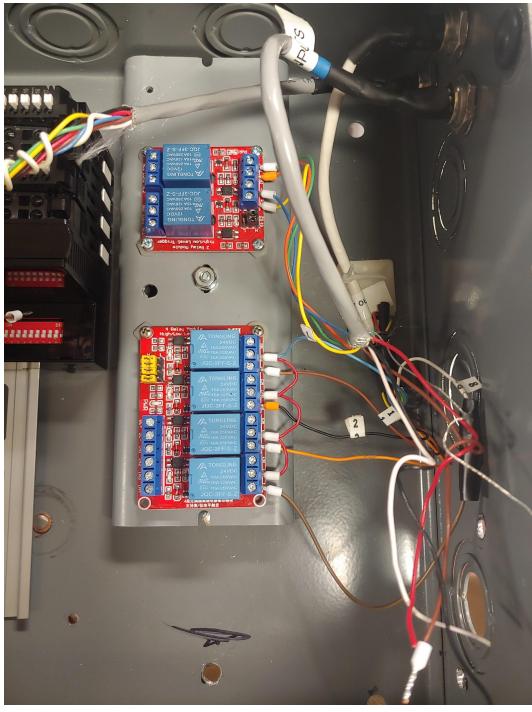
Wait until the block is picked up by the first photo sensor, stop conveyor belt and triggers the inspection camera.

Turn the conveyor belt back on until the second photo sensor detects the block.

Once the belt is off have the arm pick it up (Further work needed for this)

How does it do it?

1. System is turned on.
2. HMI Button is pressed starting the program.
3. Output from PLC goes to Input on Robot.
4. Piston activates to send block onto belt.
5. VFD starts conveyor belt.
6. Belt activates to send block to first sensor triggers camera to capture image for judgement.
7. Block continues to second sensor and stops to activate the R17 arm.
8. From judgement, the PLC tells the arm to run the correct subroutine, red or green route.
9. Repeats all block are sorted.
10. Arm homes for further instructions.
11. Shoot sensor times for five seconds.
12. If no blocks inserted, an alarm will trigger a message saying NO BLOCKS.
13. Also, Conveyor belt stops when ten seconds are done along with the shoot sensor.
14. When ready, put blocks back and click HMI button again.



Photos of wiring, relays, Terminal strips, and Modbus.

