Tutorial 01 – PLC Ladder Programming Based on Real-World Applications

Question 1: Automatic Street Light Control

Streetlights should turn ON when it gets dark (based on a light sensor) and OFF when it becomes bright.
Inputs:

- LDR Sensor (I0.0) – HIGH in daylight, LOW in darkness

Outputs:

- Streetlight (Q0.0)

Task:
Write a ladder logic program to control a streetlight using an LDR sensor input.

Question 2: Water Tank Level Control System

A motor should fill a water tank when the low-level sensor is triggered and should stop when the high-level sensor is triggered.
Inputs:

- Low-level sensor (I0.0)
- High-level sensor (I0.1)

Outputs:

- Water pump (Q0.0)

Task:
Write a PLC program to automate this process, ensuring the pump operates only when needed.

Question 3: Conveyor Belt Sorting System

A sensor detects metallic items on a conveyor. When a metal is detected, a piston pushes the item to a bin.
Inputs:

- Proximity Sensor (I0.0)
- Start Button (I0.1)
- Stop Button (I0.2)

Outputs:

- Conveyor Motor (Q0.0)
- Piston Actuator (Q0.1)

Task:
Write a PLC ladder diagram to:

- Start/stop the conveyor using buttons.
- Activate the piston only when a metal is detected.

Question 4: Elevator Control for Two Floors

An elevator operates between two floors. Pressing the button on the floor calls the elevator. It should move only if the doors are closed.
Inputs:

- Ground Floor Button (I0.0)
- First Floor Button (I0.1)
- Door Closed Sensor (I0.2)

Outputs:

- Motor Up (Q0.0)
- Motor Down (Q0.1)

Task:
Write a PLC program to control elevator movement between two floors.

Question 5: Traffic Light Controller for Pedestrian Crossing

A pedestrian button allows people to cross. Traffic stops for a set time (e.g., 10 seconds), then resumes.
Inputs:

- Pedestrian Button (I0.0)

Outputs:

- Green Light (Q0.0)
- Yellow Light (Q0.1)
- Red Light (Q0.2)
- Pedestrian Signal (Q0.3)

Task:
Write a ladder program to:

- Change lights in sequence on button press.
- Return to normal traffic cycle after 10 seconds.

Question 6: Automatic Bottle Filling System

When a bottle arrives (sensor triggered), a valve opens to fill it for 5 seconds and then closes.
Inputs:

- Bottle Presence Sensor (I0.0)

Outputs:

- Valve (Q0.0)

Task:
Use a timer to write a PLC program that fills bottles for exactly 5 seconds when detected.

Question 7: Automatic Door System

When a person is detected near the door, it opens. After 5 seconds, it closes automatically.

Inputs:

- Motion Sensor (I0.0)

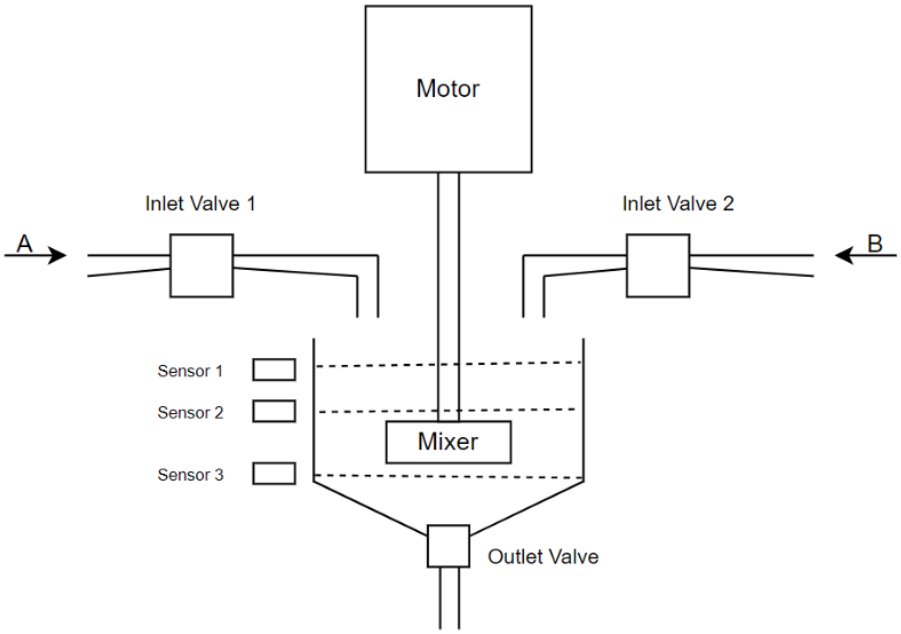
Outputs:

