Department of Computer Science and Engineering
Premier University

EEE 314: Control Systems Laboratory

Title: Demonstration of Simple Boolean Operations

Submitted by:

Name	Mohammad Hafizur Rahman Sakib
ID	0222210005101118
Section	C
Session	Spring 2025
Semester	7th Semester
Submission Date	12.08.2025

Submitted to:
Sharith Dhar
Lecturer, Department of EEE
Premier University
Chittagong

Remarks

Department of Computer Science and Engineering
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Title: Demonstrating Output Latching Technique

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EEE 314: Control Systems Laboratory

Title: Demonstrating the concept of using Memory Bits in output Latching technique

Submitted by:

Name	Mohammad Hafizur Rahman Sakib
ID	0222210005101118
Section	C
Session	Spring 2025
Semester	7th Semester
Submission Date	02.09.2025

Submitted to:
Sharith Dhar
Lecturer, Department of EEE
Premier University
Chittagong

Remarks

1 Objective

The objective of this experiment is to demonstrate the application of simple Boolean operations using a Programmable Logic Controller (PLC). The experiment involves implementing a ladder logic diagram to control an output based on the AND and OR Boolean operations, utilizing specific input switch combinations.

2 Equipment

The following equipment is required for this experiment:

1. Siemens S7 1200 PLC Module or LOGO PLC.

2. PC with TIA PORTAL or LOGO SOFT Comfort installed.

3 Lab Work

In this section, the provided ladder diagram is developed using the appropriate software (TIA PORTAL for Siemens S7 1200 or LOGO SOFT Comfort for LOGO PLC). After creating the ladder logic, it is uploaded to the PLC module and executed to verify the functionality.

3.1 Ladder Diagram

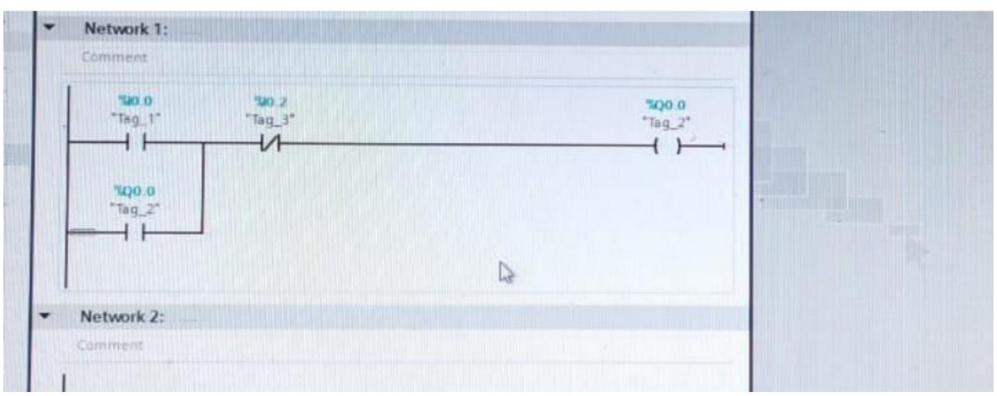

Figure 1: Ladder Diagram for Simple Boolean Operations

Additional details: Verify that the ladder logic correctly implements the Boolean expression (S1 AND S2) OR (S3 AND S4). Test the system by simulating input switch combinations to observe the output behavior.

4 Experimental Work

The experiment involves controlling an indicator lamp (L1, output

- The first branch connects inputs
- The second branch connects inputs

The output

Additional details: The experiment validates the correct implementation of Boolean logic in a PLC environment. Monitor the PLC's input/output status to confirm that the lamp activates only under the specified conditions.

5 Discussion

The experiment, titled ”Demonstration of Simple Boolean Operations,” effectively utilized a Siemens S7 1200 PLC Module or LOGO PLC, programmed through TIA Portal or LOGO Soft Comfort, to implement a ladder diagram showcasing basic Boolean logic operations. The objective was successfully met by designing a circuit that controls an indicator lamp (L1,

The ladder diagram featured two parallel branches, each embodying an AND condition: the first with inputs

The system demonstrated reliable performance, with the PLC accurately processing input conditions and controlling the output. This experiment highlights the practical utility of Boolean logic in automation, such as in control systems requiring specific input combinations to trigger outputs, like safety interlocks or sequential processes.

