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Harsh Dubey
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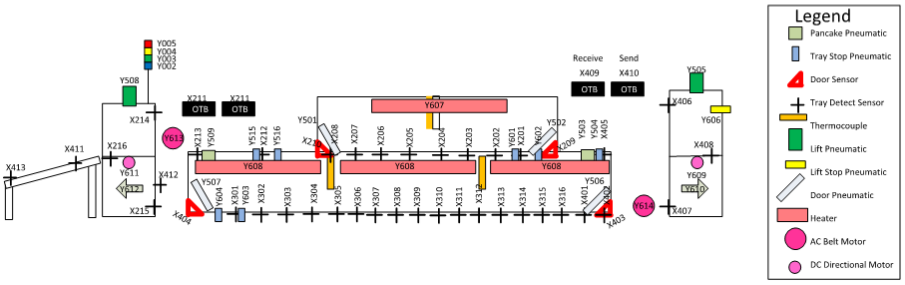
06/24/19

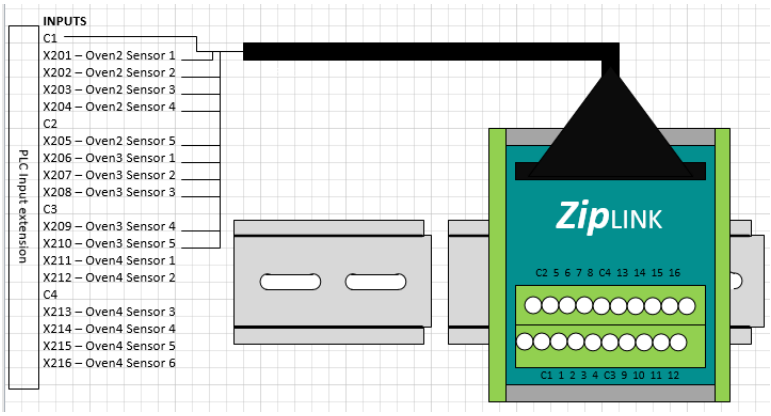
INPUTS	INPUTS	INPUTS	INPUTS	OUTPUTS	OUTPUTS
X1 – Not Used	X201 – PH Sensor 1	X301 – Bot Sensor 1	X401 – Bot Sensor 17	Y501 – PH Enter Door	Y601 – PH Exit Stopper B
X2 – Not Used	X202 – PH Sensor 2	X302 – Bot Sensor 2	X402 – Bot Sensor 18	Y502 – PH Exit Door	Y602 – PH Exit Stopper A
X3 – Not Used	X203 – PH Sensor 3	X303 – Bot Sensor 3	X403 – Bot Enter Door Sensor	Y503 – Pot Station Pancake	Y603 – Bot Exit Stopper B
X4 – Not Used	X204 – PH Sensor 4	X304 – Bot Sensor 4	X404 – Bot Exit Door Sensor	Y504 – Pot Station Stopper	Y604 – Bot Exit Stopper A
X5 – Not Used	X205 – PH Sensor 5	X305 – Bot Sensor 5	X405 – Pot Station Sensor	Y505 – En Lift Up Down	Y605 – Ex Lift Safety Stopper
X6 – Not Used	X206 – PH Sensor 6	X306 – Bot Sensor 6	X406 – En Lift Top Limit Sensor	Y506 – Bot Enter Door	Y606 – En Lift Safety Stopper
X7 – Not Used	X207 – PH Sensor 7	X307 – Bot Sensor 7	X407 – En Lift Bot Limit Sensor	Y507 – Bot Exit Door	Y607 – PH Heater
X8 – Not Used	X208 – PH Sensor 8	X308 – Bot Sensor 8	X408 – En Lift Pallet Sensor	Y508 – Ex Lift Up Down	Y608 – Bot Heaters
OUTPUTS	X209 – PH Exit Door Sensor	X309 – Bot Sensor 9	X409 – Call Pallet from PH	Y509 – Line Station Pancake	Y609 – DC Motor En Lift
	X210 – PH Enter Door Sensor	X310 – Bot Sensor 10	X410 – Send Pallet to Bottom	Y510 – Solenoid NOT CONNECTED	Y610 – DC Motor En Lift Dir
Y1 – Not Used	X211 – Send Pallet to PH	X311 – Bot Sensor 11	X411 – Gravity Conv Full Sensor	*Y511 – Solenoid Spare 1*	Y611 – DC Motor Ex Lift
Y2 – Blue Light	X212 – PH Enter Stopper Sensor	X312 – Bot Sensor 12	X412 – Ex Lift Safety Sensor	*Y512 – Solenoid Spare 2*	Y612 – DC Motor Ex Lift Dir
Y3 – Green Light	X213 – Line Lift Station Sensor	X313 – Bot Sensor 13	X413 – Gravity Conv End Sensor	*Y513 – Solenoid Spare 3*	Y613 – PH Conveyor
Y4 – Yellow Light	X214 – Ex Lift Top Limit Sensor	X314 – Bot Sensor 14	*X414 – Not Used*	*Y514 – Solenoid Spare 4*	Y614 – Bot Conveyor
Y5 – Red Light	X215 – Ex Lift Bot Limit Sensor	X315 – Bot Sensor 15	*X415 – Not Used*	Y515 – PH Enter Stopper B	*Y615 – UNUSED 1*
Y6 – Not Used	X216 – Ex Lift Pallet Sensor	X316 – Bot Sensor 16	*X416 – Not Used*	Y516 – PH Enter Stopper A	*Y616 – UNUSED 2*



6/25/19

Main objective: Make the wiring diagram for the Oven timer project in Visio.

Visio was not responding, took more than half a day for me and IT support to re-install Visio and have it working. Wiring diagram for oven 2 and 3 was built. Will finish the diagram tomorrow.



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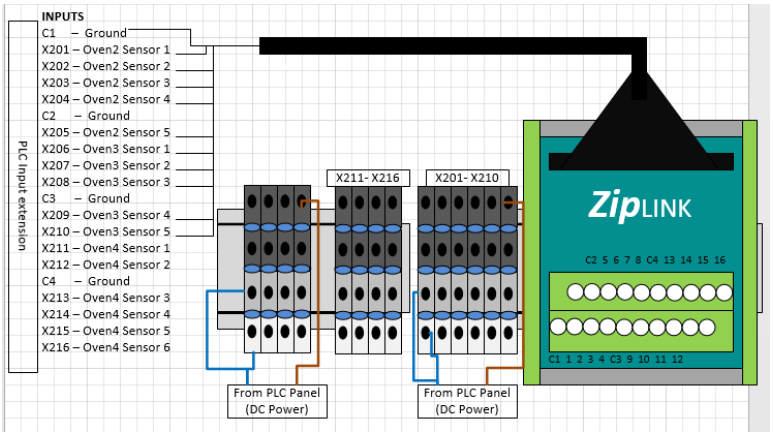
6/26/19

Main objective: Finish the wiring diagram and check the PCB fixture. Production line complained that the PCB fixture is glitching and getting stuck. Find why is that happening and fix it.

Wiring diagram is completed.

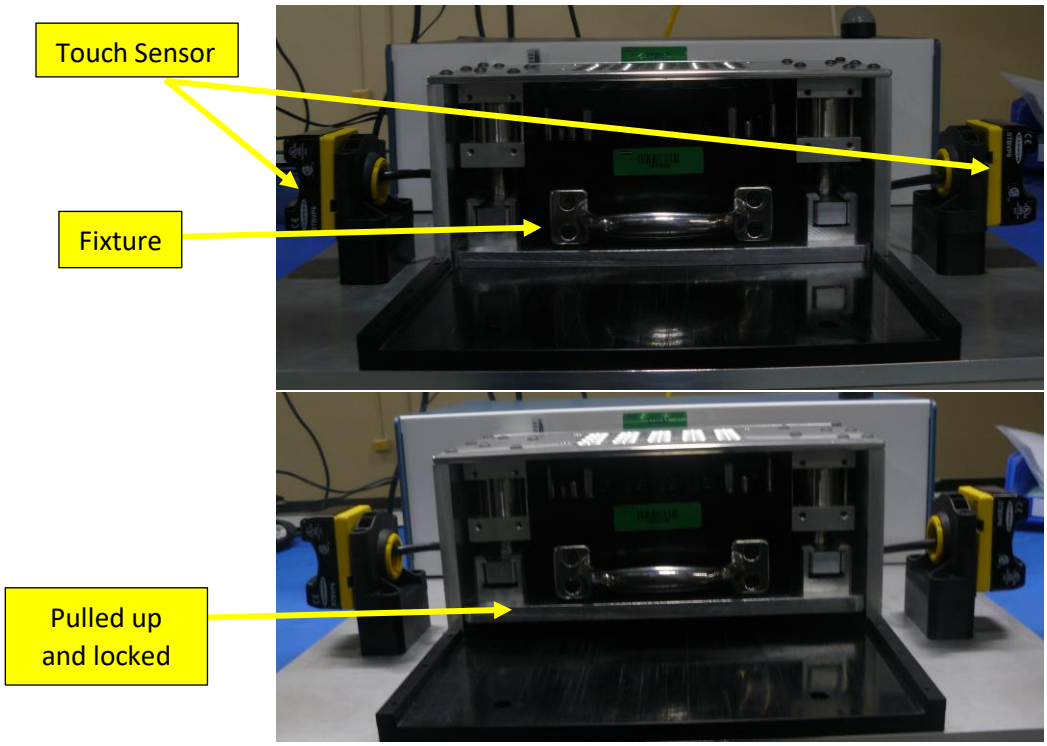


Upon inspecting the PCB fixture, numerous problems were detected. First was, violation of safety conditions by the production line employees. Employees must touch the sensor for at least 134 ms ± 8 ms. The fiber optic sensor and touch sensor has a response time of 10 ms, and they are debounced for 50 ms using a safety controller that has a response time of 6 ms, with PLC having a scan time of 4 ms(PLC takes 2 scans to display the output). Hence, total delay becomes 134 ms.

Total delay = (Sensor response time +debounce time) *2 + safety controller response time + PLC scan time + PLC scan time = (50ms+10ms) *2 +6ms+4 ms+4 ms = 134 ms.

With ±8 ms error, since the input is scanned every 2 scan cycles. And if input is missed in the first scan, then it must wait 8 ms for the other scan.

However, employees don't touch the sensors long enough, hence, the safety controller sees it a as a violation of safety condition and locks the systems. Second problem was with fiber optic sensors, three fiber optics sensors are used and for some reason sometimes they don't work. Conducted few tests on these sensors, will conduct more tomorrow.



6/27/19

Main objective: Test the fiber optics sensors and design a solution for the PCB fixture.

