SIMON FRASER UNIVERSITY

MSE310
Sensors and Actuators
Instructor: Prof. Ahad Armin

Final Project Report

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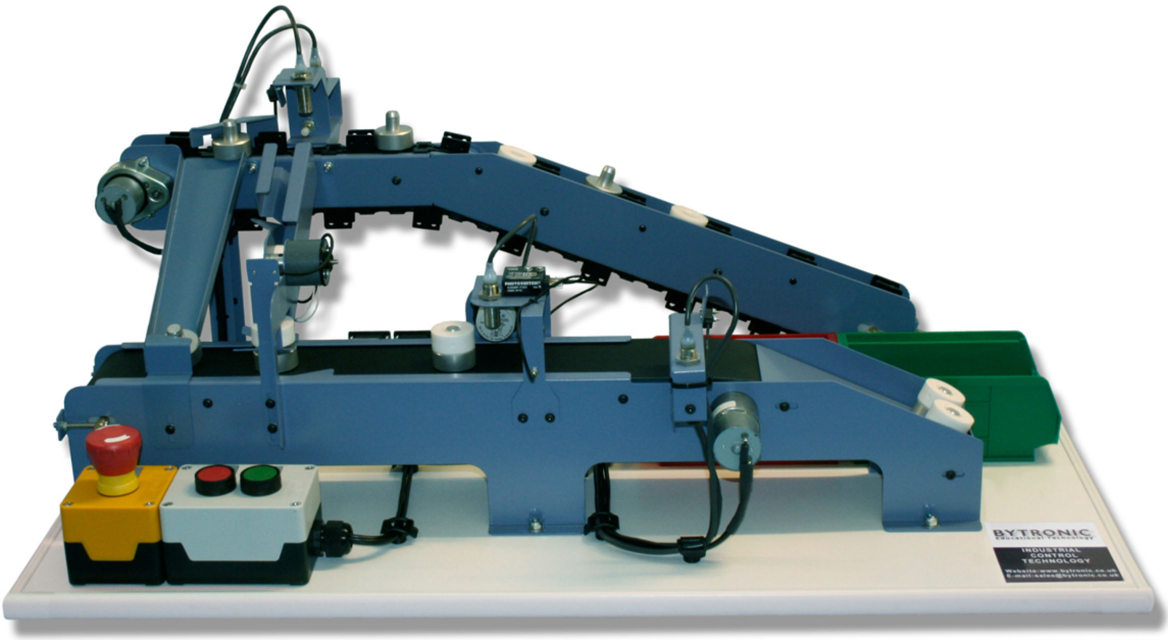
Introduction



In this project, we seek to learn how to set up, activate, and operate various sensors and actuators in a simple industrial manufacturing system. Depicted above is an image of the ICT in the MSE310 Lab. The ICT is first turned on and then loaded with metal or plastic pieces that ride up the top belt. The pieces are sorted based on what type of piece they are, and code in LabVIEW is programmed and run to tell the ICT how to differentiate between each piece. On the bottom side, the pieces are assembled together and checked for assembling accuracy. The efficiency of the machine is calculated, and the non-assembled pieces are rejected.

