LABORATORY PROJECT REPORT 5 :

Programmable Logic Controller (PLC) Interfacing

MCTA 3203

SEMESTER 2, 2024/2025

Date of submission : 13 April 2025
Group : 10
Section : 1

NO.	NAME	MATRIC NO.
1.	MUHAMMAD FAIZ BIN MD RIZAM	2229695
2.	ISMA ASYRAF BIN MOHD HAFIDZ	2210105
3.	MUHAMMAD ARIEF ZULKARNAIN BIN ABDUL RAHMAN	2217275

Table of Contents

Abstract

A Programmable Logic Controller (PLC) is an industrial computer that automates and controls electromechanical processes in factories, machines, and other settings. This lesson focuses on using the OpenPLC Editor to design a Start-Stop Control Circuit with a ladder diagram. The ladder diagram is compiled, simulated, and then uploaded to an Arduino board for implementation. The circuit's functionality, including pin configuration, is presented and explained, highlighting the integration of PLC programming with microcontroller platforms to improve automation possibilities.

Introduction

Programmable Logic Controllers (PLCs) are essential components of modern industrial automation, providing strong and adaptable tools for regulating electromechanical processes in a wide range of applications. These controllers are extensively used in manufacturing plants, automated machinery, and other industrial systems that require high precision and reliability. With technological improvements, merging PLCs with microcontrollers has become a popular technique for expanding functionality, improving performance, and streamlining processes.

This webinar focuses on the OpenPLC Editor, a powerful software platform for programming and simulating PLCs. By connecting it to a microcontroller, we hope to show how this integration improves the ability to develop, implement, and optimize automation systems.

Materials and Equipment

- Arduino Board
- 2 Push Button Switches
- Jumper Wires
- LED
- Resistors
- OpenPLC Editor software

Experimental Setup

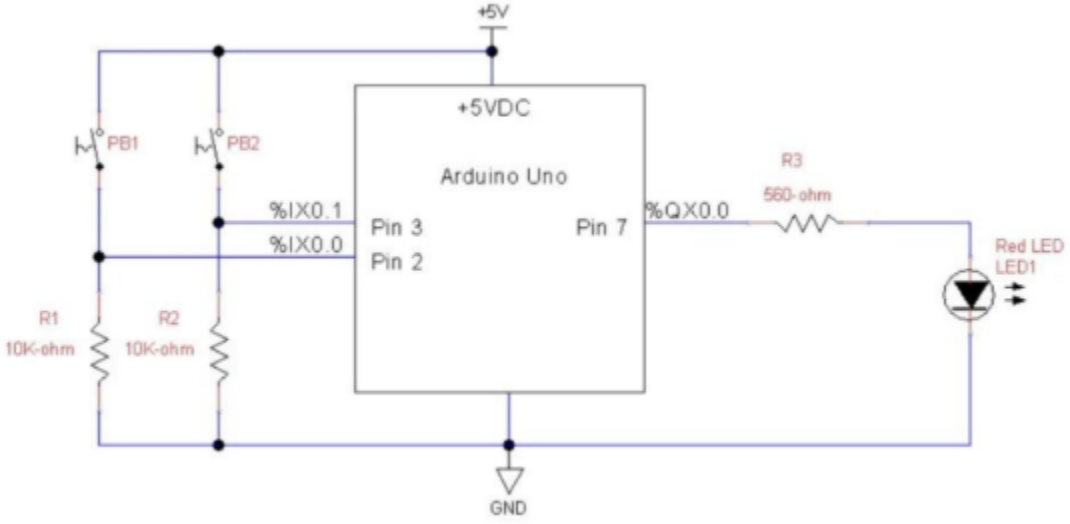
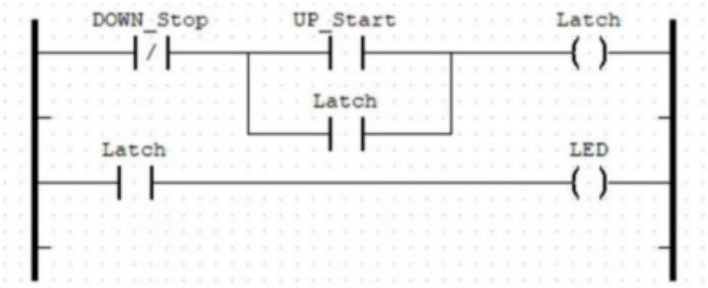