After thorough testing, it was concluded that all three fiber optics sensors are working. They were reinstalled in the fixture and were tested again. It was noticed that after prolonged use of the fixture, signal strength received by the sensor decreases. This is seen as the violation of safety conditions by the safety controller and hence it locks the fixture. I investigated sensor's data sheet, sensor's performance changes with respect to the distance and is affected by dust. It was noticed that with the change in distance the excess gain of the sensor must be changed, shown in the figure below. For example, at 0.1 inches, the gain should 20 times the original signal for correct performance. Fiber optics cable attached to the emitter and receiver of the sensor were cleaned and sensors were re-installed. They were tested again but still they are failing. Will investigate other problems tomorrow.

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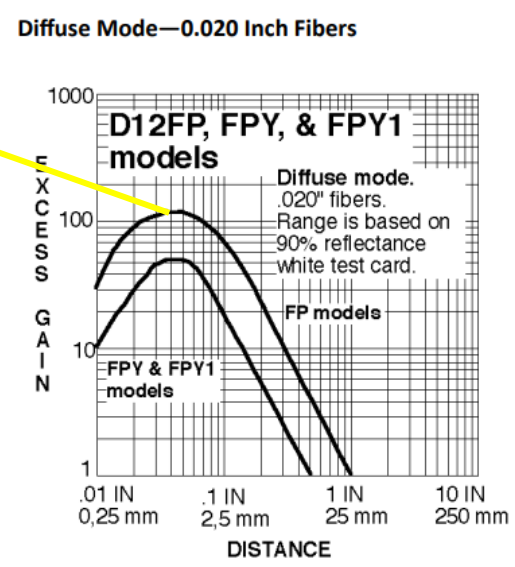
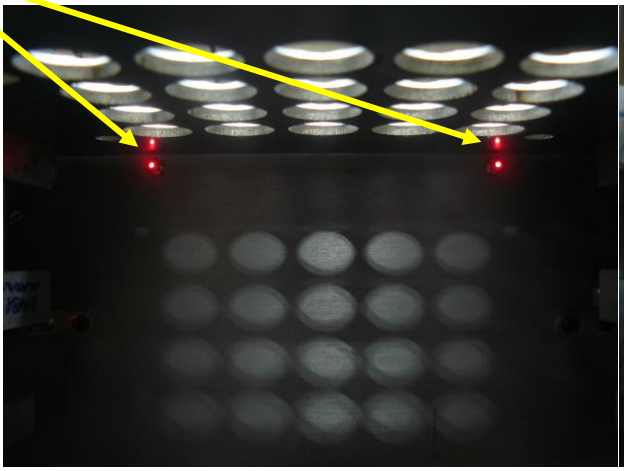
Performance chart

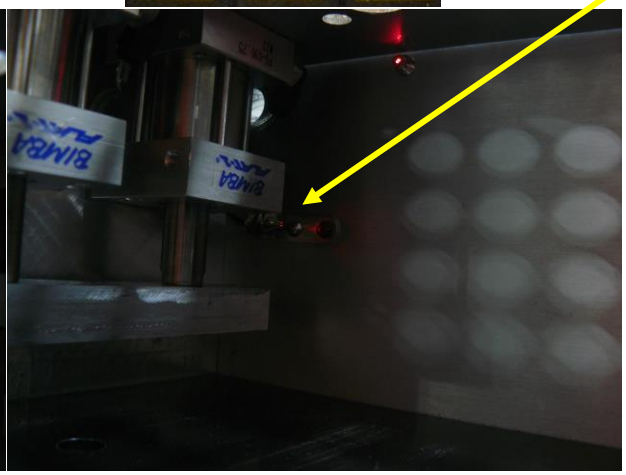


Strength of signal is displayed here

Rear sensor to see if the fixture is pulled up

Side sensor to see if the fixture is all the way in

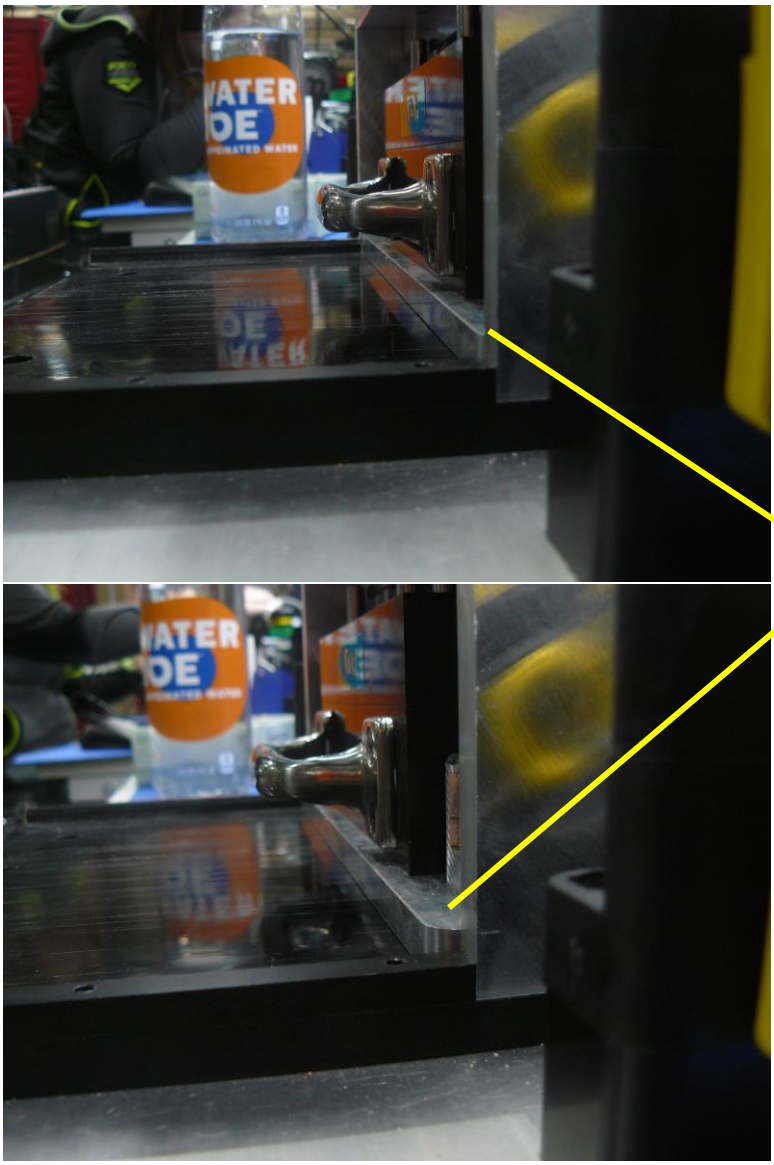




07/01/19

Main objective: Work on the fixture.

I probed all the connections inside the fixture, everything is connected correctly. I tested the PLC, relay and the power controller too and everything is working as expected. However, after more testing it was noticed that the fixture gets displaced from its position by a fraction of an inch. This happens after the fixture is used for few cycles, shown in figure. This displacement in fixtures position changes the between the sensor and the fixture, and the sensors are calibrated for fixed gain/distance ratio. Since, the sensor is very sensitive to the distance, seen in the sensor's performance graph, hence with the increase in slightest of distance the gain also must increase. And in this case, if the fixture is pulled up then this causes sensor fault, and the safety controller locks the fixture. Only way to fix this would be to open the fixture and readjust the gain. Will work on the possible solutions tomorrow.



07/02/19

Main objective: Find the solution for the fixture.

After using the fixture for few times, there is a cascaded error in the fixture's position, this causes sensor fault. However, the fixture also displaces itself when it's pulled up, too minute of a displacement to show, but this also causes sensor fault. This happens due to structural constraints of the fixture, to create a smooth pulling up and down operation the fixture is structured in a certain way. This structure cannot change and hence the fixture will always get locked after few consecutive uses. To fix this, RGY (red, green and yellow) light was used. Red light was used to indicate the danger zone, rear sensor fault and was also used to indicate if the fixture ever gets stuck. Yellow light was used to indicate the side sensor status. And green light was used as a to indicate when it is safe for employees to pull out the fingers. RGY light was ordered and the PLC was reprogrammed.

Red light would turn on if the system is locked, or if rear sensor fails or if the systems is in lockdown zone. Locked down zone is programmed to be 390 ms, which is more than debounce and response time i.e. 134 ms.

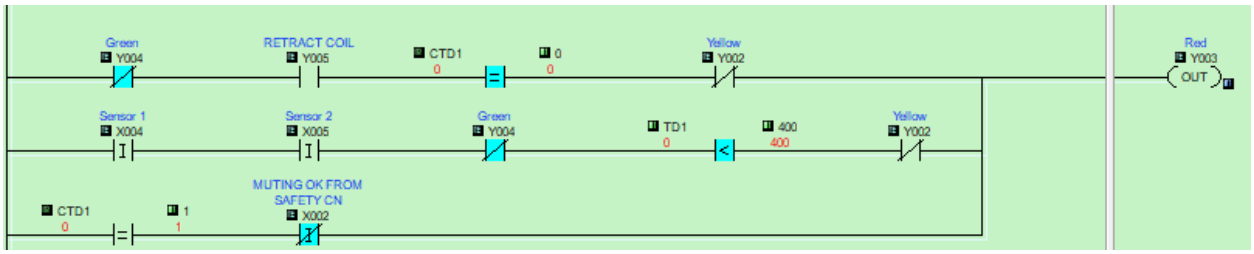
To pull the fixture up user must touch the sensor and hold it till red light goes OFF. As soon as the sensors are touched the red light would turn on and would remain turned on till 390 ms, if the user lets go of his/her finger before the red light turns off then the systems would lock. To unlock the system either the user can hold the sensor for 5 seconds or turn the power off and back on.

Once, 390 ms elapse, green light will turn on and the fixture is safe to use now.

Since, the fixture was getting displaced, hence, yellow light was used to display the status of the position. Yellow light will turn ON if the fixture is displaced from its desired position. Hence, user can push it back all the way in before using it, this will cause yellow light to turn off, and then user can use the fixture.

To pull the fixture down, user can touch the sensor again and hold it till the red light turn green, will again have to hold the sensors for 390 ms. If user lets go of his/her finger before the red light goes green, then the fixture would get stuck.