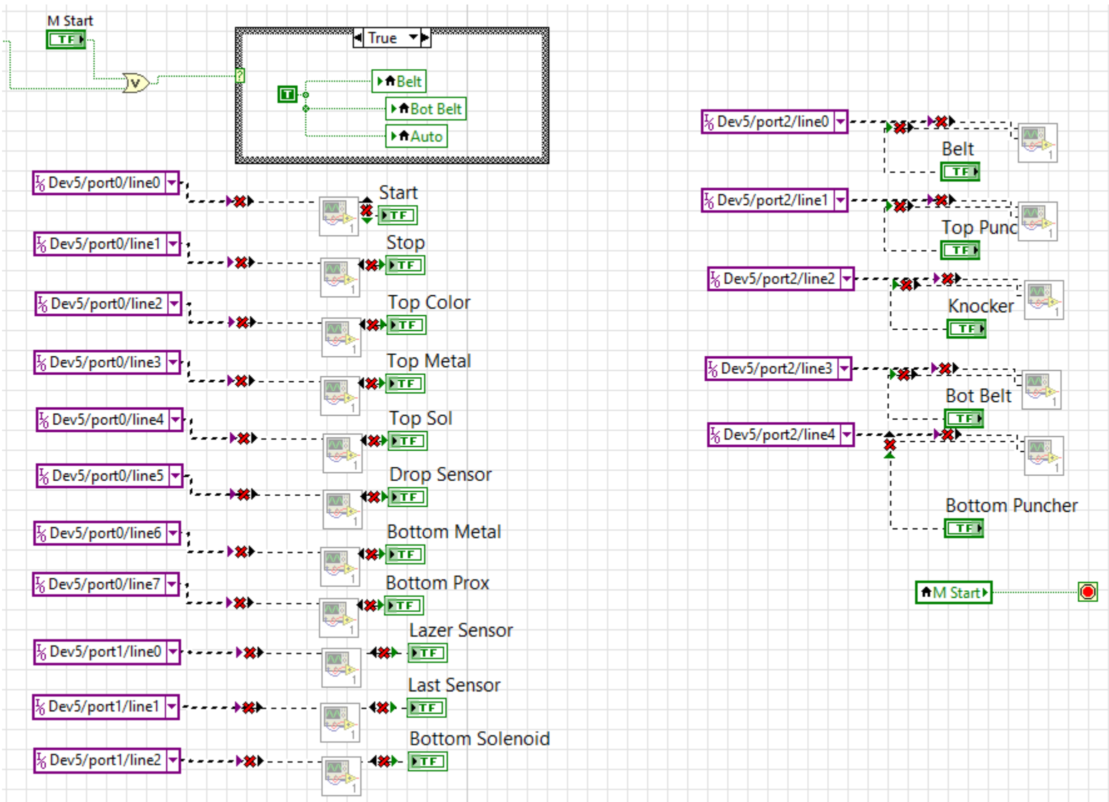
Design stages

Our project group formulated and composed the ICT project in two sections, by separating it into two design stages: one stage for the topside operation, and one stage for the bottom side operation. We first had to figure out how to activate and operate the belts using the start and stop buttons. Then, we began figuring out how to differentiate between the two types of pieces: metal and plastic. Next, we had to decide what to do with each type of piece before moving on to the bottom side operation. On the bottom side, we had to figure out a way to indicate to the solenoid whether or not the upcoming pieces were fully assembled, or were to be rejected. After these two sections were thoroughly understood and formulated into code, our ICT was able to operate.

