COVERSHEET

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Assignment, Report & Laboratory Coversheet for Individual & Group Assignment

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UNIT NAME Process Instrumention		UNIT CODE ELEC5506
TITLE/TOPIC OF ASSIGNMENT – LAB1		NAME OF LECTURER/TUTOR Professor Brett Nener
DATE/TIME DUE 3/04/2025 – 11:00 AM		DATE/TIME SUBMITTED 3/04/2025 – 10:45 AM

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Unless other arrangements have been made it will be assumed that all group members have contributed equally to group assignments/laboratory reports

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ELEC5506: Process Instrumentation & Control

Dual-conveyor workcell system

Objective

The dual-conveyor workcell system consists of,

- Two conveyors with sensors and actuators
- Micro logix 1400 series PLC, and
- Computer with RS Logix software to programmatically control the system.

For this lab, you will be working only with **ONE conveyor (the top conveyor belt**) that will be used to sort washers based on their size (height) and composition material (plastic or metal).

General overview of the top conveyor belt

The following components are used to carry out the identification and sorting of the washers:

- The top conveyor is used to carry the washers.
- One dispenser is used to dispense (drop) the washers on the conveyor Opto sensors are used to sense the presence of washers A height sensor is used to measure the height of the washers.
- An inductive detector identifies the metal parts so that the metal washers can be separated from plastic washers
- Solenoid operated flippers are used to ”flip” the washers into appropriate chutes. Only washers with correct height will be flipped into the chutes. Washers with incorrect height will be sent to the bin. Metal washers with correct height will be flipped to Chute 1 whereas plastic washers with correct height will be flipped to Chute 2.

Exercise 1:
Write a program to dispense a washer from dispenser 1 and latch SOL 2 when the start button is pressed and then run the conveyor belt until the stop button is pressed.