Potential challenges include ensuring proper switch debouncing to avoid false triggers due to electrical noise. Additionally, scaling the logic to include more inputs or complex conditions could increase programming complexity. Future experiments could incorporate additional Boolean operations, such as NOT or XOR, or explore fault detection mechanisms to enhance system robustness.

1 Objective

The primary objective of this experiment is to demonstrate the output latching technique in Programmable Logic Controllers (PLCs). This involves implementing a ladder logic diagram that controls two motors, ensuring mutual exclusivity in their operation through latching and unlatching mechanisms.

2 Equipment

The following equipment is required for this experiment:

1. Siemens S7 1200 PLC Module or LOGO PLC.
2. PC with TIA PORTAL or LOGO SOFT Comfort installed.

3 Lab Work

In this section, develop the given ladder diagram using the appropriate software (TIA PORTAL for Siemens S7 1200 or LOGO SOFT Comfort for LOGO PLC). Once the ladder logic is created, upload it to the PLC module and execute the program to observe the behavior.

3.1 Ladder Diagram

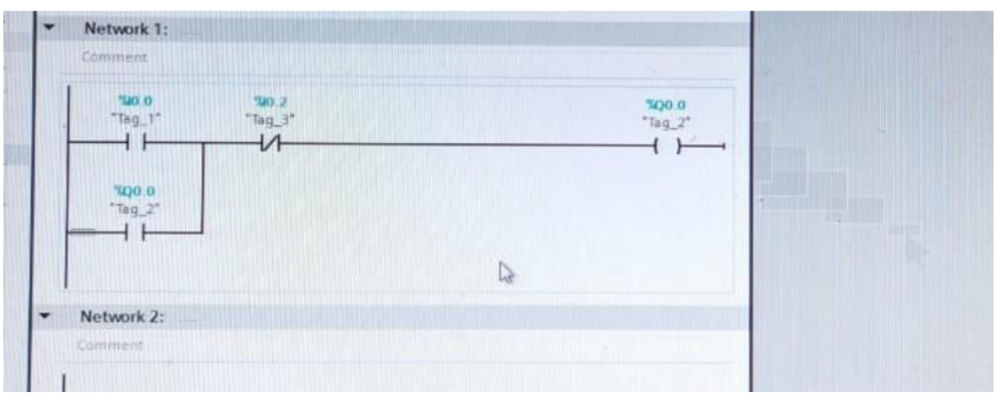

Figure 1: Ladder Diagram for Output Latching Technique

Additional details: Ensure that the ladder logic incorporates latching coils for each motor output. Test the setup by simulating button presses to verify the switching mechanism.

4 Experimental Work

The experiment focuses on controlling two motors using a Programmable Logic Controller (PLC) with a ladder diagram. The setup includes two start buttons: Start1 for Motor1 and Start2 for Motor2.

When Start1 is pressed, Motor1 begins running and latches its output to continue operating until interrupted. Similarly, pressing Start2 starts Motor2, which latches and runs until interrupted.

A key feature of this logic is the mutual exclusivity: if one motor is running and the button for the other motor is pressed, the currently running motor unlatches and stops, while the other motor latches and starts. This ensures that only one motor operates at a time, with the system seamlessly switching between Motor1 and Motor2 based on the button inputs.

Additional details: This technique prevents simultaneous operation, which could be useful in applications where resource sharing or safety interlocks are required. Observe the PLC's input/output status during execution to confirm the latching behavior.

5 Discussion

The experiment successfully demonstrated the output latching technique using a PLC-based ladder logic diagram. The implementation of latching and unlatching mechanisms ensured that only one motor could operate at a time, highlighting the effectiveness of the mutual exclusivity logic. The seamless switching between Motor1 and Motor2 upon pressing the respective start buttons validated the reliability of the latching technique in controlling sequential operations.