Figure 1 : Start-Stop Control Circuit



#	Name	Class	Type	Location
1	UP_Start	Local	BOOL	%IX0.0
2	DOWN_Stop	Local	BOOL	%IX0.1
3	Latch	Local	BOOL	
4	LED	Local	BOOL	%QX0.0

Documentation
Will Turn ON the LED
Will Turn OFF the LED
Latch Bit Instruction
Output indicator for Latch_Unlatch Program

Figure 2 : Ladder Diagram for Start-Stop Control Circuit

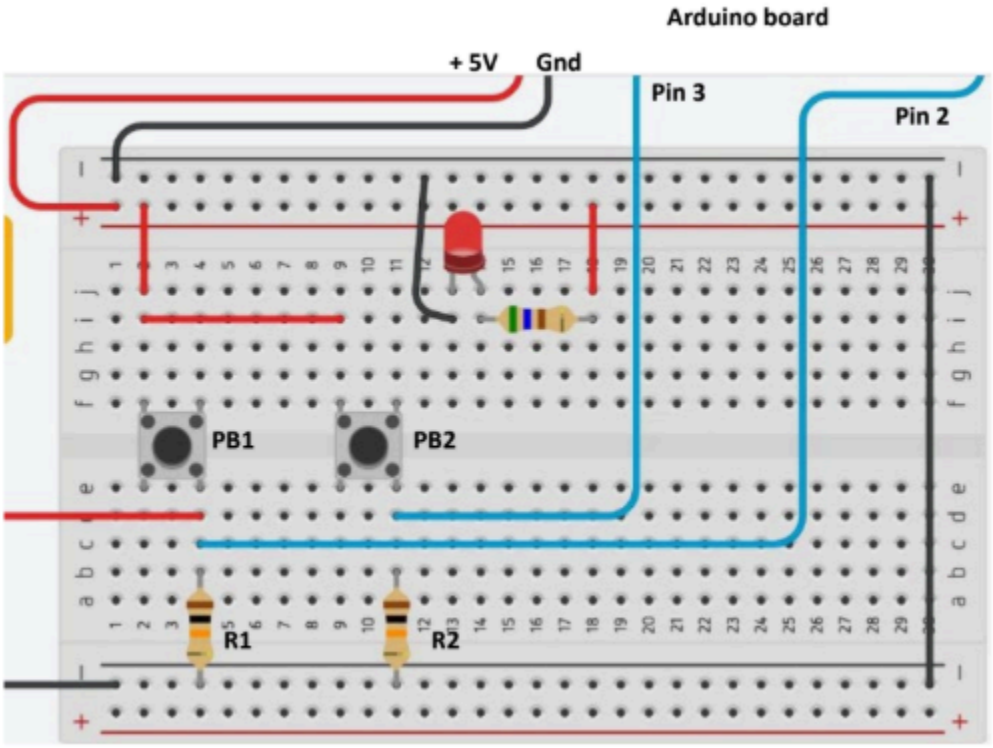


Figure 3

Methodology

1. Create the ladder diagram shown in Fig. 2
2. Specify all variables used in the ladder diagram.
3. Compile and simulate the ladder diagram in OpenPLC Editor.
4. Upload the ladder diagram to the Arduino board.
5. Ensure the selection of the correct COM port number and all pin associations between the OpenPLC variables and the Arduino board.
6. Build the circuit as shown in Fig. 3
7. Test the functionality.