Flowchart

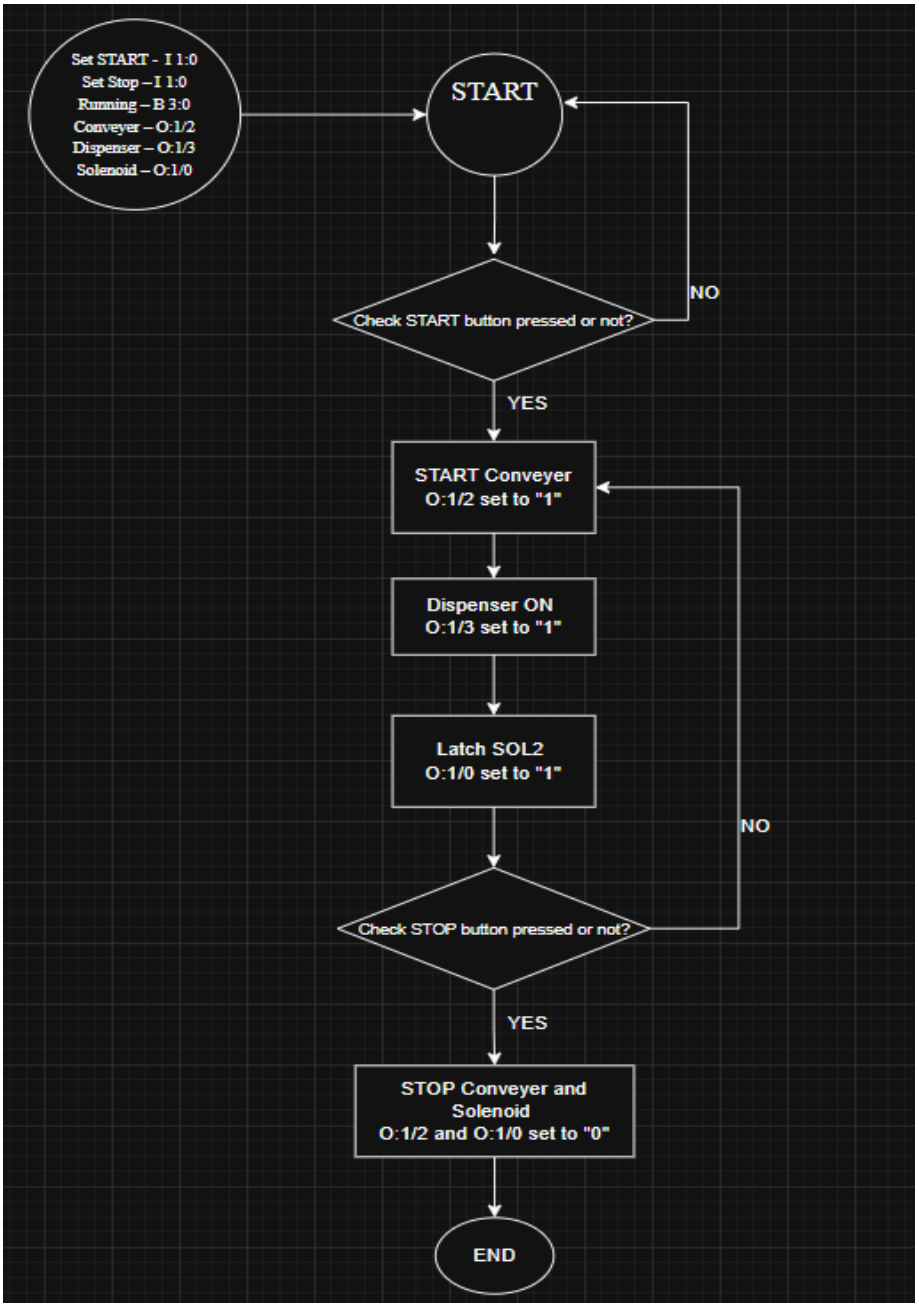

Fig 1 : Flowchart of exercise1

Explanation of flowchart:

Step1 : Set all initial address of START, STOP, RUNNING,DISP1,SOL2, CONV1.

Step 2: Check whether diamond shape START button is pressed or not. If it pressed start conveyor belt and if not then go back to same process. Also, make output RUNNING bit 1. This bit will use as a input with START button.

Step 3: Start conveyor belt. Activate the dispenser and enable solenoid2.

Step 4: If STOP button pressed then STOP conveyor belt turn off solenoid, dispenser. If not then go back to conveyor start process as shown in fig1 and repeat process.

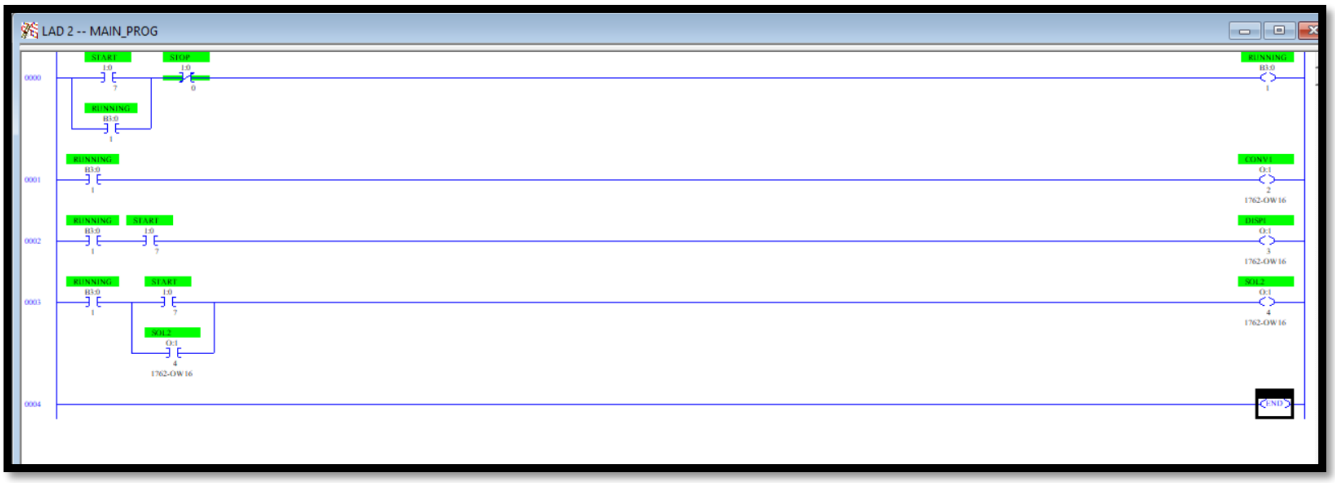

Fig 2 : Ladder logic of exercise 1

Explanation of each rung

In PLC programming there are 3 types of bit logic. 1) NO contact 2) NC contact and 3)Output coil. Right side of ladder logic is named as positive side and left side is named as end.