Red Light:



Yellow light:

Green Light:

07/03/19

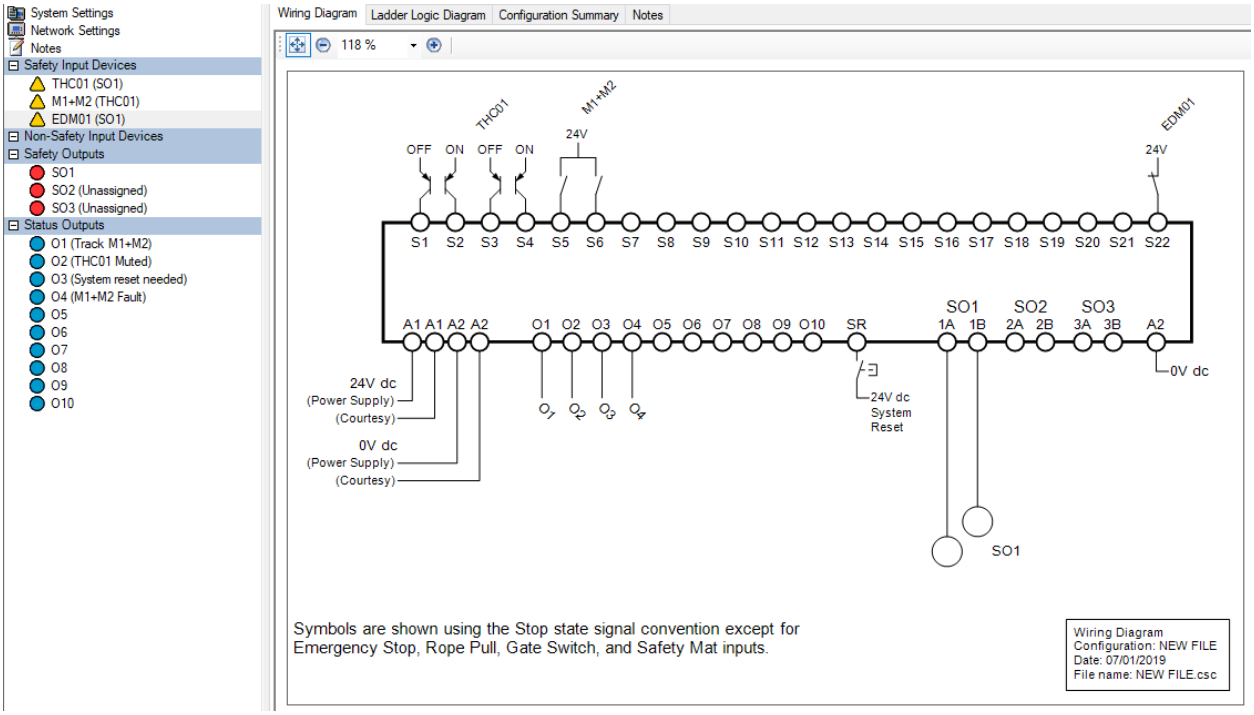
Main objective: Work on the fixture.

This morning the fixture got stuck again, upon inspection it was noticed that the safety controller needs a system reset after every 24 hours. The safety controller can be resetted by recycling the power. Safety controller was reprogrammed to monitor the side sensor faults, rear sensor fault and systems reset separately, shown in figure. The output of the safety controller is fed to the PLC and previous

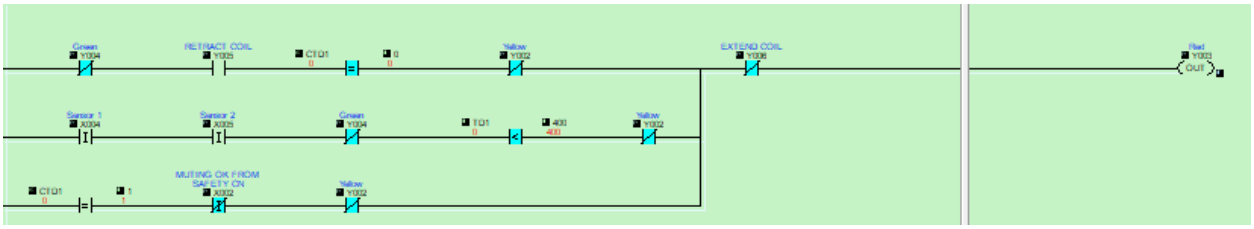
connections were removed. Now, the safety controller will inform the PLC about the status of side sensor, top rear sensor and system reset separately. And if any fault occurs the PLC would tun on the respective light.

Furthermore, the PLC was reprogrammed to have an instant drop for the fixture. Before, user would have to wait for the red light to turn green before they can remove their finger i.e. for 390 ms. However, this is not desired, since if someone's hand is stuck then they shouldn't have to hold the sensor for 390 ms. Hence, PLC was reprogrammed so the fixture can have an instant drop-down, this was done by making the operation event dependent rather than time dependent. Also red and green light were reprogrammed to not turn on anymore in pulling down operation.

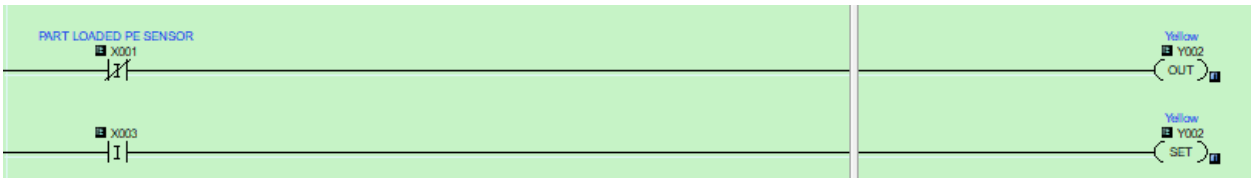
Safety Controller:



Red:

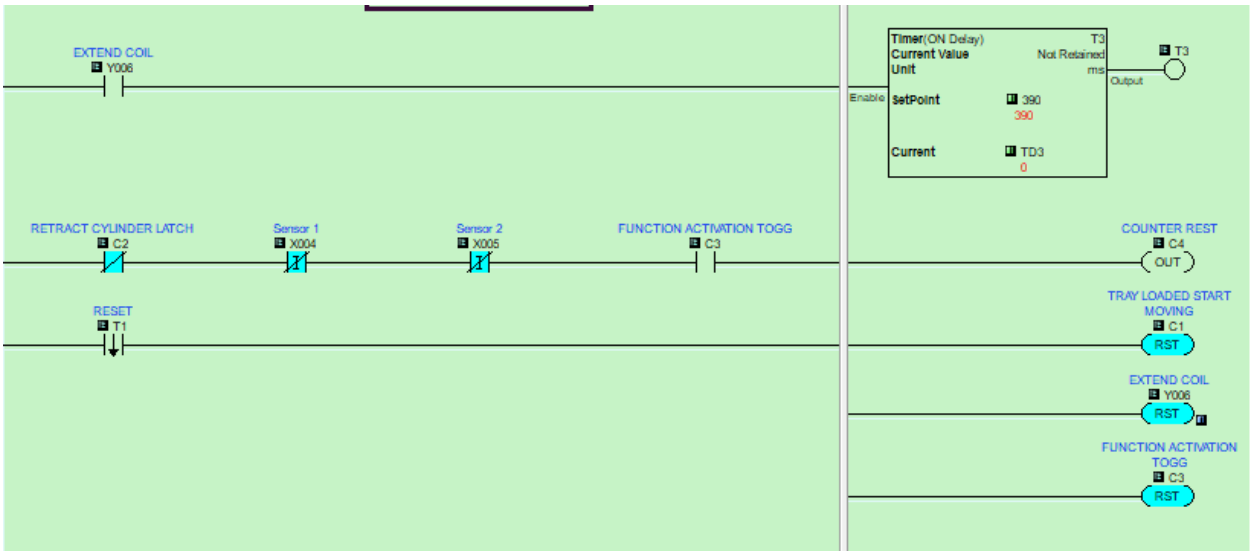


Yellow:



Green:

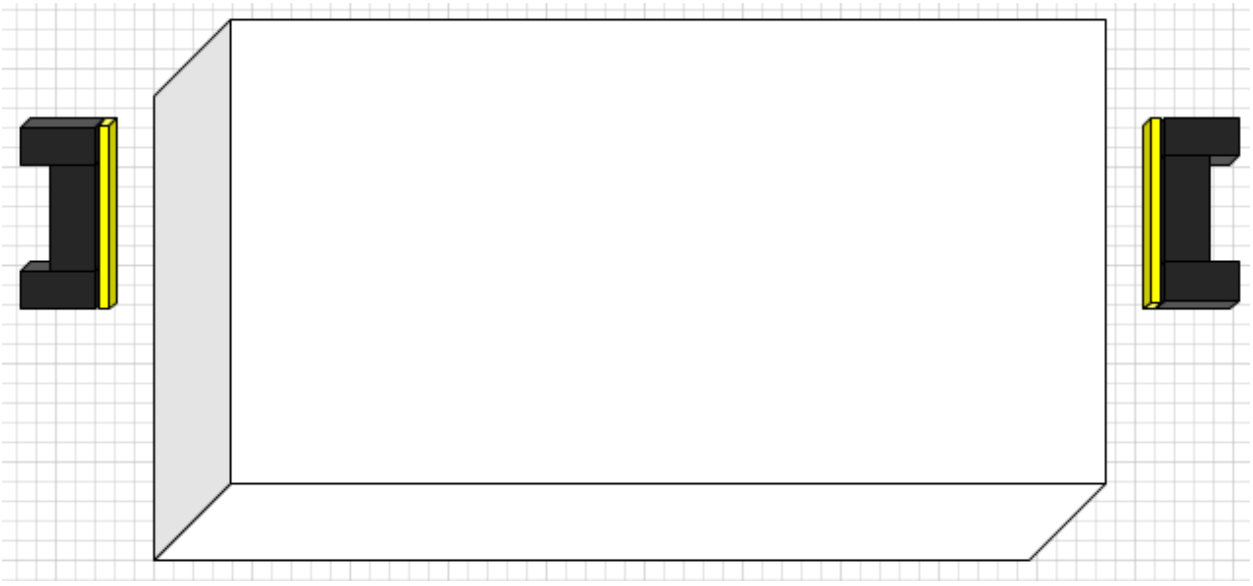
Instant drop-down:

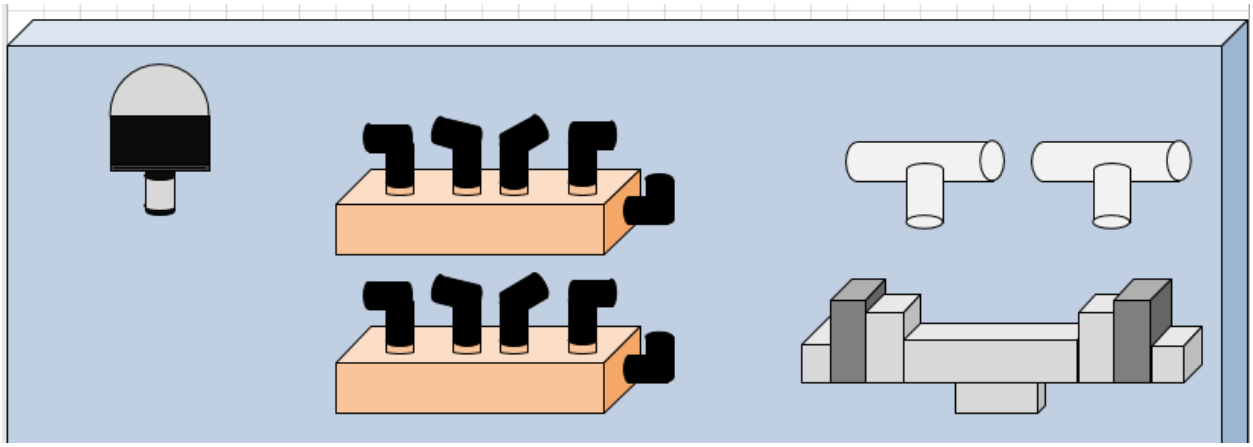


07/08/19

Main objective: Draw the wiring diagram of the fixture.