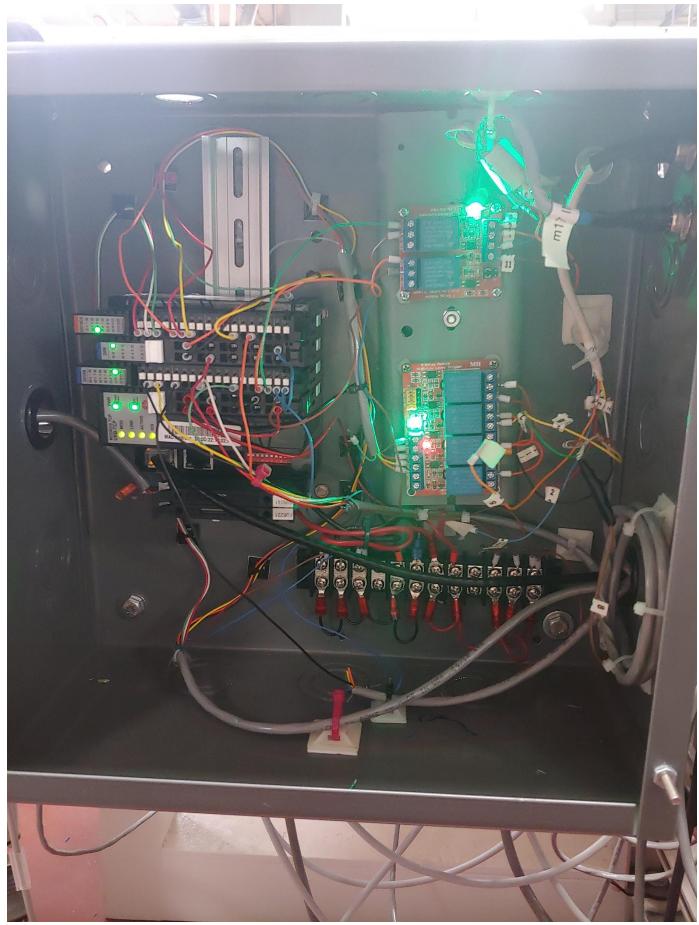
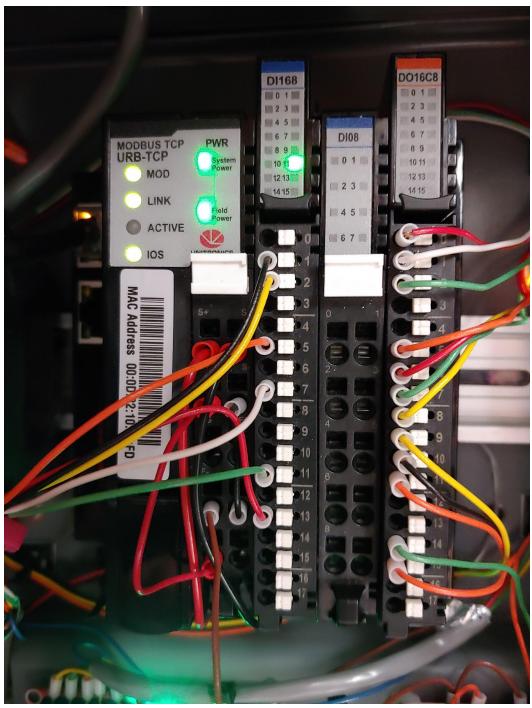
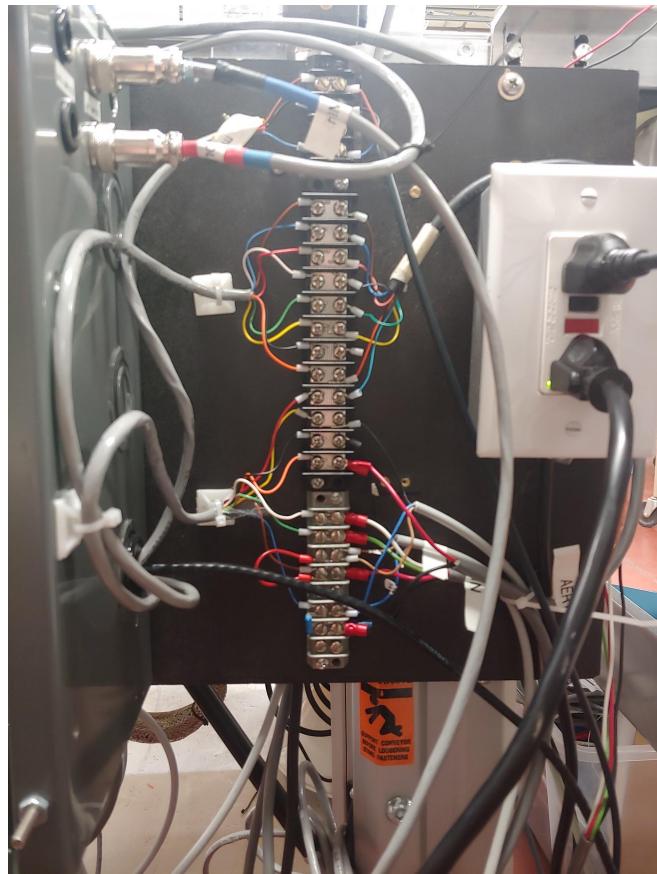
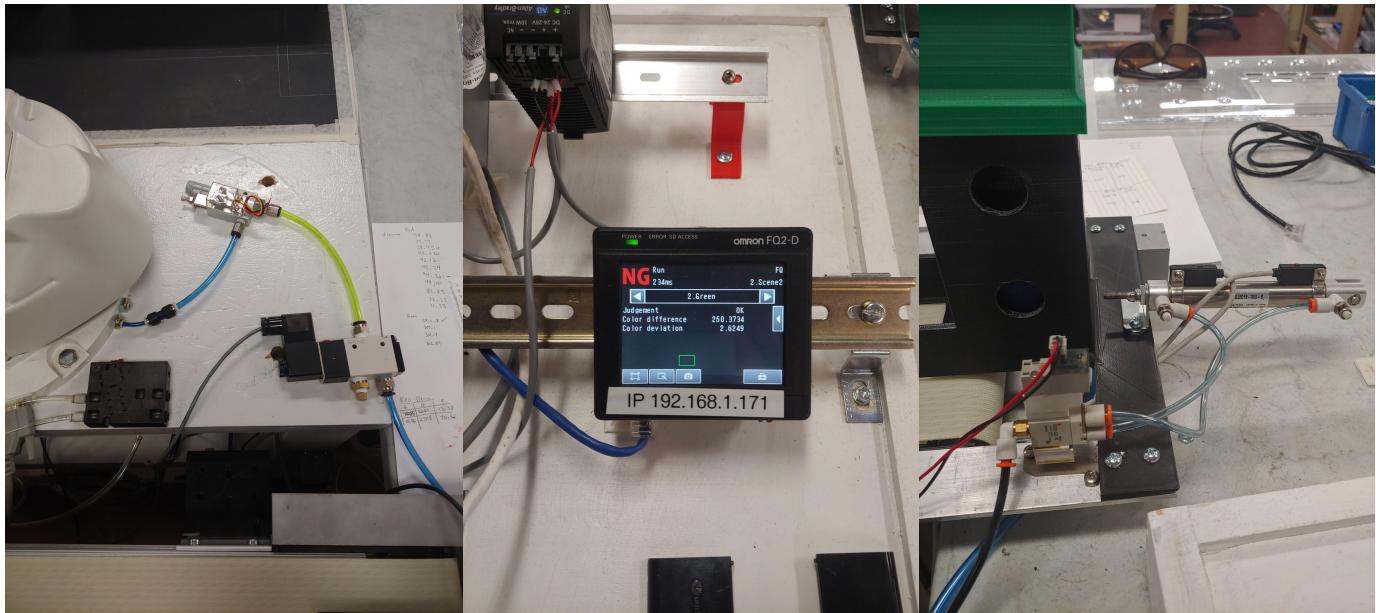