Rung 0000
This rung has two NO contacts (it will pass supply when "1" or "HIGH") - START and RUNNING. Here, RUNNING bit used for OUTPUT as well. It is possible to use OUTPUT as a INPUT address but not viceversa. This term called as Latching. It is allow to save last state even if we turn off our INPUT. Furthermore more NC contact used as a STOP button (it will pass supply when "0" or "LOW").

Rung 0001
When we press start button the HIGH value will save in RUNNING bit and it will start conveyor belt. In other words, O:1/2 set to "HIGH" or "1".

Rung 0002
When RUNNING bit "HIGH" and again START button pressed, the dispenser will be turn on and it will dispense a washer (O:1/3 set to "HIGH" or 1).

Rung 0003

To hold state rung 3 has latching of solenoid with START button. RUNNING bit is “HIGH” and if we pressed START button SOL2 will turn on (O:1/2) and that state will save in address O:1/4.

Exercise 2:

Modify your program so that when a washer reaches OPT1 the conveyor belt dispenses another washer.

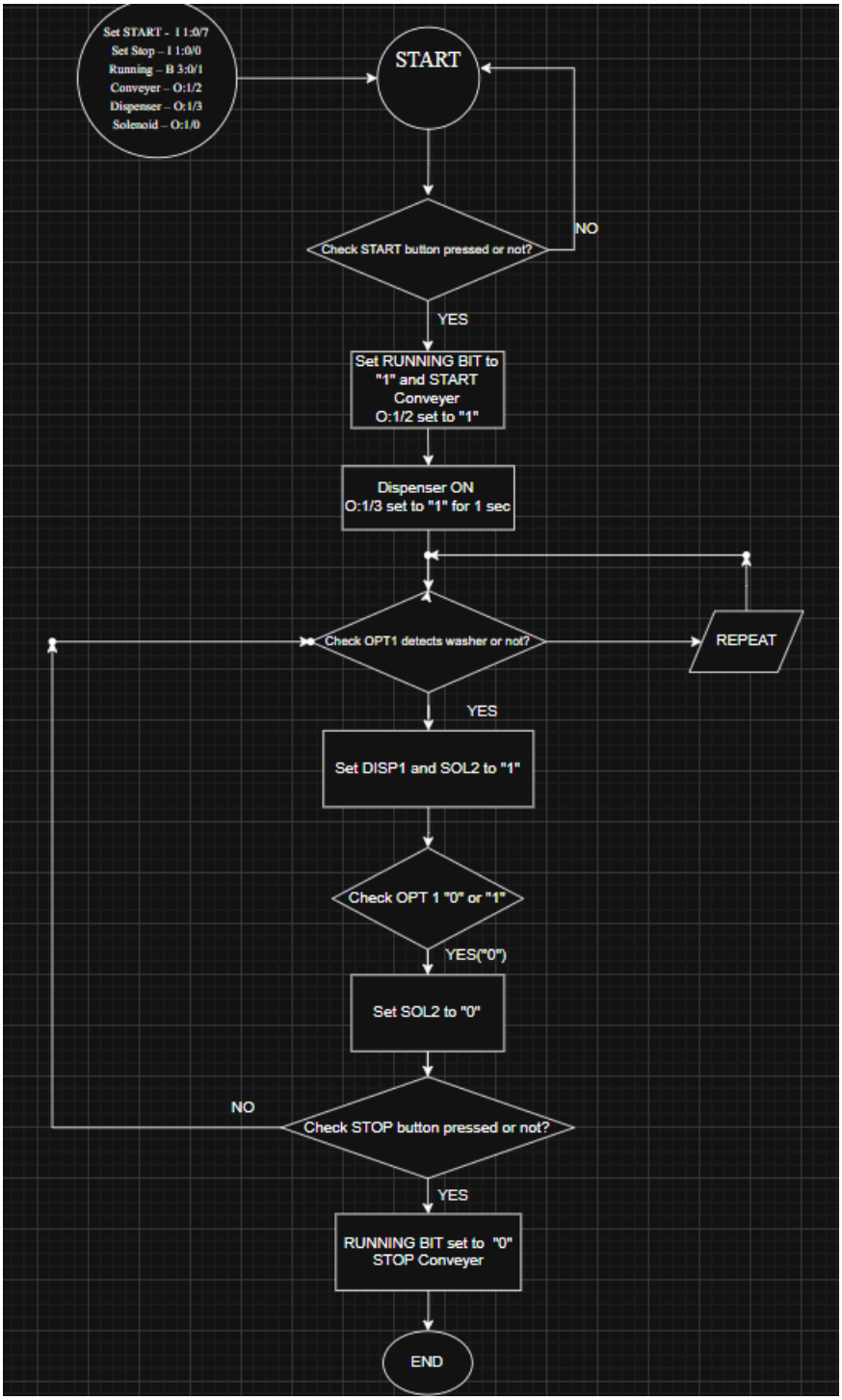

Fig 2 : Flowchart logic of exercise 1

Explanation of flowchart:

Step1 : Set all initial address of START, STOP, RUNNING,DISP1,SOL2, CONV1.

Step 2: Check whether diamond shape START button is pressed or not. If it pressed start conveyor belt and if not then go back to same process. Also, make output RUNNING bit 1. This bit will use as a input with START button.

Step 3: Start conveyor belt (O:1/2 = “HIGH”).

Step 4 : Check optical sensor detects washer or not? IF yes then activate the dispenser and enable solenoid2.if washer not found then repeat.

Step 5: Check sensor status if it has “LOW” value then turn of solenoid.