Most of the wiring diagram is done, will work on it tomorrow.






BANNER
Safety Controller

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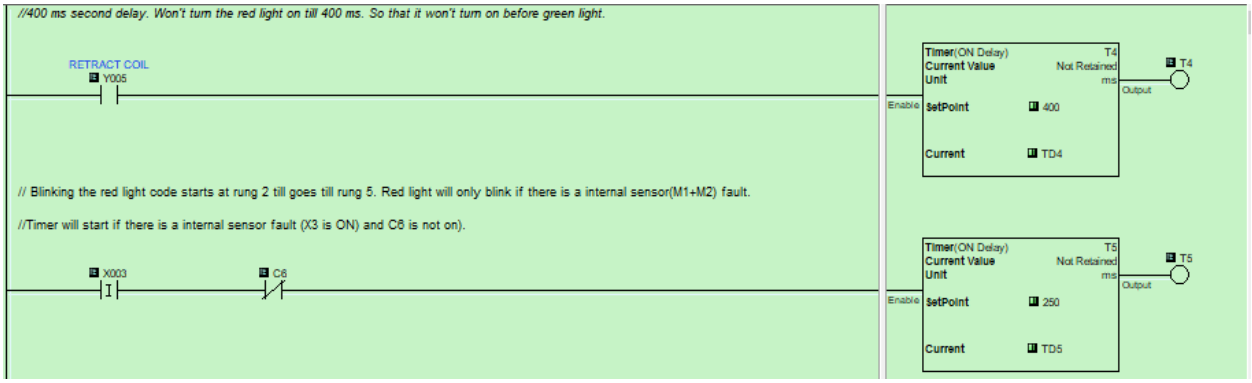
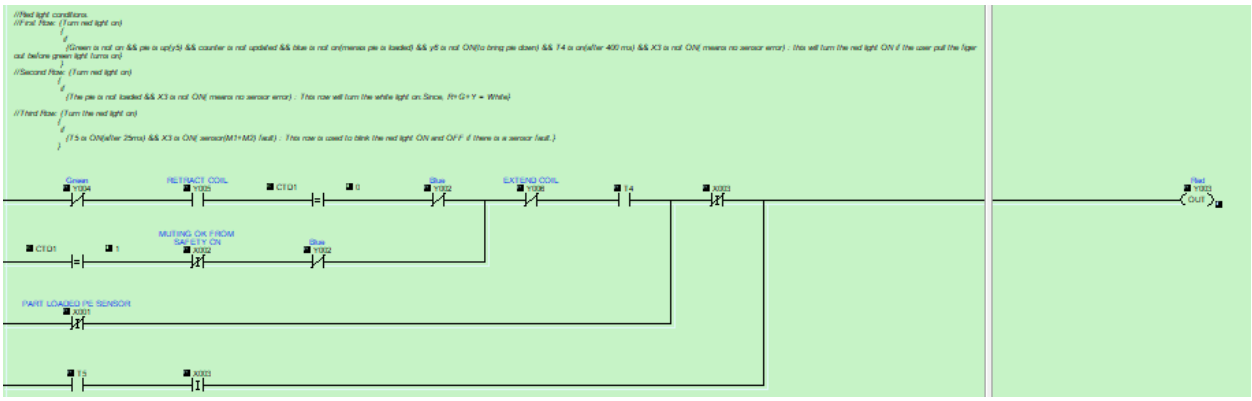
EE-494 Journal

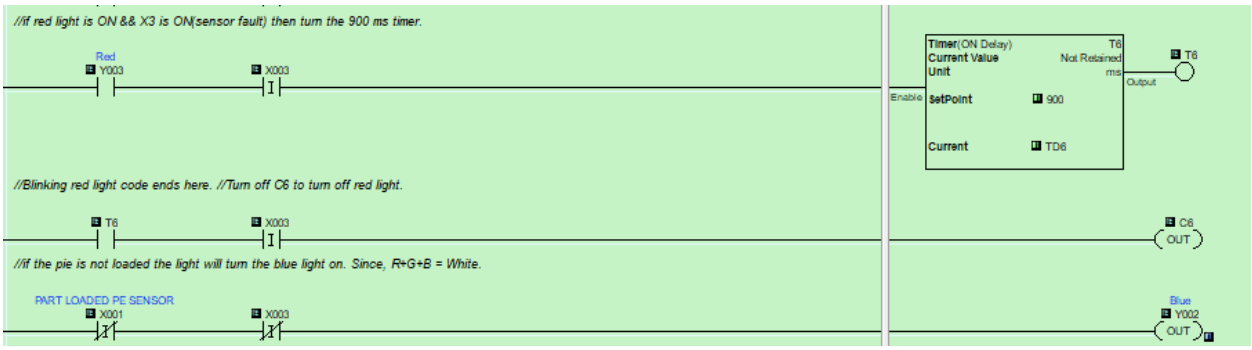
7/09/19

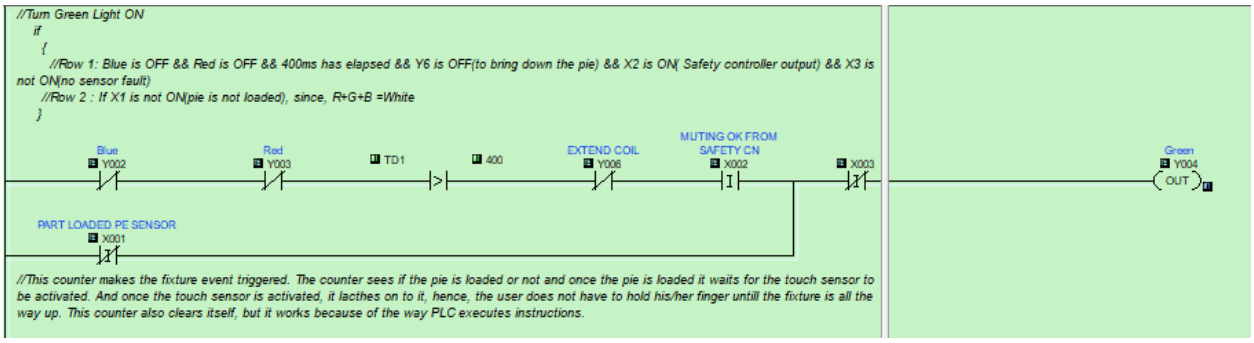
Main objective: Install the light and update the code so it's institutive and easy to use for production line employees.

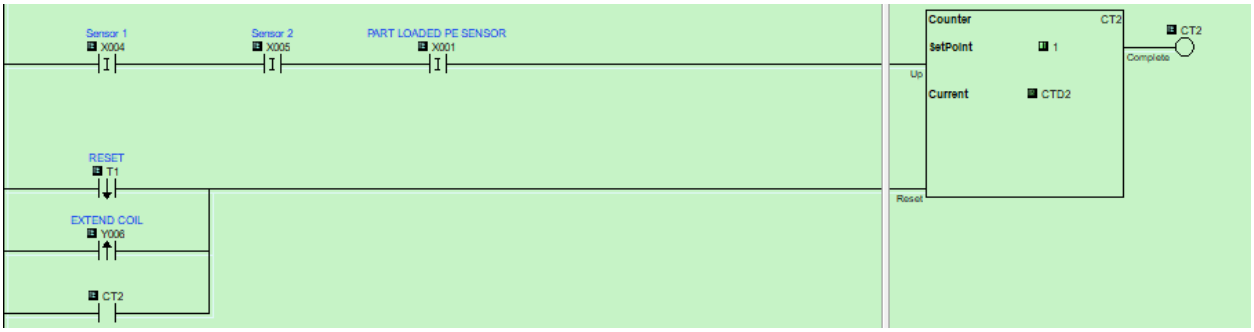
Production line employees said that the combination of red, green and yellow light was confusing. Hence, the PLC was reprogrammed. Now user must only wait for green light to turn on before he/she can remove the finger. Furthermore, red light will only turn on if the fixture is stuck or need a system reset. Red light will also blink if there is top-rear sensor fault. White light would turn on if the fixture is displaced from its position.