One key observation was the robustness of the ladder logic in handling real-time inputs. The system responded promptly to button presses, with the active motor stopping and the other starting without noticeable delays. This responsiveness is critical in industrial applications where precise control and timing are essential, such as conveyor systems or automated machinery requiring exclusive operation of components.

However, challenges may arise in scaling this system. For instance, if additional motors or complex interlocks are introduced, the ladder logic could become more intricate, potentially increasing the risk of programming errors. Additionally, the experiment assumed ideal conditions without external interferences, such as electrical noise or button malfunctions, which could affect the PLC's performance in a real-world setting. To mitigate such issues, incorporating debouncing mechanisms for the input buttons or fault detection routines in the ladder logic could enhance reliability.

The latching technique showcased here is widely applicable in automation scenarios where resource sharing or safety is paramount. For example, it could be used in systems where two processes must not occur simultaneously, such as in chemical plants or robotic assembly lines. Future experiments could explore integrating stop buttons or emergency shut-off mechanisms to further enhance the system's safety and functionality.

1 Objective

The objective of this experiment is to demonstrate the concept of using memory bits in the output latching technique within a Programmable Logic Controller (PLC). The experiment involves implementing a ladder logic diagram that utilizes memory bits to maintain the state of outputs, specifically controlling a main contactor and two pumps.

2 Equipment

The following equipment is required for this experiment:

1. Siemens S7 1200 PLC Module or LOGO PLC.

2. PC with TIA PORTAL or LOGO SOFT Comfort installed.

3 Lab Work

In this section, develop the provided ladder diagram using the appropriate software (TIA PORTAL for Siemens S7 1200 or LOGO SOFT Comfort for LOGO PLC). After creating the ladder logic, upload it to the PLC module and execute the program to observe the behavior.