Step 6: If STOP button (1:0/0) pressed then STOP conveyor belt turn off solenoid, dispenser. If not then go back to conveyor start process as shown in fig1 and repeat process. If not then go to step 4 and follow next step.

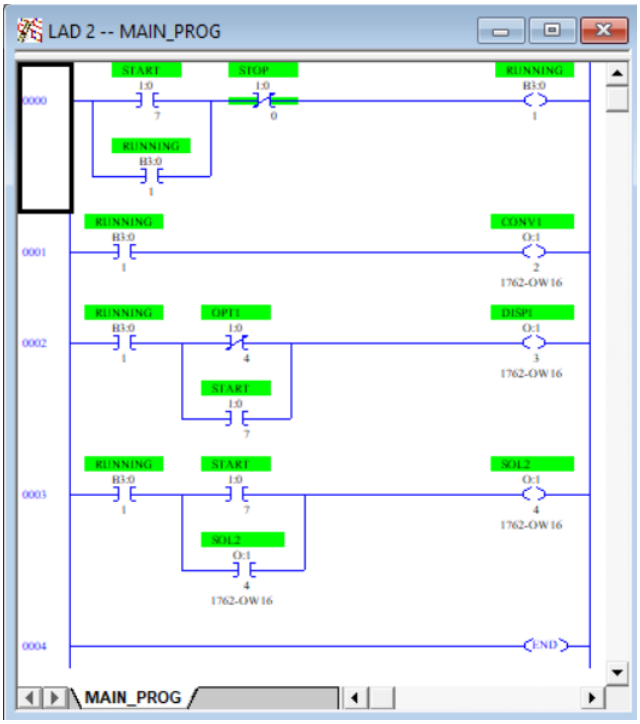

Fig 4 : Ladder logic of exercise 2

Explanation of each rung

In this exercise we used NC contact for optical sensor which detects washer. It will pass supply when "0" or "LOW".

Rung 0000
This rung has two NO contacts (it will pass supply when "1" or "HIGH") - START and RUNNING. Here, RUNNING bit used for OUTPUT as well. It is possible to use OUTPUT as a INPUT address but not viceversa. This term called as Latching. It is allow to save last state even if we turn off our INPUT. Furthermore more NC contact used as a STOP button (it will pass supply when "0" or "LOW").

Rung 0001
When we press start button the HIGH value will save in RUNNING bit and it will start conveyor belt. In other words, O:1/2 set to "HIGH" or "1".

Rung 0002
When RUNNING bit is "HIGH" there are two possibilities to start dispenser. Firstly, OPT1(I:1/4) has value "0" - detecting washer and START button(I:1/0) pressed again.

Rung 0003
To hold state rung 3 has latching of solenoid with START button. RUNNING bit is "HIGH" and if we pressed START button SOL2 will turn on (O:1/2) and that state will save in address O:1/4.

Exercise 3:

Finally add a condition to your program that if the start button is pressed a second time it stops dispensing washers (no matter how many times start is pressed) and continues running the conveyor belt until the stop button is pressed.

