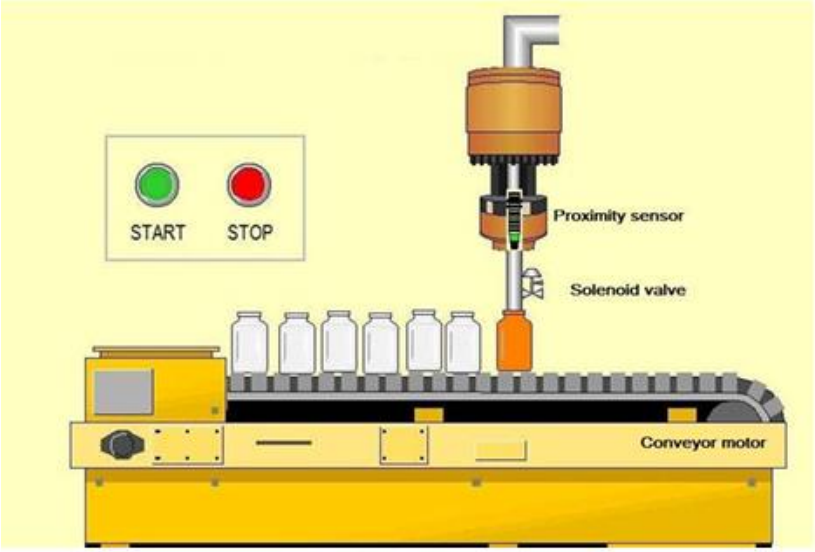
Exercise 1

A bottle filling system in a factory is automated to efficiently fill bottles. The process must be controlled using Start and Stop Push Buttons along with a Proximity Sensor to detect the presence of bottles.

Write a **PLC ladder program** to control the above automated bottle filling system. The system should meet the following criteria:

- The conveyor starts moving when the Start PB is pressed. The conveyor should continue moving until the Proximity Sensor is ON.
- Once the Proximity Sensor is triggered (indicating the presence of a bottle), the solenoid valve will open for 5 seconds to allow the filling process to occur.
- After 5 seconds, the solenoid valve closes, and the conveyor resumes movement for the next bottle.



- **Identify Inputs & Outputs**

Device	Type	Address
Start Push Button		
Stop Push Button		
Proximity Sensor		
Conveyor Motor		
Solenoid Valve		
Timer		

Control Logic Overview

Step 1: Conveyor Start/Stop Control

- Condition: When the **Start PB** is pressed, the conveyor will start. If the **Stop PB** is pressed, it will stop.

Step 2: Conveyor Stops when Proximity Sensor is ON

- Condition: The **Conveyor** continues moving until the **Proximity Sensor** detects a bottle.

Step 3: Solenoid Valve Operation for 5 Seconds

- Condition: If **Proximity Sensor** is ON, then open **Solenoid Valve** for 5 seconds and closes afterward.

Step 4: Conveyor Resumes After Solenoid Valve Operation

- After 5 seconds, the **Conveyor** resumes moving.

Exercise 2

Now, the system must be enhanced by integrating an additional step to count the number of bottles filled. The system should meet the following criteria:

- The system should repeat this process for a total of 6 bottles. After the sixth bottle, the system should automatically shut down.

- **Identify Inputs & Outputs**

Device	Type	Address
Bottle Counter		

Control Logic Overview

Step 1: Conveyor Start/Stop Control

- Condition: When the **Start PB** is pressed, the conveyor will start. If the **Stop PB** is pressed, it will stop.

Step 2: Conveyor Stops when Proximity Sensor is ON

- Condition: The **Conveyor** continues moving until the **Proximity Sensor** detects a bottle.

Step 3: Solenoid Valve Operation for 5 Seconds

- Condition: If **Proximity Sensor** is ON, then open **Solenoid Valve** for 5 seconds and closes afterward.

Step 4: Conveyor Resumes After Solenoid Valve Operation

- After 5 seconds, the **Conveyor** resumes moving.