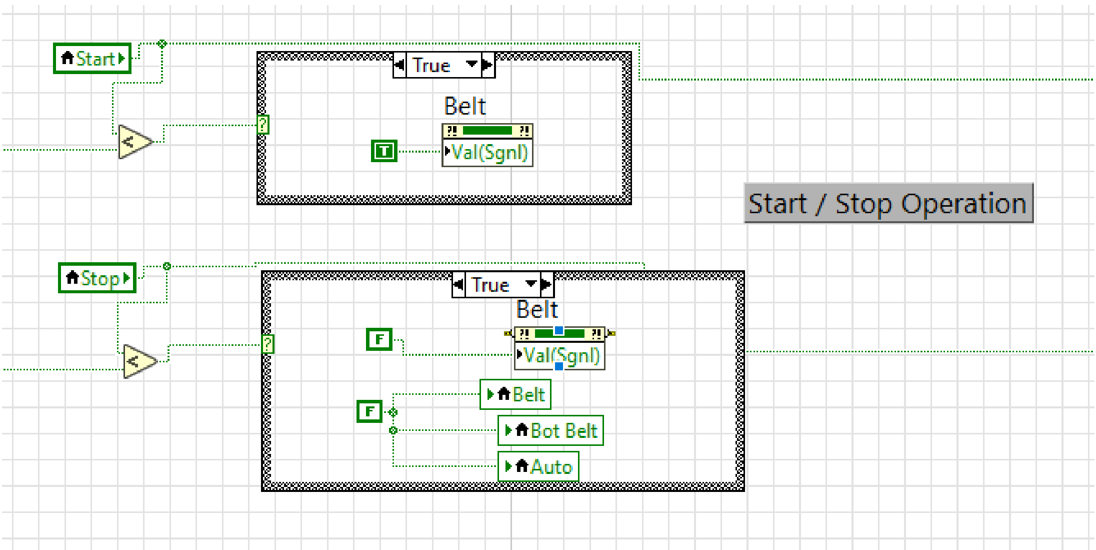
Explanation of code

Initializing Sensors and Actuators

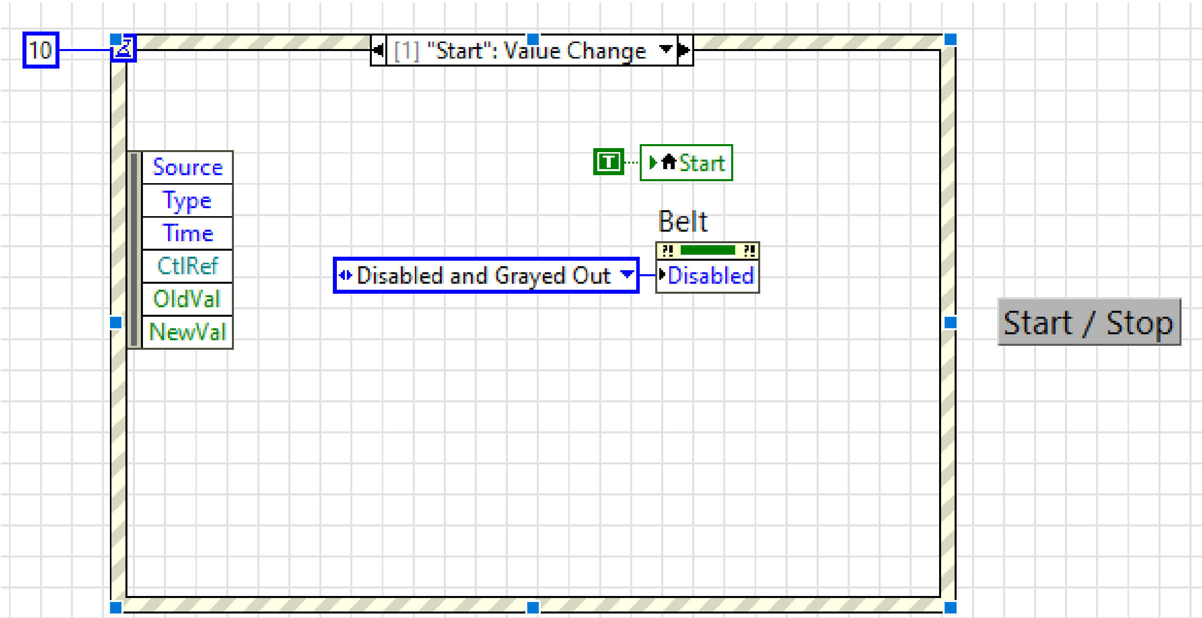
Starting and stopping the program



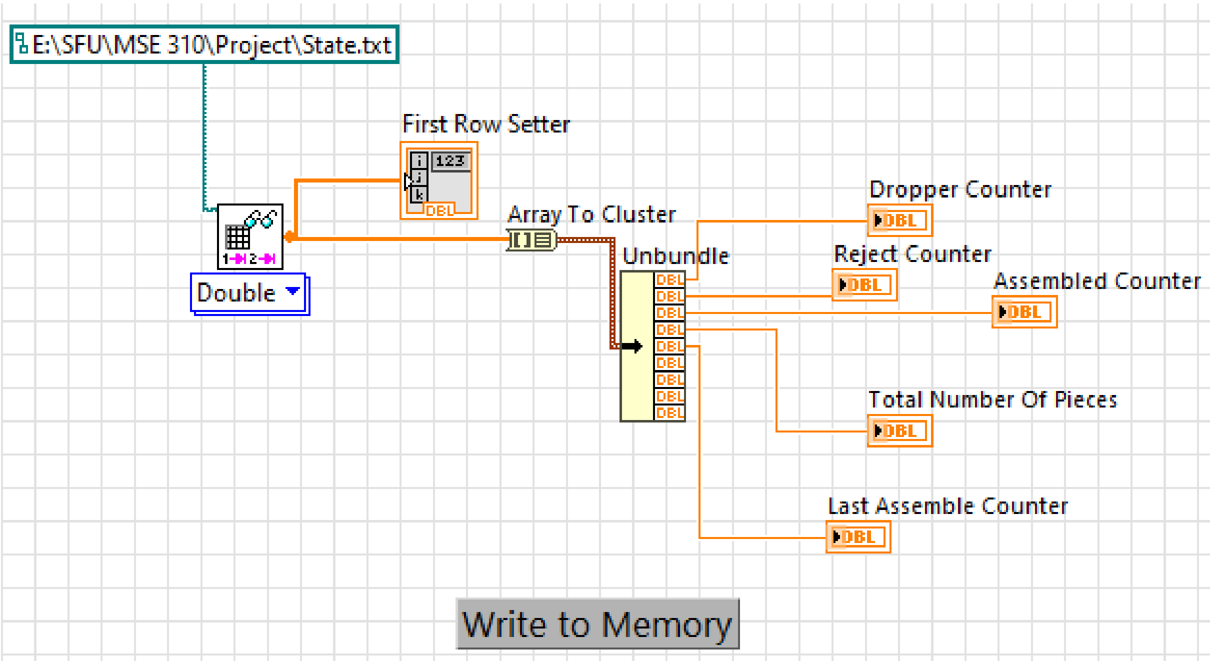
This part of the code is used to initialize and set up all of the sensors and actuators. These tell the program what each port of the ICT is called so that references can be made later to activate them.



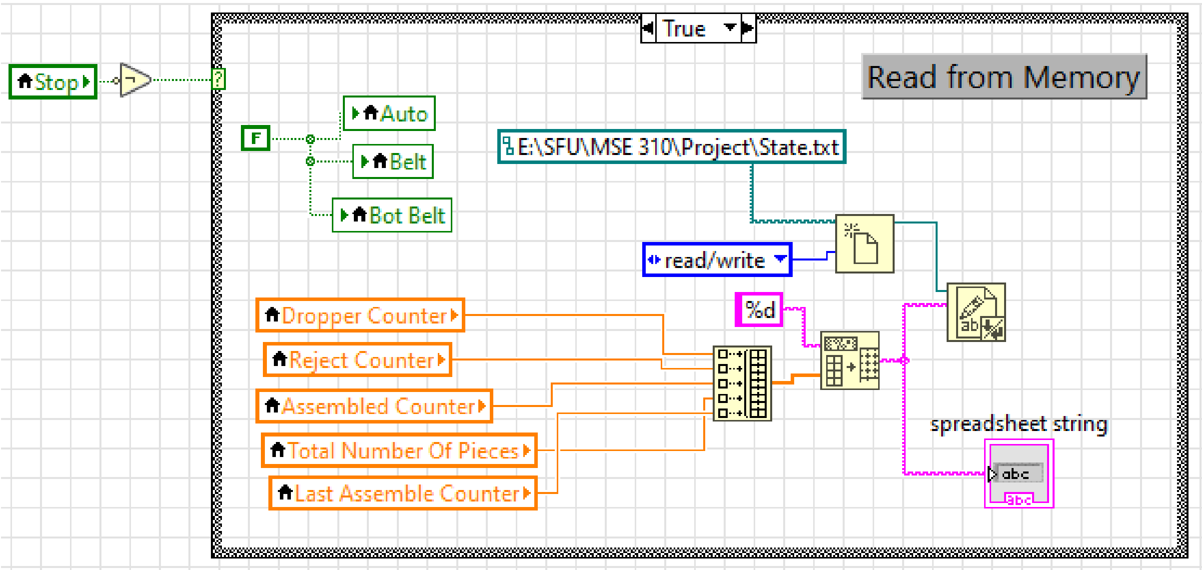
The start and stop buttons are set here to activate multiple things at once: when started, the program will begin running both the top and bottom belts of the machine.