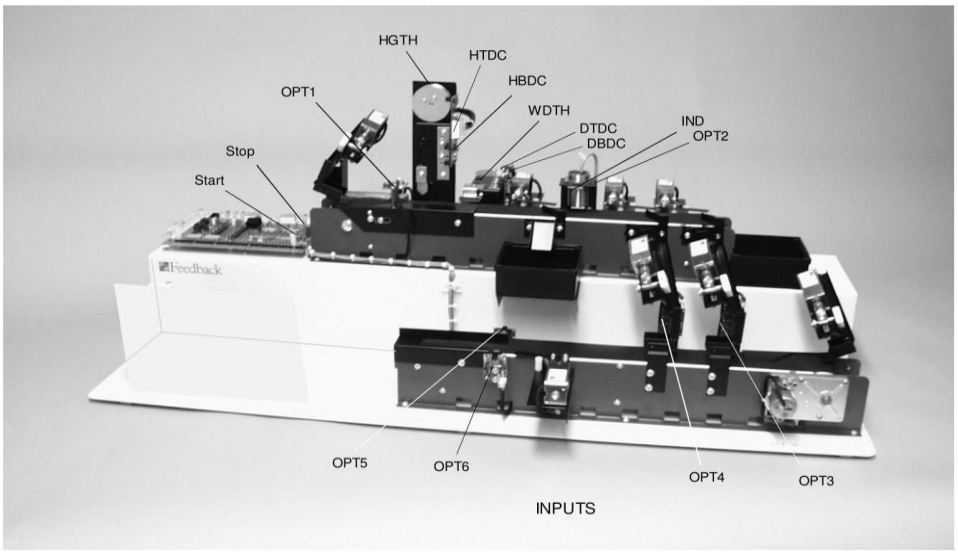

Fig 5: Inputs of the dual-conveyor workcell system (WDTH, DTDC & DBDC is not present in our system)

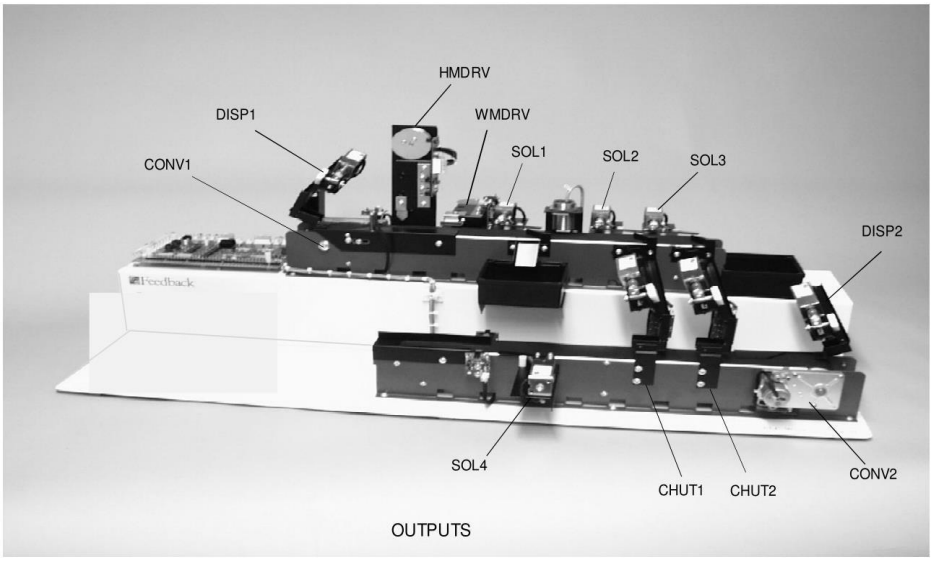

Fig 6: Outputs of the dual-conveyor workcell system (WMDRV is not present in our system)