3.1 Ladder Diagram

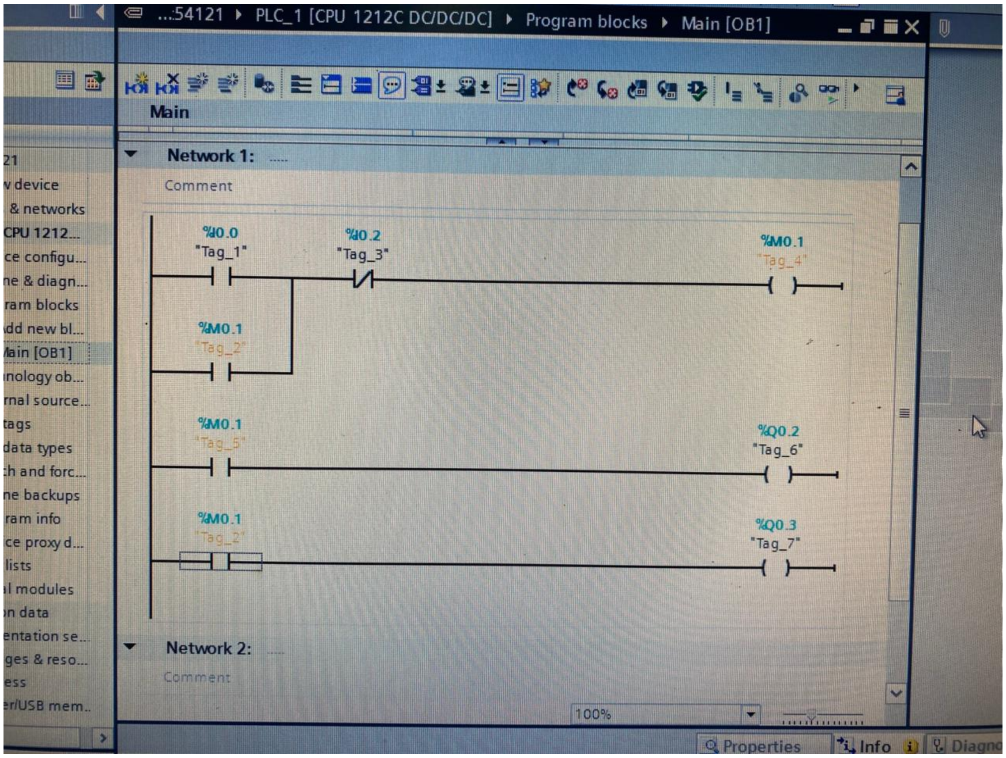

Figure 1: Simple Demonstration of Using Memory Bits

Additional details: Ensure the ladder logic incorporates memory bits to latch the outputs for the main contactor and pumps. Test the system by simulating the start and stop button presses to verify the latching and unlatching functionality.

4 Experimental Work

The experiment focuses on controlling a main contactor and two pumps (Pump A and Pump B) using a PLC with a ladder diagram that employs memory bits for output latching. The setup includes:

- A start button that, when pressed, activates the main contactor, Pump A, and Pump B. Memory bits ensure these outputs remain on even after the start button is released.
- A stop button that deactivates all outputs (main contactor, Pump A, and Pump B), resetting the system.

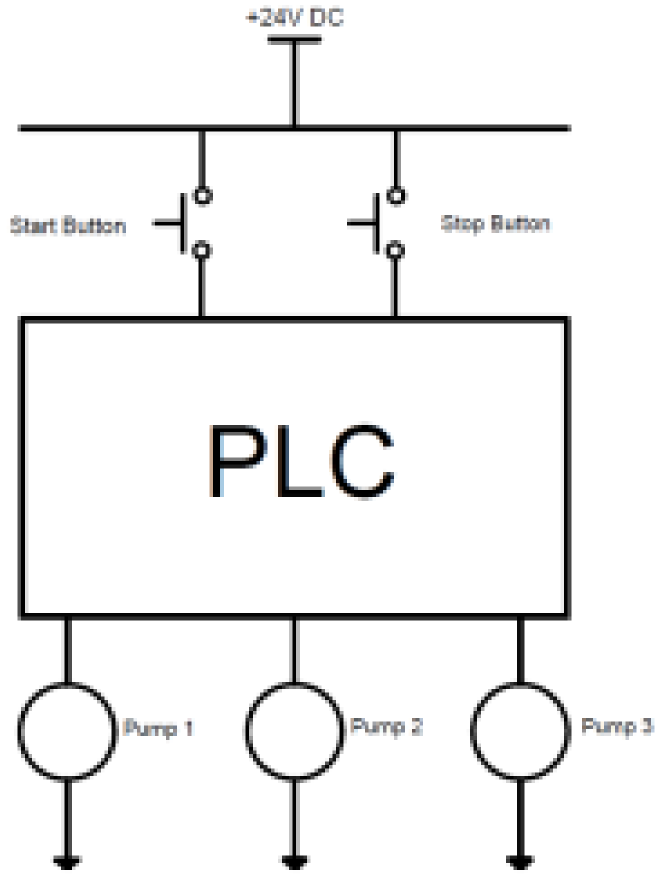

Figure 2: Pump Operation Using Memory Bits

Additional details: The use of memory bits ensures continuous operation of the pumps until the stop button is pressed, demonstrating a practical application of latching in industrial control systems. Monitor the PLC's input/output status to confirm proper latching behavior.

5 Discussion

The experiment, titled "Demonstrating the Concept of Using Memory Bits in Output Latching Technique," successfully utilized a Siemens S7-1200 PLC Module or LOGO PLC, programmed via TIA Portal or LOGO Soft Comfort, to design a ladder logic circuit. The circuit latched a main contactor and two pumps (Pump A and Pump B) using a start button, maintaining their state through memory bits until the stop button was pressed. This demonstrated reliable latching and unlatching, mirroring real-world pump control systems, such as those in water treatment or industrial automation, where continuous operation is required until an explicit stop command is issued.