This part of the code is to make sure that once we hit the start button, the belt button will be disabled and grayed out so we can't manually activate the button from the code interface.

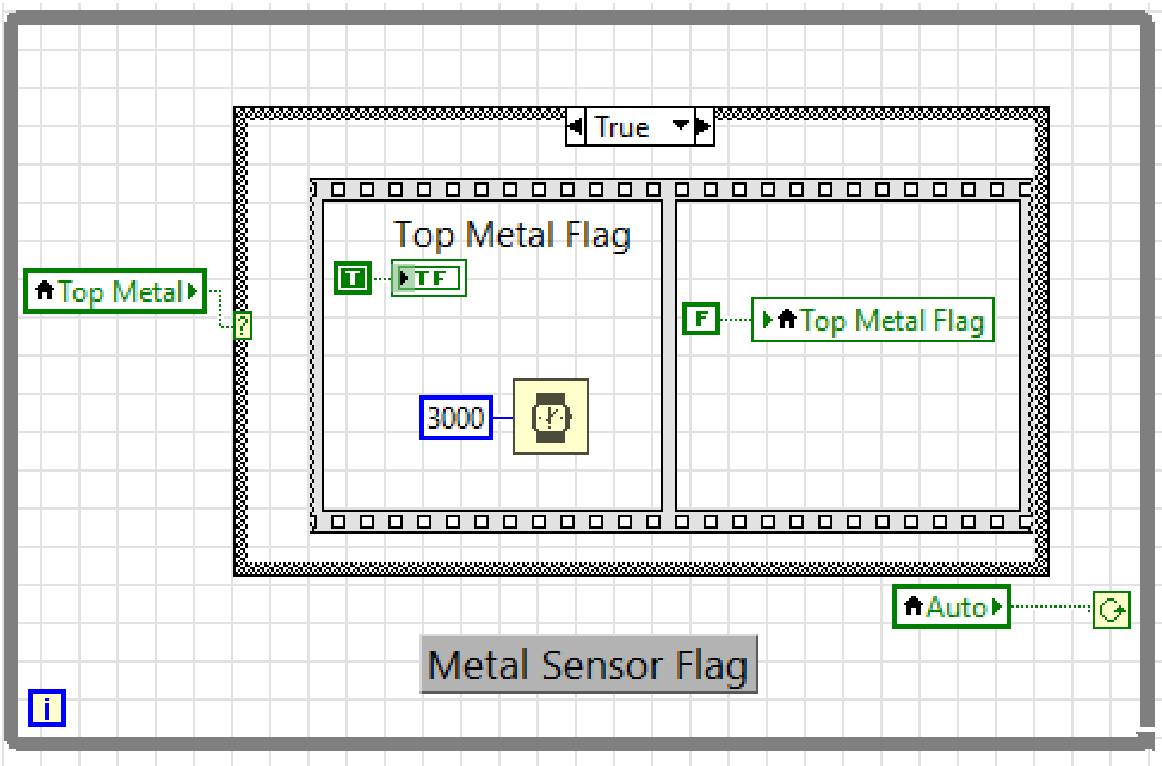


This part of the code is what is used to write the current state of the assembly to memory. We have the counters for the dropper, number of rejected pieces, number of assembled pieces, total number of pieces, and a last assembled counter which is all written into a txt file