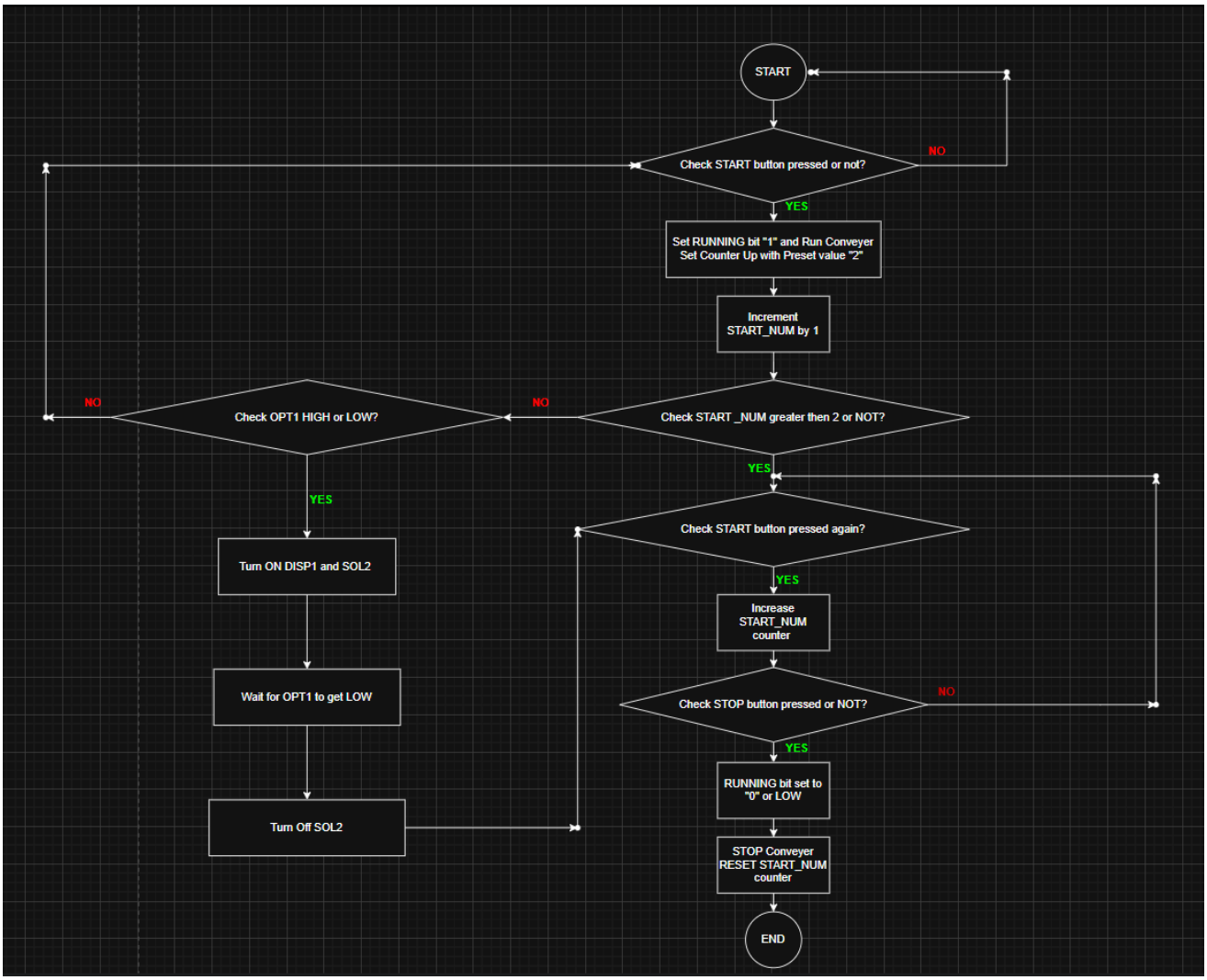

Fig 7 : Flowchart of exercise 3

Explanation of flowchart:

Step1 : Set all initial address of START, STOP, RUNNING,DISP1,SOL2, CONV1.

Step 2: Check whether diamond shape START button is pressed or not. If it pressed start conveyor belt and if not then go back to same process. Also, make output RUNNING bit 1. This bit will use as a input with START button. Set counter up with preset value = 2.

Step3 : then Increment START_NUM bit by 1.

Step 4 : Check START button is greater than 2 or not. If no then check optical sensor value is HIGH or LOW? If it is LOW then go to step 2 and repeat.

Step 5: Check START button is greater than 2 then check pressed again or not. If yes then increase START_NUM counter.

Step 6: Check STOP button status.If not pressed go to step 4. If pressed then set RUNNING bit 0 and stop conveyor belt and END process.

Step 7 : If OPT1 is high then turn on dispenser and solenoid and wait for OPT1 to get “LOW” state. Again activate solenoid. Go to step 4.