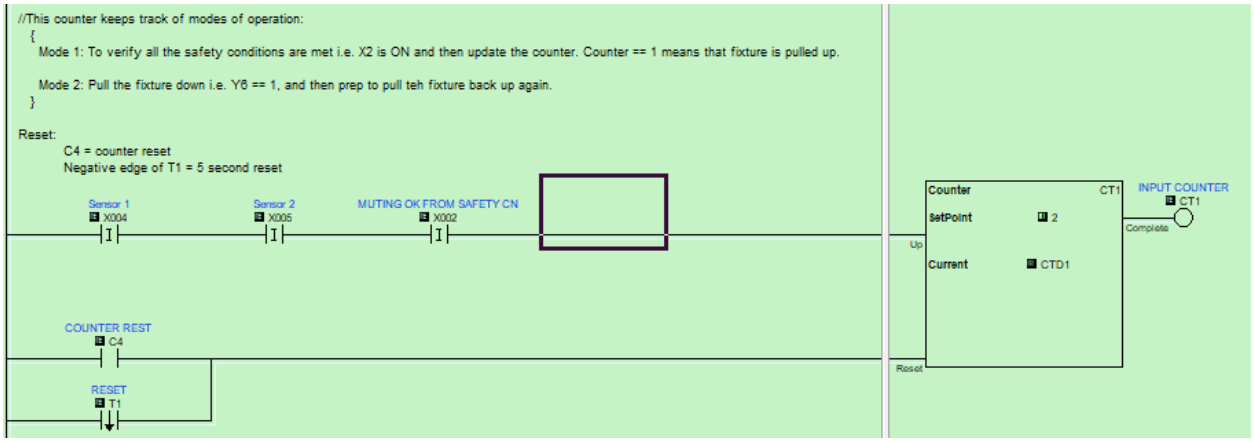


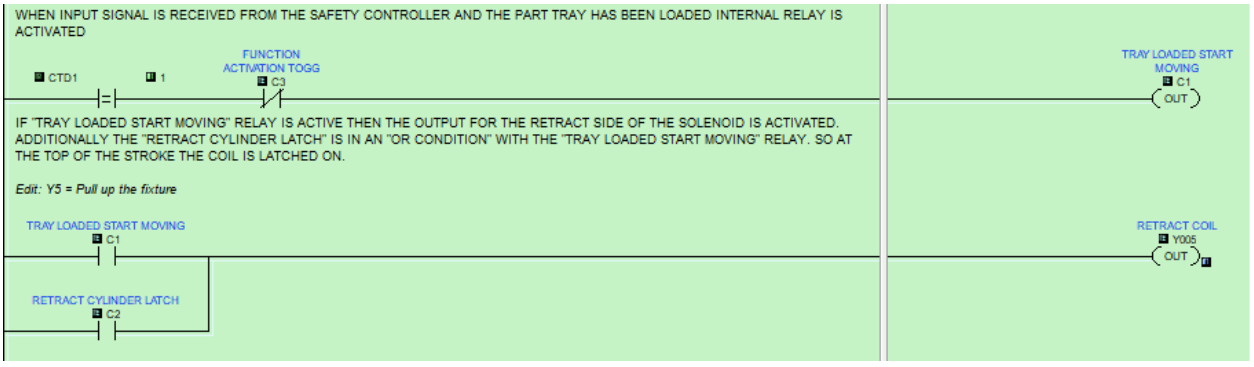


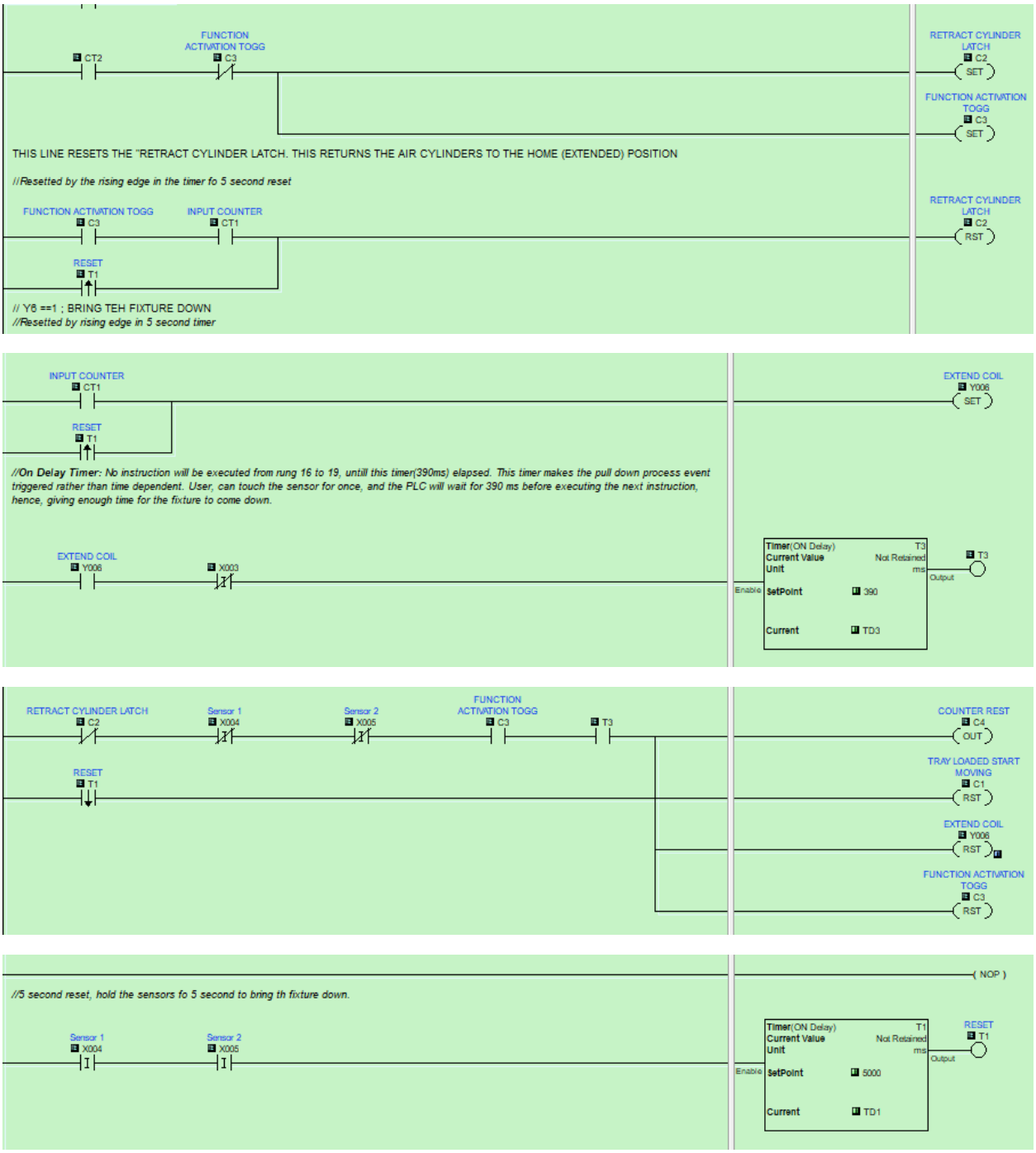



//Turn Green Light ON
if
{
//Row 1: Blue is OFF && Red is OFF && 400ms has elapsed && Y6 is OFF(to bring down the pie) && X2 is ON(Safety controller output) && X3 is not ON(no sensor fault)
//Row 2 : If X1 is not ON(pie is not loaded), since, R+G+B =White
}
Blue
Y002
Red
Y003
TD1
400
EXTEND COIL
Y006
MUTING OK FROM SAFETY CN
X002
X003
PART LOADED PE SENSOR
X001
Green
Y004
OUT
//This counter makes the fixture event triggered. The counter sees if the pie is loaded or not and once the pie is loaded it waits for the touch sensor to be activated. And once the touch sensor is activated, it lacthes on to it, hence, the user does not have to hold his/her finger untill the fixture is all the way up. This counter also clears itself, but it works because of the way PLC executes instructions.


Sensor 1
X004
Sensor 2
X005
PART LOADED PE SENSOR
X001
RESET
T1
EXTEND COIL
Y006
CT2
Counter
CT2
SetPoint
1
Up
Current
CTD2
Reset
CT2
Complete


//This counter keeps track of modes of operation:
{
Mode 1: To verify all the safety conditions are met i.e. X2 is ON and then update the counter. Counter == 1 means that fixture is pulled up.
Mode 2: Pull the fixture down i.e. Y6 == 1, and then prep to pull teh fixture back up again.
}
Reset:
C4 = counter reset
Negative edge of T1 = 5 second reset
Sensor 1
X004
Sensor 2
X005
MUTING OK FROM SAFETY CN
X002
COUNTER REST
C4
RESET
T1
Counter
CT1
SetPoint
2
Up
Current
CTD1
Reset
INPUT COUNTER
CT1
Complete

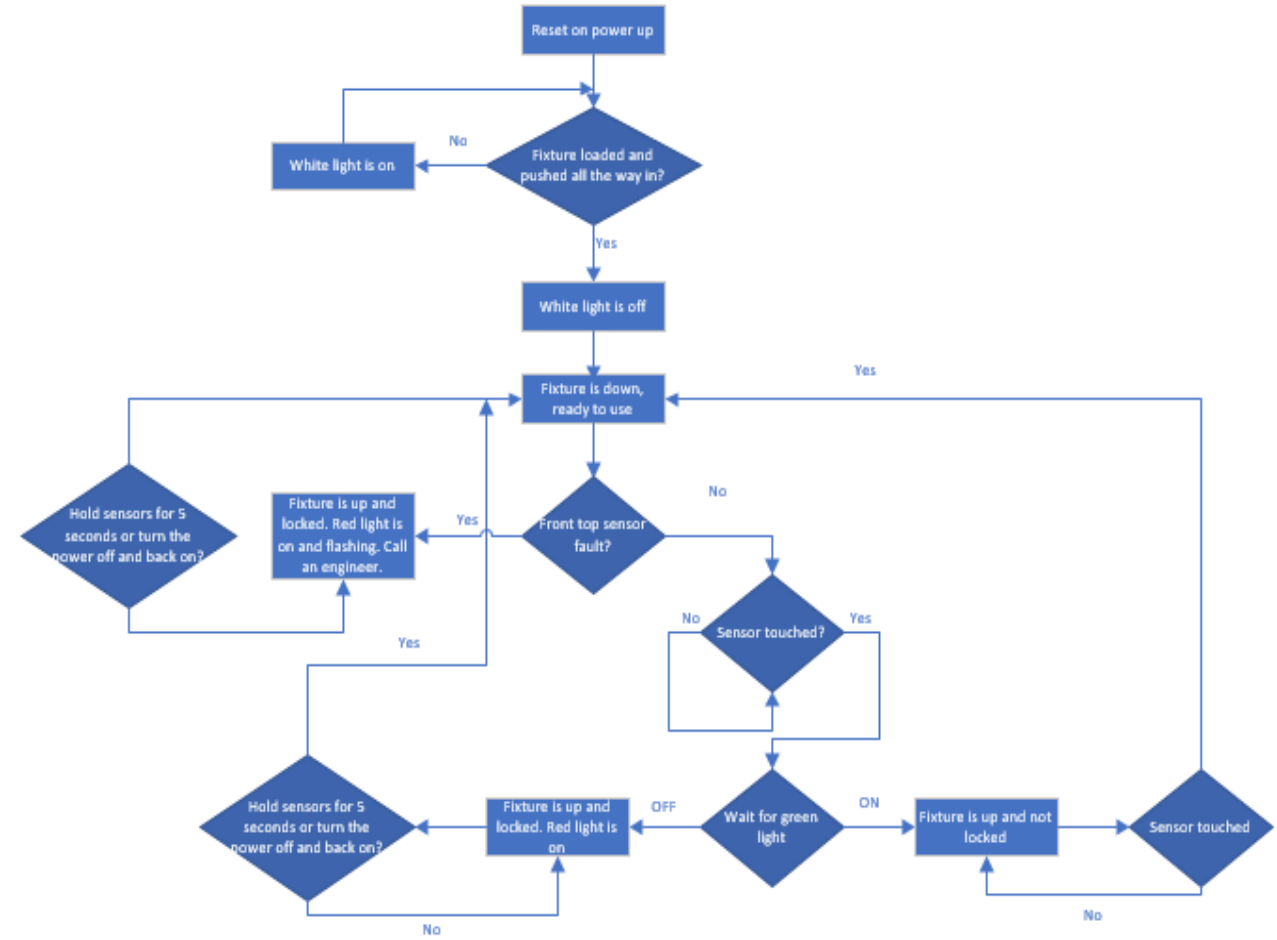

WHEN INPUT SIGNAL IS RECEIVED FROM THE SAFETY CONTROLLER AND THE PART TRAY HAS BEEN LOADED INTERNAL RELAY IS ACTIVATED
CTD1
1
FUNCTION ACTIVATION TOGG
C3
IF "TRAY LOADED START MOVING" RELAY IS ACTIVE THEN THE OUTPUT FOR THE RETRACT SIDE OF THE SOLENOID IS ACTIVATED. ADDITIONALLY THE "RETRACT CYLINDER LATCH" IS IN AN "OR CONDITION" WITH THE "TRAY LOADED START MOVING" RELAY. SO AT THE TOP OF THE STROKE THE COIL IS LATCHED ON.
Edit: Y5 = Pull up the fixture
TRAY LOADED START MOVING
C1
RETRACT CYLINDER LATCH
C2
TRAY LOADED START MOVING
C1
OUT
RETRACT COIL
Y005
OUT