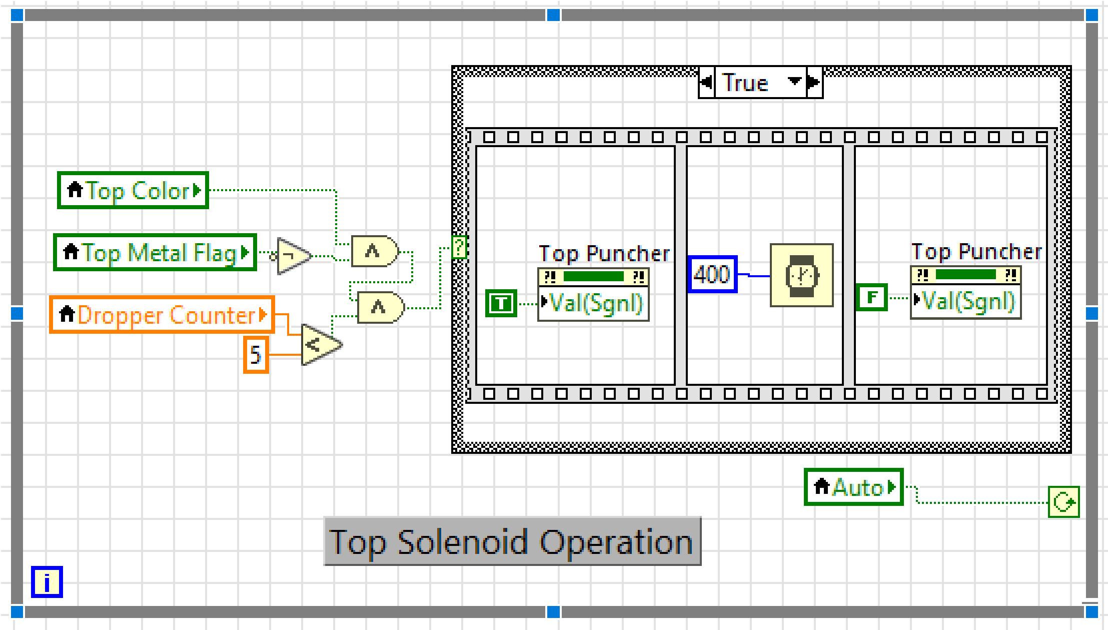


When the stop button is pressed, all of the stored information about the current state of assembly will be saved into memory.

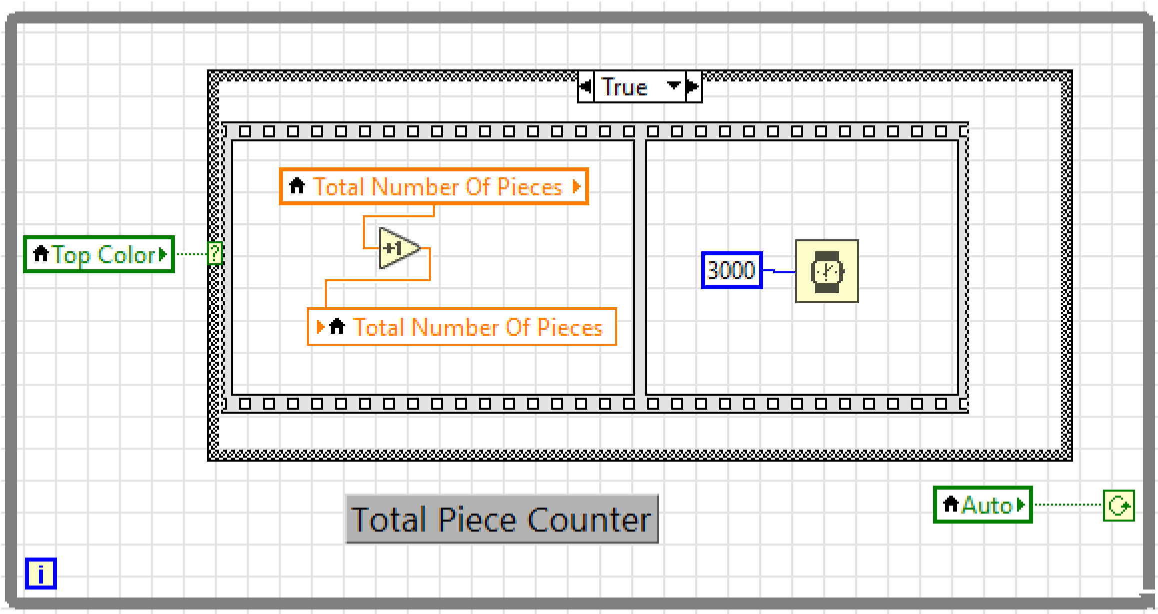
ICT Operation



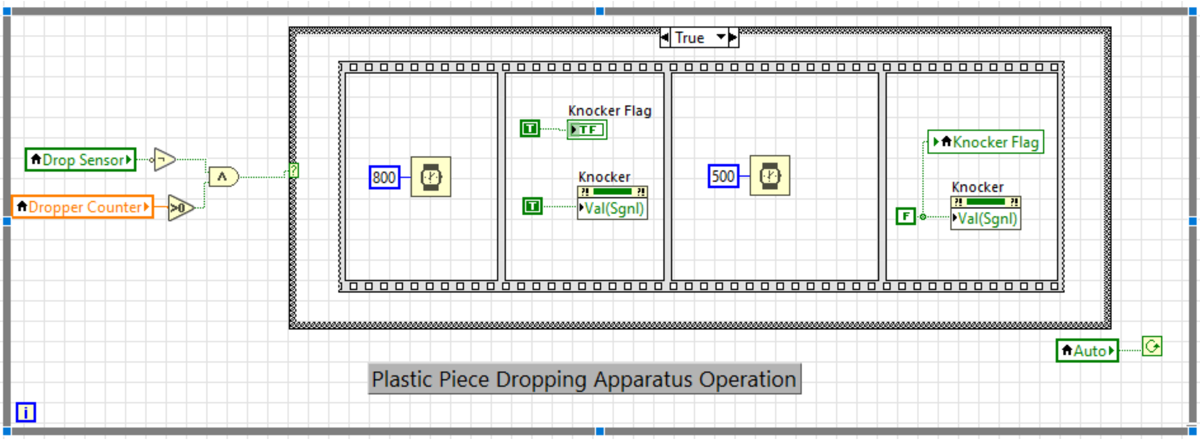
Code to identify whether or not the piece in front of the solenoid is a metal piece.