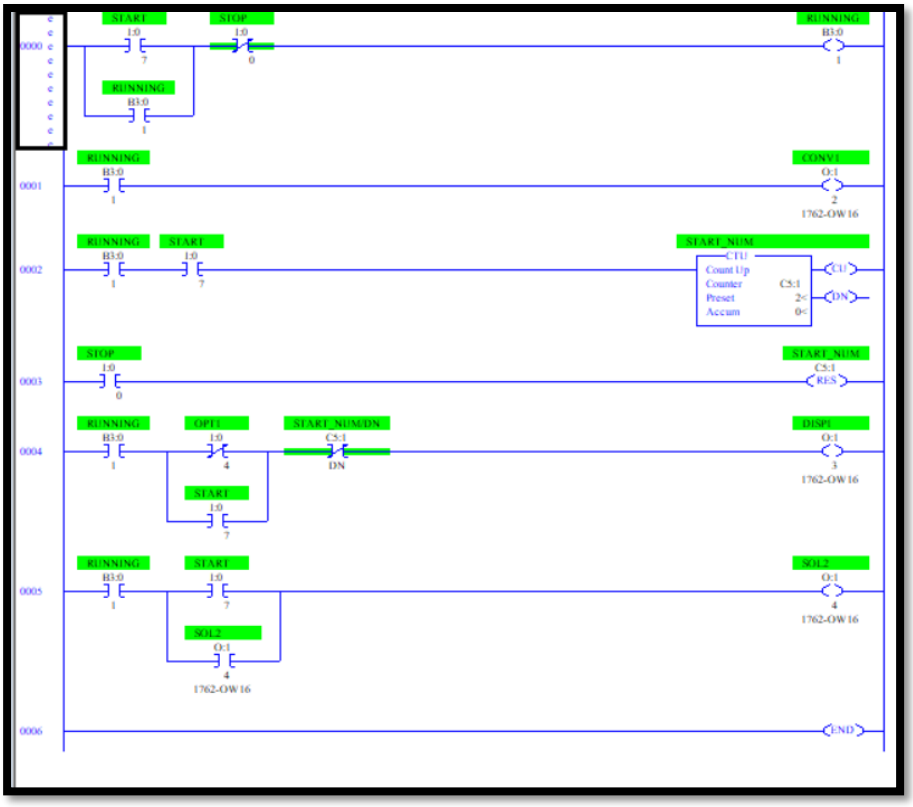

Fig 8 : Ladder diagram of exercise 3

Explanation of each rung

Counter is very useful for tracking products running by tracking data. Accumulator will increment every time when input is activated until it gets to Preset value. Then after that counter is done. For this exercise we use Up counter with address C5:1. In inintial stage accumulator is 0 and preset value is 2.

Rung 0000
This rung has two NO contacts (it will pass supply when "1" or "HIGH") - START and RUNNING. Here, RUNNING bit used for OUTPUT as well. It is possible to use OUTPUT as a INPUT address but not viceversa. This term called as Latching. It is allow to save last state even if we turn off our INPUT. Furthermore more NC contact used as a STOP button (it will pass supply when "0" or "LOW").

Rung 0001
When we press start button the HIGH value will save in RUNNING bit and it will start conveyor belt. In other words, O:1/2 set to "HIGH" or "1".

Rung 0002
Counter will save and increment accumulator when we press START button again. As mentioned inn above step. RUNNING bit will save its previous state when we press start button

Rung 0003
When we press STOP button it will RESET up counter by its preset value.

Rung 0004
START_NUM/DN C5:1 represents done bit by DN. When RUNNNING bit on plus independent state of optical sensor whether it is "0" or "1" dispenser will be activated with condition of START_NUM bit not done. Here , DN used by NC contact.

Rung 0005
To hold state rung 3 has latching of solenoid with START button. RUNNING bit is "HIGH" and if we pressed START button SOL2 will turn on (O:1/2) and that state will save in address O:1/4.

Suggestions/Weak points:

- **In all exercise there is continous speed for conveyor belt whether washer is coming or not. Hence , for a longer run it is inevitable to overcome this problem by automation for conveyor belt. First solution is to detcet**

whether we actual need to run belt all the time or by detecting circumstances we can add more logics in each rung to save energy and increase operation efficiency.