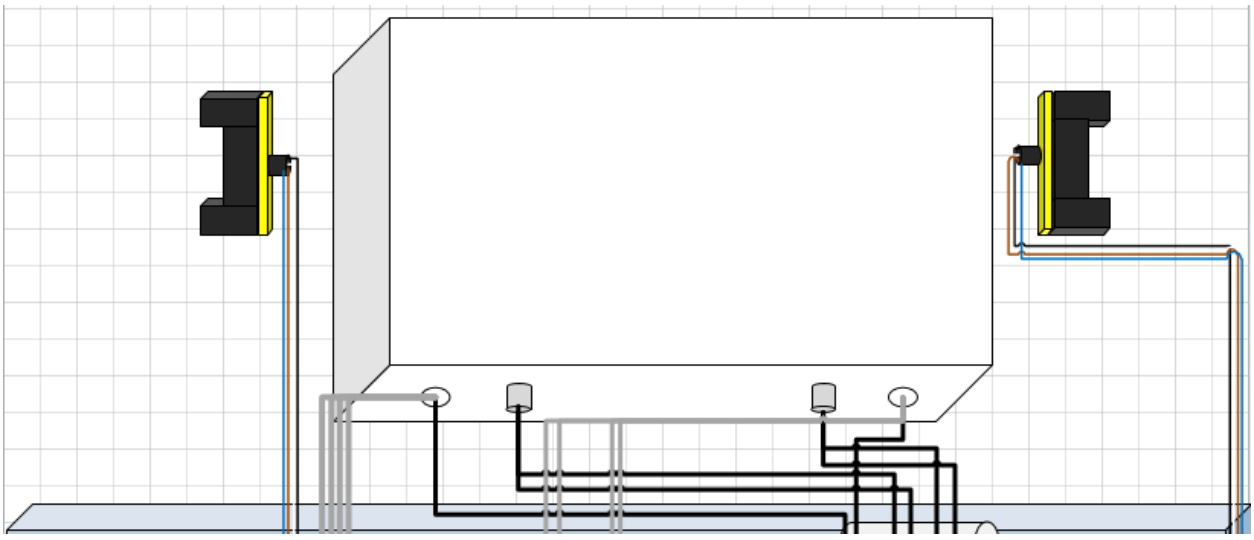


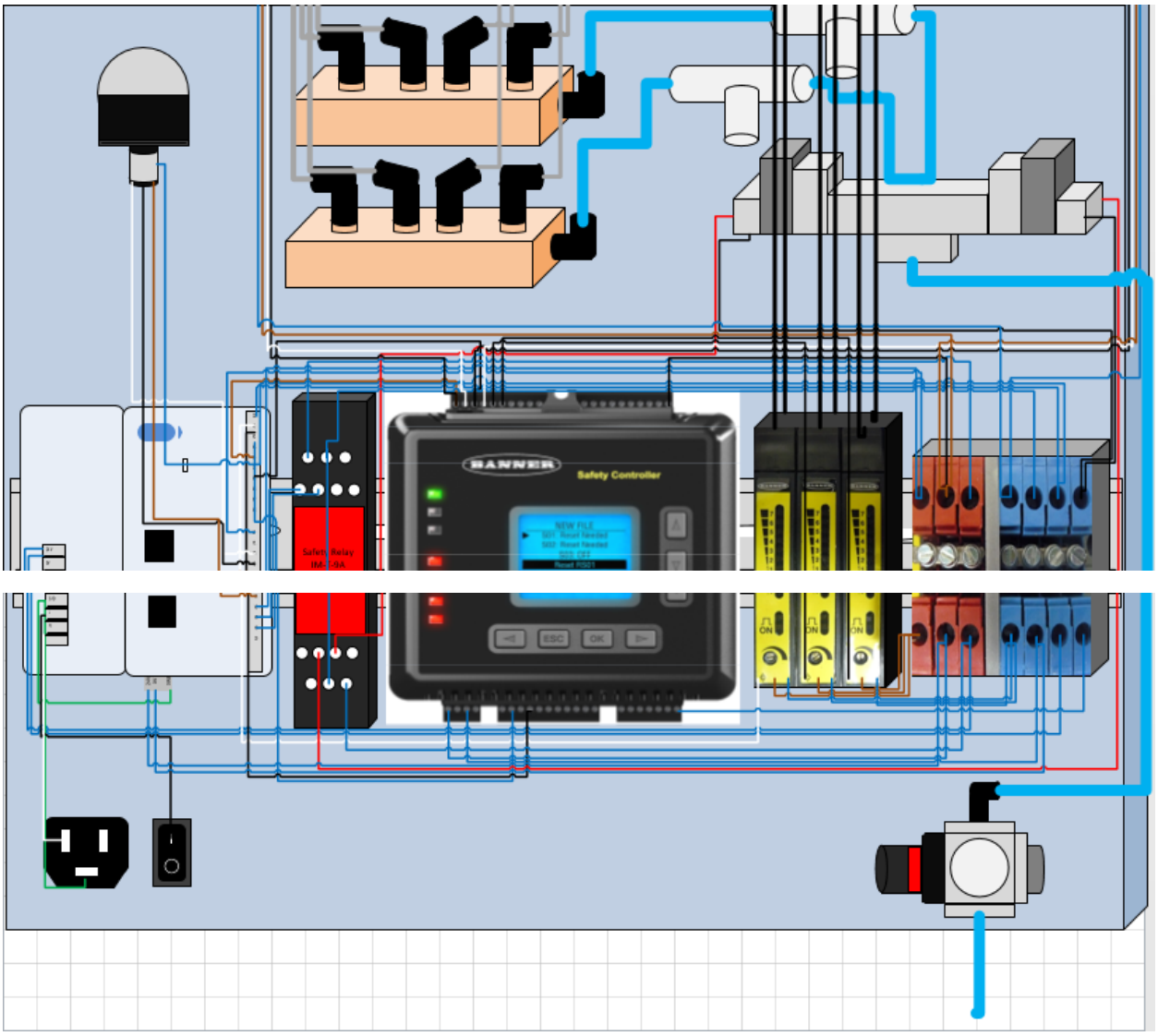
07/10/2019

Main objective: Make a flow chart for the fixture. And update the wiring diagram.

Made the flow of fixture's operation and finished fixture's wiring diagram.


Reset on power up
Fixture loaded and pushed all the way in?
No
White light is on
Yes
White light is off
Fixture is down, ready to use
Yes
Front top sensor fault?
No
Yes
Fixture is up and locked. Red light is on and flashing. Call an engineer.
Hold sensors for 5 seconds or turn the power off and back on?
Yes
Sensor touched?
No
Yes
Wait for green light
OFF
ON
Fixture is up and locked. Red light is on
Hold sensors for 5 seconds or turn the power off and back on?
No
Fixture is up and not locked
Sensor touched
No

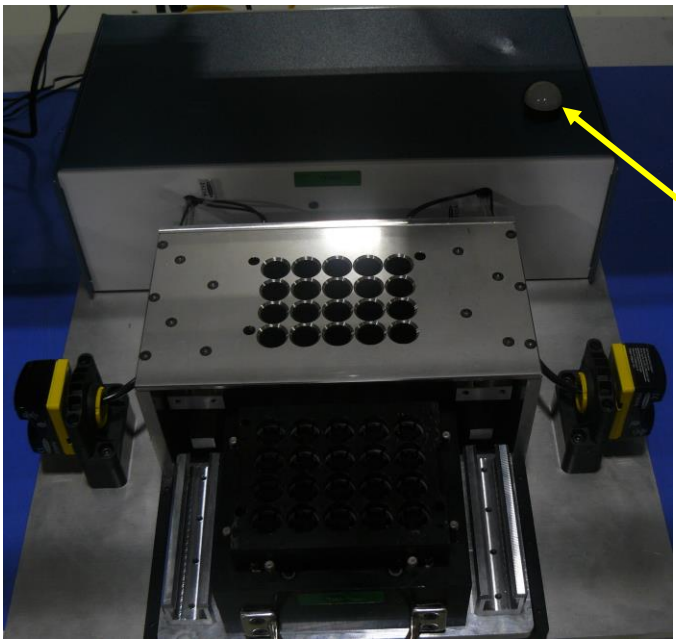




7/11/19

Main objective: We have one more PCB fixture, updated the PLC code in it, add a safety controller and make it exactly like the previous fixture.

Everything in the new fixture is wired according to the wiring diagram, all connections are probed and are connected correctly. New code is updated in the PLC, safety controller is configured, and relay connection are changed accordingly. However, since the components are arranged differently inside, hence the RGB light was installed in the opposite side, due special constraints while wiring. Tested the 2nd PC fixture and it is working as expected. Will work on the ovens tomorrow.



07/15/19

Main objective: We have 5 ovens. Start wiring the sensors in the oven.

Drilled a hole on top of oven 1, installed the sealing grommet on the oven. Wired the sensors beside the racks, however, the black standing brackets that were used to keep the sensors still are not stable and can be knocked out easily if an employee inserts a tray wrong. Hence, grey brackets are used, which are more stable. However, the sensors are seeing the racks. To avoid this, sensors were mounted higher, however, some sensors are still seeing the racks, and when can only increase the height so much. Will investigate the source of error tomorrow.