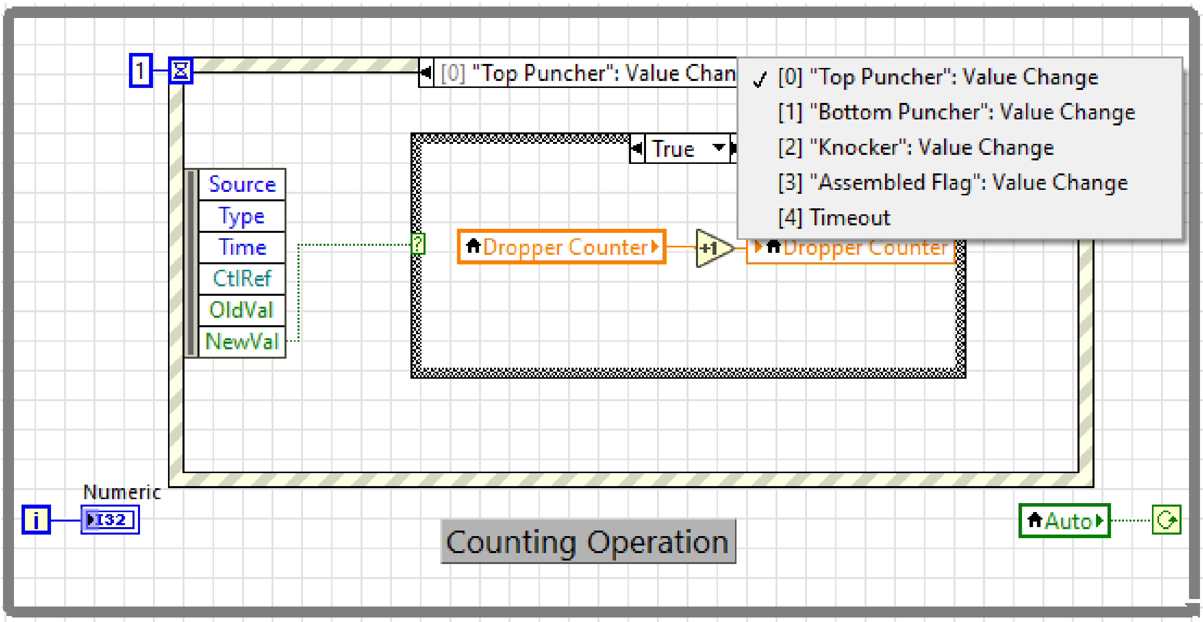
Code to operate the top solenoid. If the proximity sensor is on, but the metal sensor is off, it means that the top collection of sensors is looking at a plastic piece. If there are fewer than 5 plastic pieces already kicked down into the queue, then it will initiate the solenoid to kick the plastic piece onto the top of the stack.



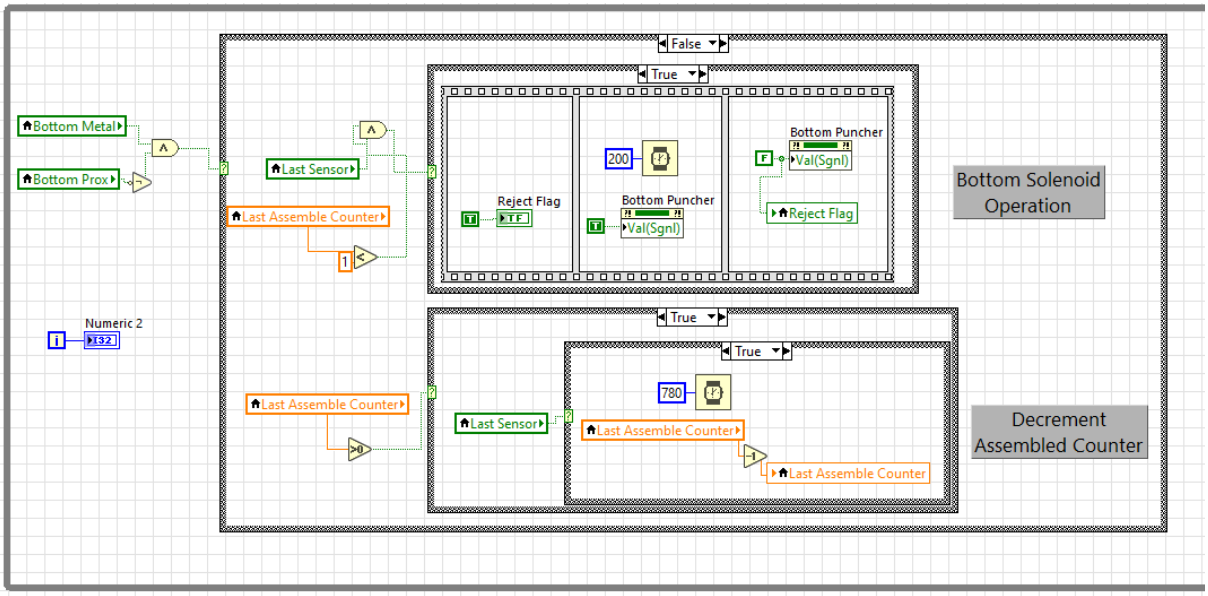
Code to count the total number of pieces; using the top proximity sensor.