- Door Motor (Open/Close) (Q0.0)

Task:

Write a PLC program that uses a timer to open and close the door automatically.

Question 8: Automatic Controlled Mixing Tank



In an industrial process, two materials, A and B, are collected in a tank. The collected materials should be mixed for 30 seconds, then released until it reaches the bottom level of the tank. This process has to repeat automatically.

• Two push buttons (Start and Stop) are provided to control the automatic process.

• Three sensors are placed to detect the levels of material A and material B and the bottom level of the tank.

• Two inlet valves are used to control the flow of material A and B, and an outlet valve is used to release/drain the mixed material.

i. State the inputs and outputs of the system.

ii. Select suitable sensors and actuators for the system.

iii. Write the PLC ladder program that facilitates the automatic mixing of these materials. Clearly indicate each step of the program and use appropriate symbols and notations. Provide comments where necessary to explain the functionality of specific ladder networks.

Question 9: Automatic Paint Filling Station (Past Paper 2024)

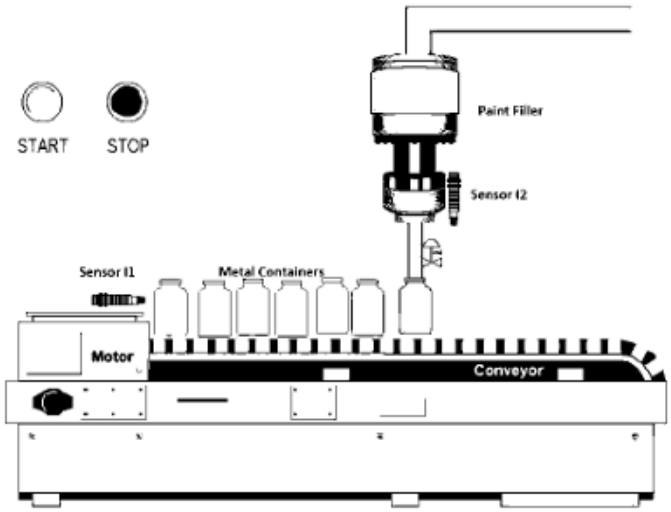


Figure 1: Automated filling station

You are required to design a ladder logic program for an automated paint-filling station as shown in the Figure. The system operates under the control of a PLC and follows this sequence:

- The system begins operation when the START pushbutton (I0) is pressed.
- The conveyor motor (Q1) starts, moving empty metal containers along the line.
- A proximity sensor (I1) detects the arrival of each container at the filling station.
- Once a container is in place, the conveyor stops automatically.
- The paint filler (Q2) is activated for 3 seconds to dispense paint into the container.
- After filling, the conveyor restarts to move the container forward.
- A second sensor (I2) checks the liquid level to ensure proper filling.
- When 5 containers are successfully filled and verified, an indicator light (Q3) is activated to notify the operator to remove them for packing.
- The process continues cyclically until the STOP button is pressed.
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  (a) Propose suitable types of sensors for I1 and I2. Justify your selections based on the requirements of the system.

  (b) Develop the complete PLC ladder logic program for the described application, incorporating the following:
    - Emergency STOP functionality
    - Comments in the program where necessary
    - A table listing all input and output addresses with descriptions
    - Clear documentation of any assumptions made