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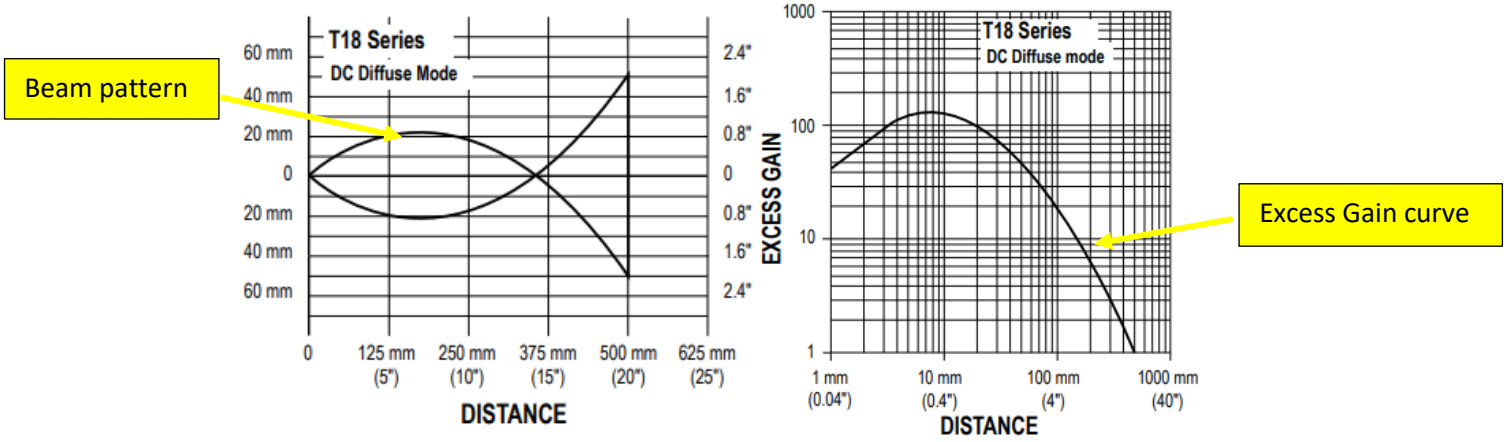
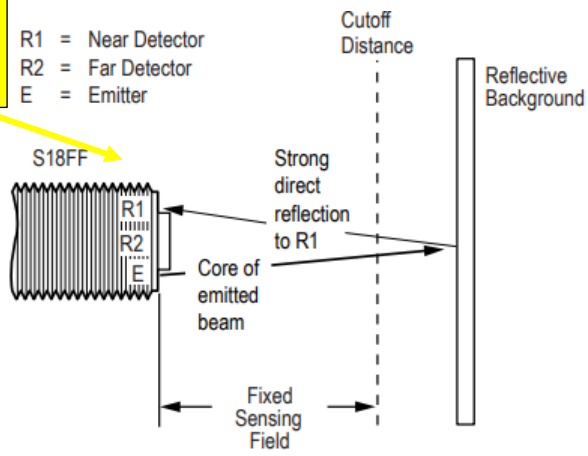
07/16/19

Main Objective: Continue wiring the sensors in oven 1.

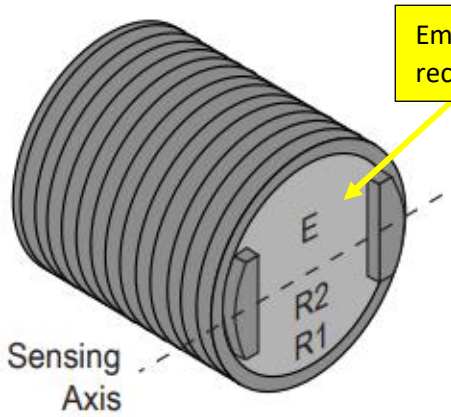
It was noticed that the racks were highly reflective, hence it was reflecting off the beam that the emitter was shooting from the sensor. Sensors were mounted higher than the racks but still they were seeing the racks, this was happening due to the beam pattern the sensor has, shown in figure. Also, the sensing axis was perpendicular to the rack, hence, the sensor was seeing the objects that are below its line of sight. Hence to fix this, brackets were wielded op top of the rack stand, and sensors were mounted on top of it. However, now sensors were seeing the reflective background. The sensor compares the R2 and R1, and if R2 i.e. far detector signal strength is more than R1 i.e. close detector signal strength then the sensor is always turned on. Hence, to fix this, layers of black tape were taped on the reflective surface to reduce the far detector signal strength. Also, the gain was reduced so that the overall signal strength reduces, and the sensor will see the object in the range of 8 inches and won't see the background. Then each sensor was the tested, the gain of each sensor and the angles of the brackets were calibrated accordingly. Will work on the other ovens tomorrow.

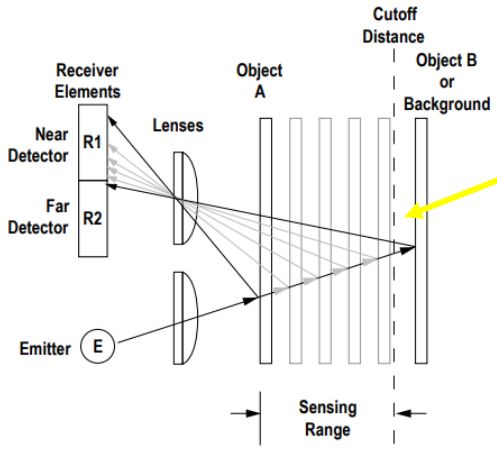


Reflective background problem



Emitter and receivers





Sensor compares R2and R1

07/17/19

Main objective: Wire the ovens and install the LCD display and PLC.

Enclosure was designed to hold the PLC, I/0 extension, power supply, terminal blocks, 34 sensors and the wires going in and out. For wires, cables glands were used instead of using knockouts. The total current requirement was determined to be 1.94 A, this included all the sensors, PLC, touch panel, I/O extension. Hence, a 2.5 A power supply was ordered and used, the extra 0.5 A can be used to add more sensors and touch screen in the future.

07/18/19:

Main objective: Wire the sensors in oven 2

Drilled a hole on top of oven 2 and installed a sealing grommet to channel all the wires through. All the 18 sensors are wired in the oven 2 and tested. Whole system was tested for its functionality and after testing the oven 2 was sent to the production line. Oven 1 and oven 2 are wired and enclosure for oven 1 is designed. Will work on oven 3 tomorrow.

07/22/19

Main objective: Wire all the sensors in oven 3.

Drilled a hole on top of oven 3 and installed a sealing grommet to channel all the wires through. All 6 sensors are wired in the oven 3. They were tested for their functionality and the oven was later sent to the production line. Still have to wire the PLC and design the enclosure for oven 3. They will be connected to the PLC that's in oven 1. Hence, a zip link extension cable will be used to connect the output of the sensors to the PLC.

7/23/19

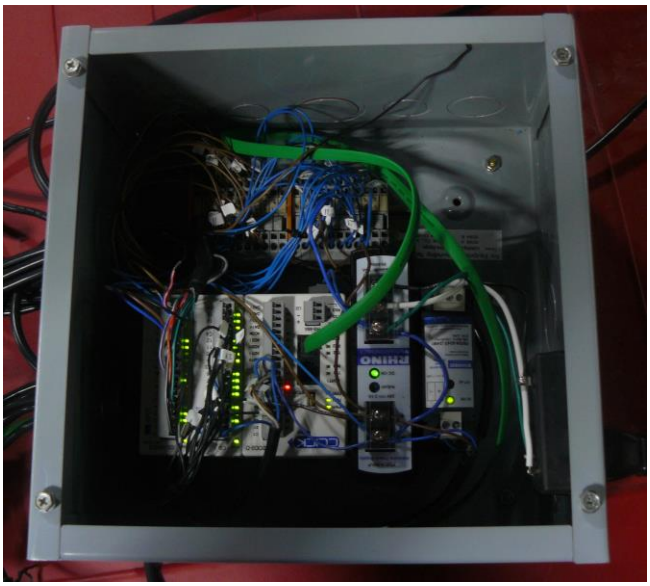
Main objective: Wire all sensors in oven 4.

Drilled a hole on top of oven 4 and installed a sealing grommet to channel all the wires through. All 5 sensors are wired in the oven 4. They will be connected to the PLC that's in oven 1. Hence, a zip link extension cable will be used to connect the output of the sensors to the PLC.

7/24/19

Main objective: Wire oven 1.

Oven 1 has been wired and tested. Two 24 V power supplies were connected in series, with total output current to be 3.5 A. One CLICK PLC with 8 I/O ports and two I/O extensions were used that added 32 extra I/O ports, a touch panel was used which was talking to PLC using UART, a power module was used to supple 120 V rms, a switch was used to turn the power on and off and a 250 V fuse was used for protection. Total current requirement came out to be 1.94 A. This include 34*0.016 A for 34 sensors, 2*0.15 A for two I/0 extension, 0.30 A for PLC, 0.5 A for the touch panel and 0.3 A for the indicator light.



7/25/19

Main objective: Wire the oven 2 and oven 3.

Oven 2 and oven 3 are wired, the indicator light was mounted on top of oven 1. A ziplink extension cable was used to jump the I/O from the main/oven 1's enclosure. Power was also jumped from the main enclosure.

7/29/19

Main objective: Wire the oven 4.

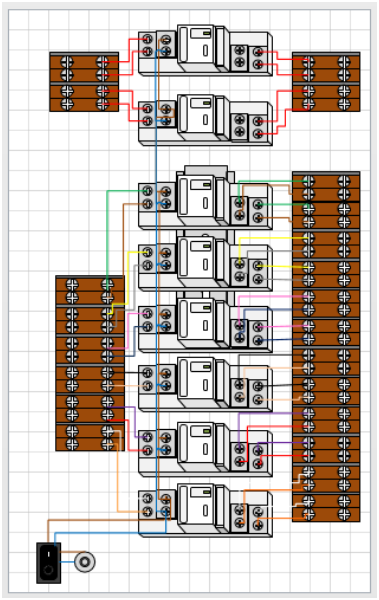
Oven 4 is wired. Touch panel was installed on top of oven 4 and oven 1 and. Power and I/O were jumped from and to the main enclosure using extension cables. Sensors from all 4 ovens were tested

and everything is working. Production line employees can use the systems now. Furthermore, 34 more sensors are ordered for oven 5 and oven 6. Will work on PCB tester tomorrow.

7/30/19

Main objective: Created the wiring diagram for the PCB tester.

Two kinds of PCB's are tested in PCB tester, first 2 relay PCB and second is 8 I/O PCB. Six 24 V Double pole double throw (DPDT) relays will be used to switch the cables. Two 24 V DPDT will be used to switch to the 4-pin connector on and off. A 24 V power supply will be used and a 24 V switch to switch between 2 relays+4 pin connector and 8 I/O PCB. Worked on wiring diagram. Will finish it tomorrow and start installing switch and relays to the tester.



7/31/19

Main objective: Work on wiring diagram and wire the PCB tester.