This bit of code is used to let a new plastic piece drop into position, where it will collide and assemble with metal pieces that slide down the left side of the ICT. Only one plastic piece is allowed through at a time so that they don't clog up the operation.

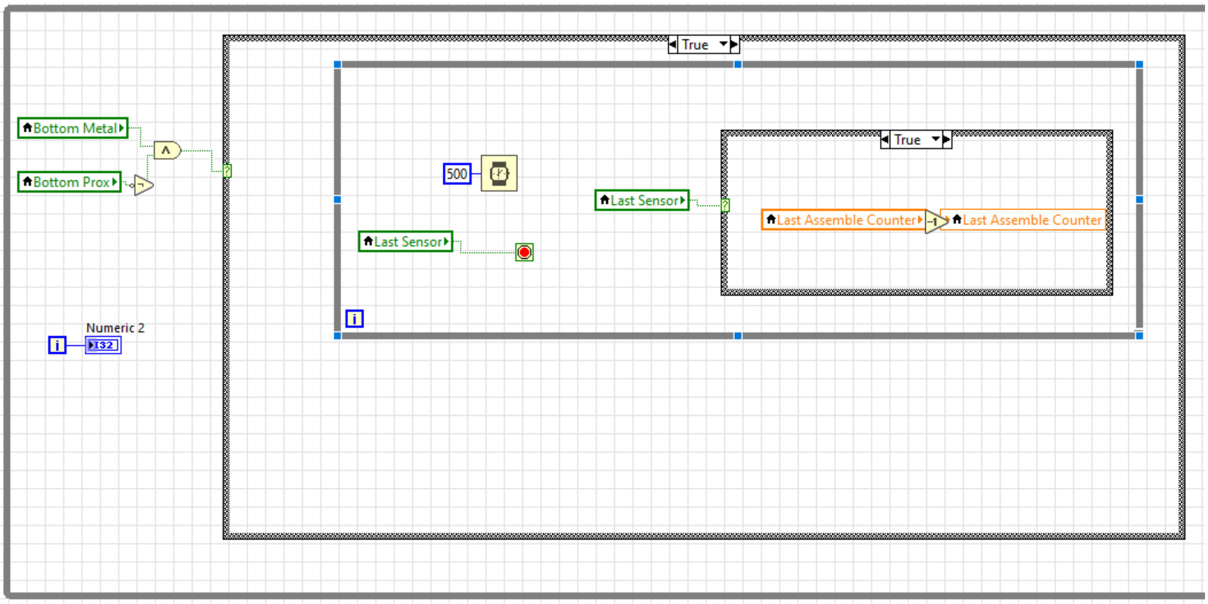


This event structure is used for the counting operation.

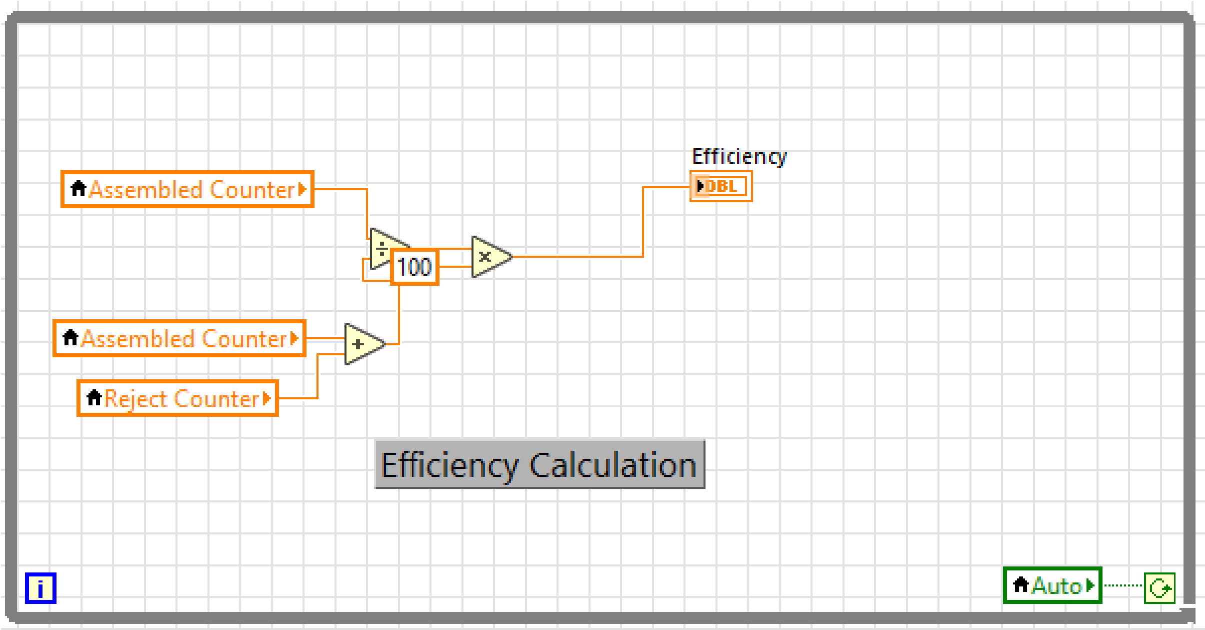


The top section of this case structure is used to operate the bottom kicker, which rejects whatever is in front of it when certain conditions are met. If the sensor bundle at the bottom doesn't sense both a metal piece and a plastic piece (indicating an assembled couple), it will reject the piece.