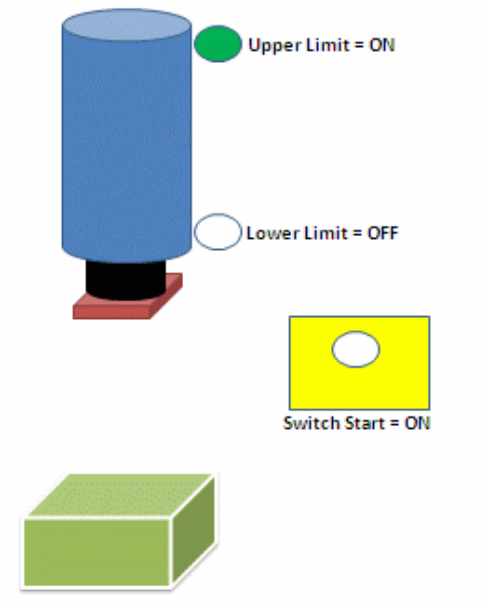
Step 5: Bottle Count and Automatic Shutdown

- The system counts the bottles using the **Counter**. After 6 bottles, the process will **automatically stop**.

Exercise 3

A manufacturing unit is implementing an **automated drilling system** using a PLC. The drilling process is controlled by a **linear motor system**, which moves the drill **up and down** based on sensor feedback. The system operates as follows:

1. When the **Upper limit Sensor** is **ON** and the **Start Push Button** is pressed, the **linear motor should move forward**, lowering the drill.
2. When the **Lower limit Sensor** is **ON**, the **linear motor should reverse**, raising the drill back up.
3. When the **Upper limit Sensor** is **ON**, the **drill motor should stop**, ensuring the drill is in its initial position.
4. If the **Stop Push Button** is pressed, **all operations must stop immediately**.



- **Identify Inputs & Outputs**

Device	Type	Address

Control Logic Overview

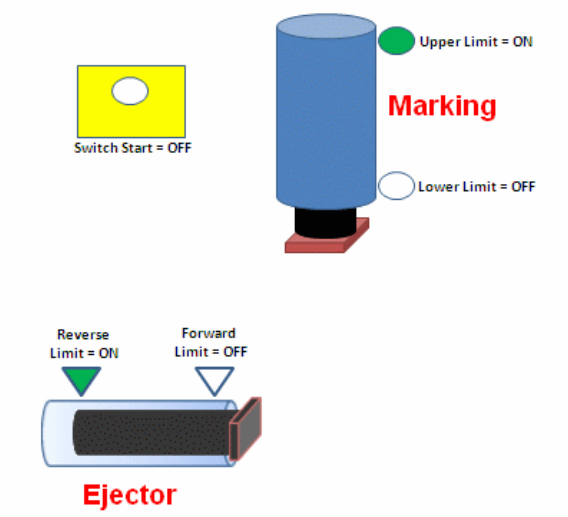
Exercise 4

You are required to **modify the existing PLC program** to include additional **safety features** while maintaining the original functionality. The improved program should:

- Prevent simultaneous activation of UP and DOWN movements (Interlock Mechanism).

Exercise 5

Now, the system must be enhanced by integrating an Ejector to automate the ejection process.



The updated system should function as follows:

1. When the **Upper limit Sensor** is **ON** and the **Start Push Button** is pressed, the **linear motor should move forward**, lowering the drill.
2. When the **Lower limit Sensor** is **ON**, the **linear motor should reverse**, raising the drill back up.
3. When the **Upper limit Sensor** is **ON**, then the **drill motor and both forward and reverse linear motors should stop**, ensuring the drill is in its initial position. And **Ejector should move forward.**
4. When the **Ejector forward limit Sensor** is **ON**, the **Ejector should reverse** back to its initial position.
5. When the **Ejector reverse limit Sensor** is **ON**, then **Ejector should stop.**
6. Process should be able to start again by pressing Start button.

Identify Inputs & Outputs

Device	Type	Address

Control Logic Overview