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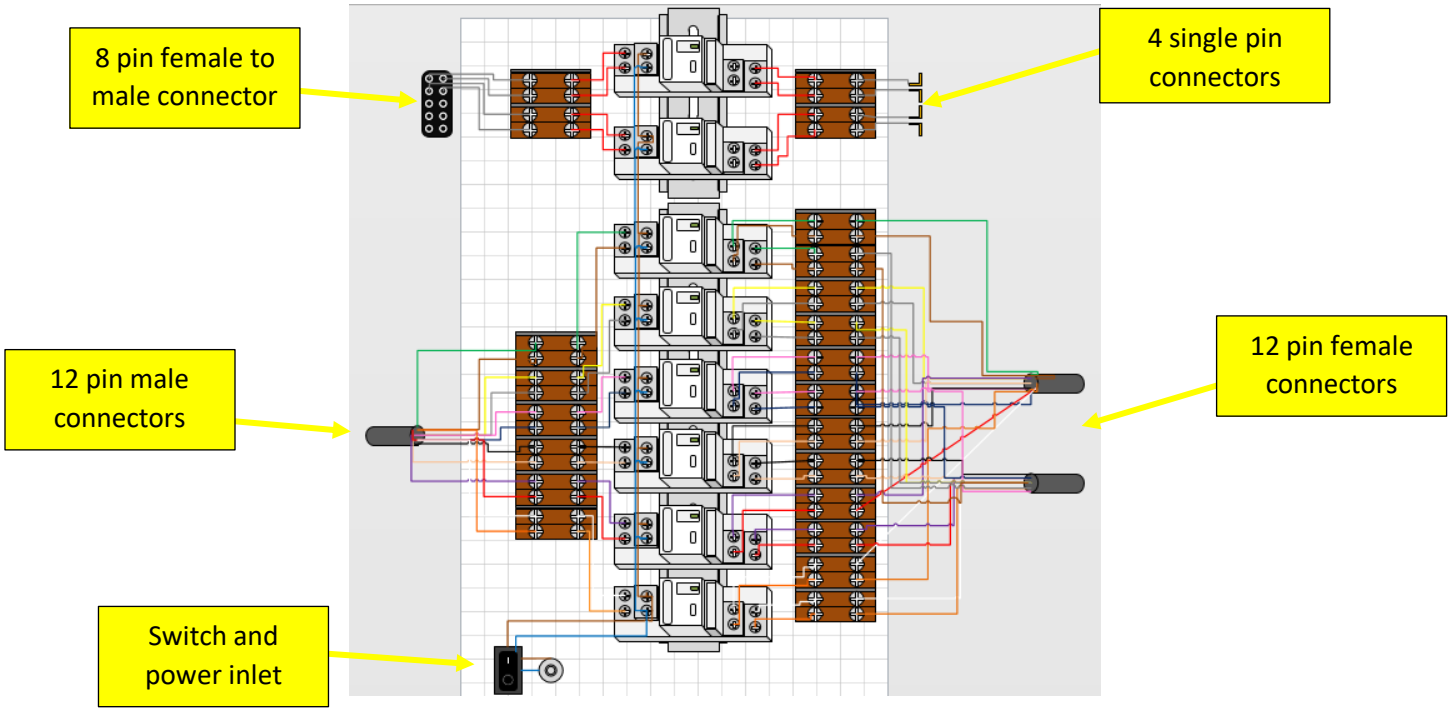
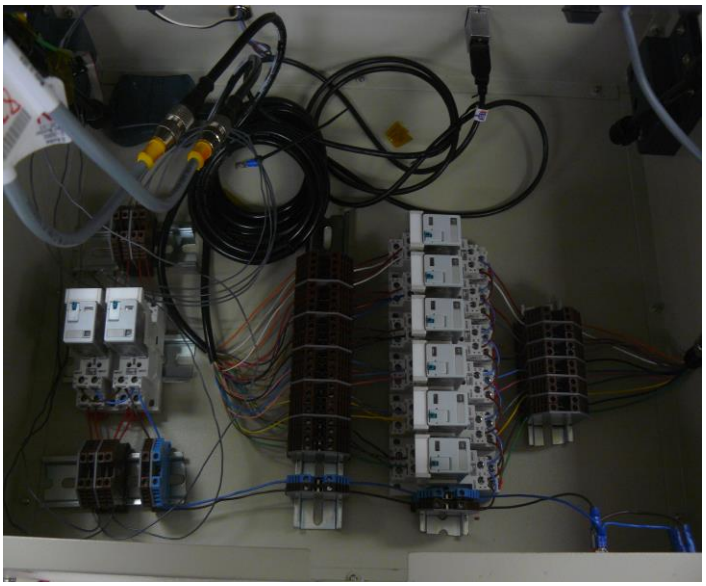
Wiring diagram completed. Assembled all the relays, striped all the wires and applied solder on them. Got the DIN rail cut to length and got all other parts needed. Will start working on wiring the relays tomorrow.

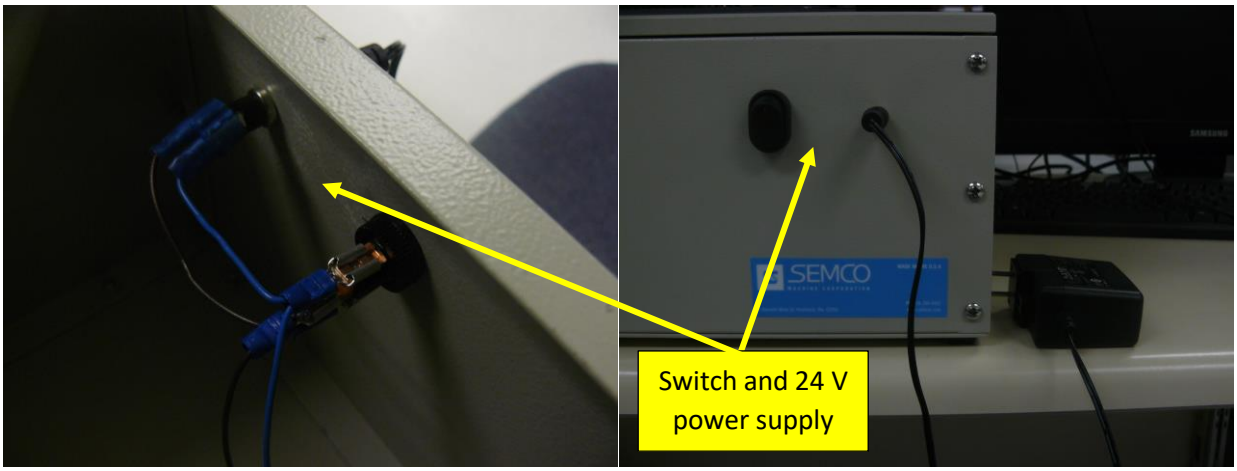


8/1/19

Main objective: Installed the relays in the PCB tester.

Soldered wires to 8 Pin female to male connector and soldered wire on 4 single pin connectors. Mounted the relays on DIN rails and wired them to the terminal blocks. On one side of the terminal blocks connected 2R and 8 I/O cables using 2 twelve pin female connectors and on other side connected the output cable to a 12-pin male connector. Later the switch and power inlet were installed on the PCB tester and DIN rails were drilled in. Will test the functioning tomorrow.





8/05/19

Main objective: Test the functioning of the PCB tester.

Started the test of the relay system using the good units. Both 2R and 8 I/O are failing the test. I tested each individual component on the relay system, and everything is passing the test, but still the good units are failing. I called a production line employee and had him test the both the PCBs, just wanted to make sure that I'm conducting the test correctly. However, still the PCBs are failing the test. I investigated the configuration information and connection diagram of the tester, later I reconfigured the data acquisition unit, multimeter, power supply and checked all the connections according to the diagrams. After restarting the whole system, I tested with the good units again, but still the PCBs are failing the tests. I disconnected the cables from the relays and made a manual connection but still the PCBs are failing the test. Therefore, something is either wrong with the good units or the tester itself. I checked the test file and results, both the PCBs are failing the PNP and NPN output test, the output is supposed to be 10 V for PNP and 0 V for NPN. However, for both the PCBs the PNP output is 5V and NPN output is 2 V, hence both are failing the tests. One test usually takes 20-25 mins, this took all my day. I

have informed the senior engineer about this and gave him the copy of test results; he will look at the tester tomorrow.

8/06/19

Main objective: Wire the 17 sensors in oven 5 and 16 sensors in oven 6. Install the LCD display and PLC.

Drilled a hole on top of oven 5 and installed a sealing grommet to channel all the wires through. All 17 sensors are mounted, wired and tested. Later, the oven was sent out for production line employees to use. Will work on oven 6 tomorrow.

8/07/19

Main objective: Wire the 16 sensors in oven 6.

Drilled a hole on top of oven 6 and installed a sealing grommet to channel all the wires through. All 16 sensors are mounted, wired and tested. Later, the oven was sent out for production line employees to use. Have ordered a new enclosure, since the enclosure I have is 8 by 8 by 6 and I need a bigger enclosure. Have ordered a 10 by 10 by 6 enclosure. Will work on it as soon as it gets delivered.

8/08/19

Main objective: Document everything I designed, modified and did this summer. Comment all the codes, create user manual, take pictures and document the progress. Upload all the documents to Banner data base.

Worked on creating a document for the oven project. Commented the code thoroughly, created a flow chart of operation, explained all the parts used. Have saved the file will upload all the documents at once. Furthermore, will work on the user manual and parts guide tomorrow.

8/12/19

Main objective: Create a user manual for the oven and give it to the production line employees.

Created a detailed user manual for the timer system. It includes features, functioning, common faults that can occur and how to fix them. Showed it to production line employees and made changes according to their feedback. Also, compiled all the documents, diagram, manuals and charts for Tx8 sensors, Vsx sensors, oven timer systems, PCB fixture, auto-polisher and PCB tester and uploaded them to banner database.

8/13/19

Main objective: Design the enclosure and wire the sensor, PLC, touch panel and indicator light to oven 5 and oven 6.

Enclosure for oven 5 and oven 6 was designed to hold the PLC, I/0 extension, power supply, terminal blocks, 34 sensors and the wires going in and out. For wires, since we have 37 cables going and out of the same enclosure, hence 3-hole cables glands were used instead of 1-hole ones. The total current requirement was determined to be same as last time i.e. 1.94 A, this included all the sensors, PLC, touch panel, I/O extension. Hence, a 2.5 A power supply was ordered and used, the extra 0.5 A can be used to add more sensors and touch screen in the future.

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8/14/19

Main objective: Wire oven 5 and oven 6.

Oven 5 has been wired to the enclosure and all the sensors were tested. Indicator light and the touch panel was installed on top on oven 5 and oven 6. Will wire oven 6 tomorrow.

8/15/19

Main objective: Oven 6 has been wired up. The entire timer system was tested for all its function. After testing, the ovens were handed to production line for use. Further, I stared the wiring diagram for the enclosure.