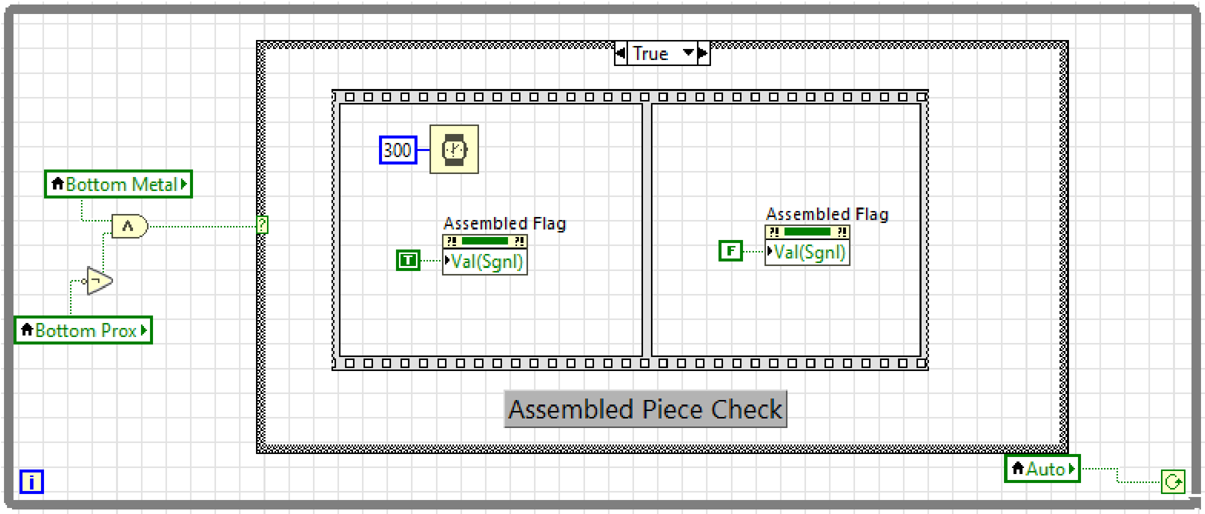
The bottom section of the case structure decrements the assembled counter.



The other side of the case structure checks the last sensor and decrements the assembled counter. Since the case structure is true, it means that the piece is not assembled.



Code that calculates efficiency based on how many pieces are assembled compared to how many total pieces were counted in total.



And finally, the last bit of code checks for fully assembled pieces at the very end.

Sensor and Actuator Parameters

The Sorting Area

Inductive proximity switch(behind the solenoid)

It is used for sensing whether or not the solenoid is activated.

Inductive proximity switch(in front of the solenoid)

It senses whether or not the current object in front of the solenoid is metal.

Infra-red Sensor:

It senses whether there is an object in front of the solenoid or not.

24V D.C. linear solenoid:

It is used to kick the plastic ring from the line to the Ring queue area.

The Assembly Chute

Infra-red sensor

It senses whether there is a ring or not in the Assembly Hopper.

24V D.C. rotary solenoid

It drops the plastic ring from the ring queue area to the Assembly Hopper.

The Sensing Station

Inductive Proximity Switch

It senses whether there is a metal peg present or not.

Capacitive Proximity Switch

It senses whether there is a plastic ring present or not.

Infra-red fiber-optic through beam sensor

It senses whether there is an object passing the sensing station or not.

The Reject Area

Inductive Proximity Switch

It detects the actuation of the linear solenoid.

Infra-red sensor

It senses whether there is an object in the reject area or not.

24V D.C. linear solenoid

It is used to kick out unassembled objects from the assembly line.

Controls

Tactile sensors

It is basically a button that provides a signal to the ICT. There are 3 different buttons that are this type of sensor: the start button, the stop button, and the emergency safety (stop) button.

Recommendations

The ICT utilizes different sensors and integrates them together to perform the assembly of the plastic and metal pieces. One recommendation we have for the ICT would be putting the laser sensor right below the metal sensor so it would be easier to detect if a piece that has gone through is assembled or not; Having the laser sensor right under the metal sensor would make the queuing section of the rejection system much easier to code.

Conclusion

Our group learned about the different sensors and each of their own properties through the experiment and the development of the ICT assembly line. Additionally, this project expanded our knowledge and gave us new ideas of different possible applications of the sensors and actuators that were used. Overall, our project was successful in managing and operating the MSE310 Lab ICT.