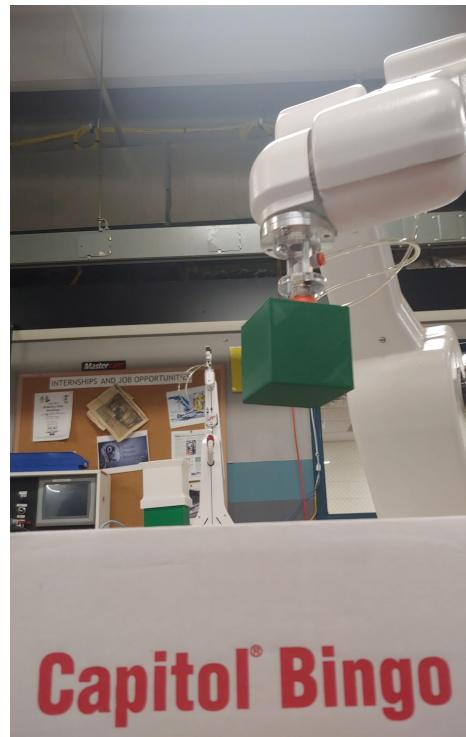
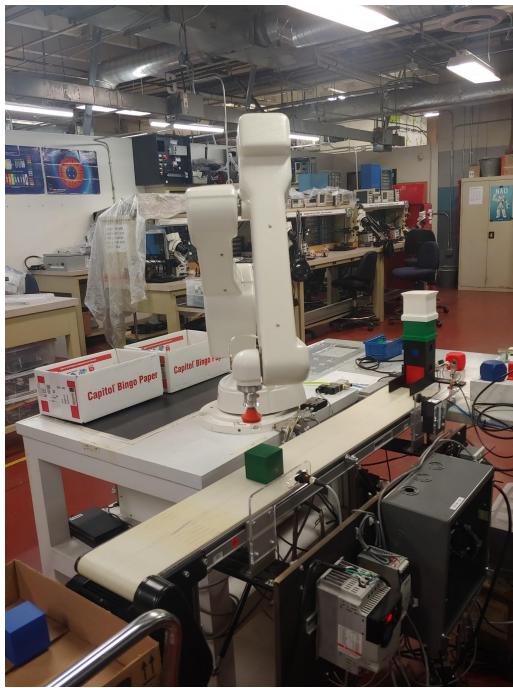


Photo of I/O Terminal strip



Other Photos





Pick up and drop block in appropriate box