Result

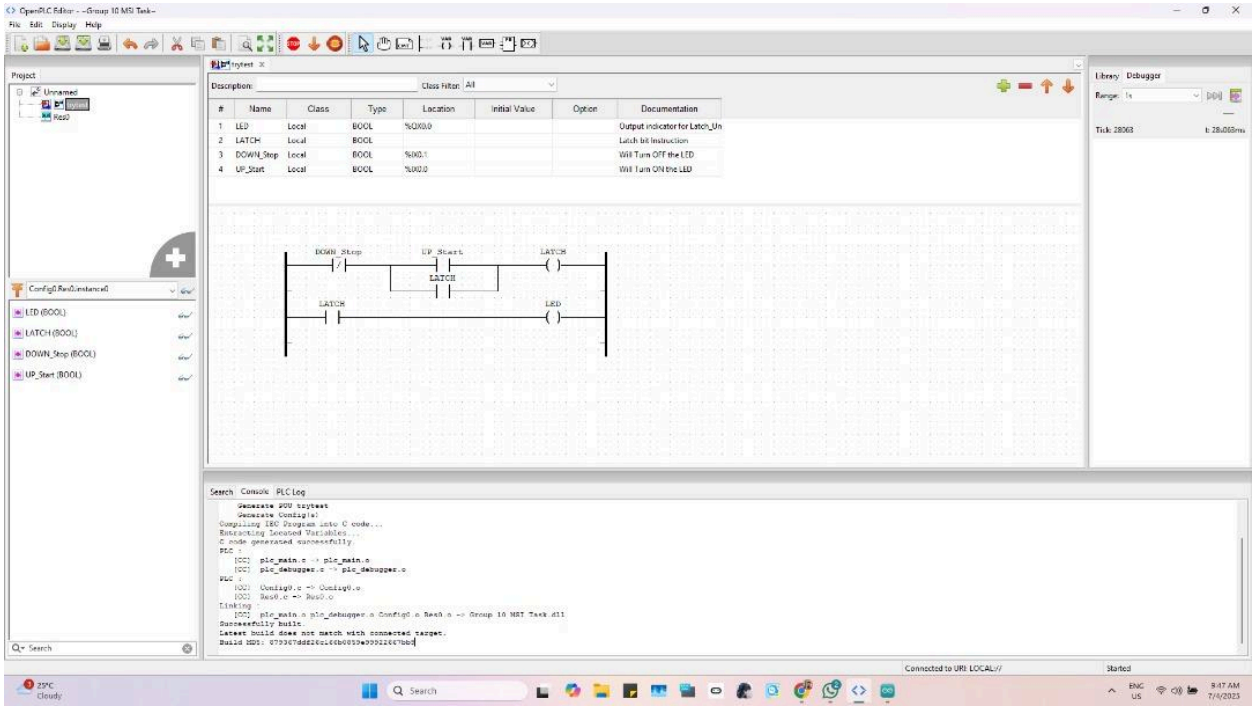


Figure 4

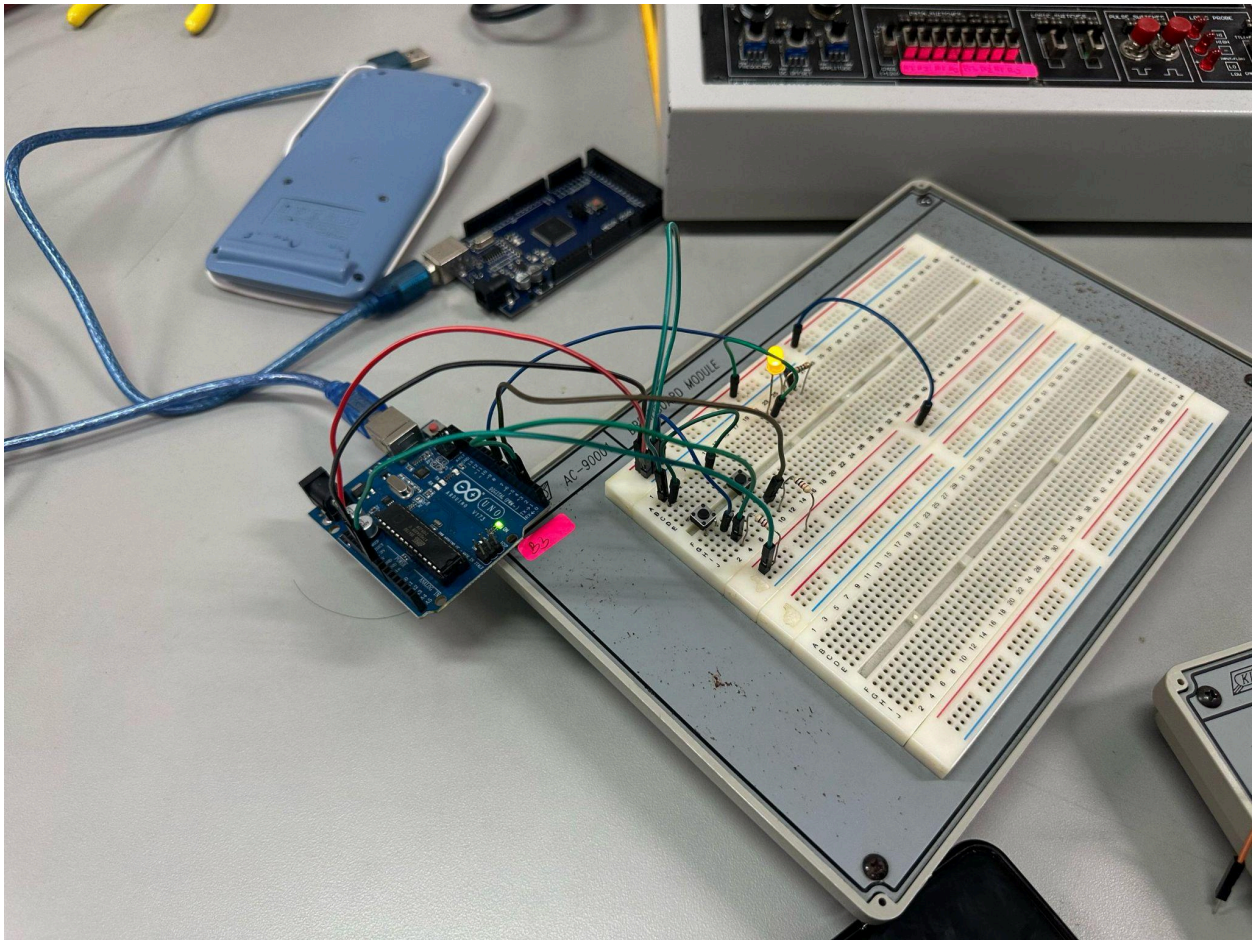


Figure 5

Discussion

In this experiment, we investigated the hardware and software requirements for efficient interface between microcontrollers and Programmable Logic Controllers (PLC). This

configuration is crucial for contemporary industrial automation, which calls for a combination of flexible, affordable microcontroller solutions and strong control from PLC.

Developing dependable and transparent communication protocols is one of the main obstacles in PLC-microcontroller interfacing. Microcontrollers typically use protocols like I2C, SPI, UART, or custom serial communication, whereas PLC typically use Ethernet/IP, Profibus, or Modbus. Programming modifications and, occasionally, extra hardware for signal conditioning are needed to close this gap. For example, to avoid possible damage to the microcontroller, it is crucial to make sure that the voltage levels between the two devices match.

On the software side, programming was an essential part of the process. Writing custom code to interpret data correctly on both the PLC and microcontroller was a learning-intensive process, as PLC and microcontrollers typically use different programming languages and environments (ladder logic for PLC, while C/C++ or assembly for microcontrollers). This part of the experiment highlighted the importance of understanding how each system processes commands and data

Error handling and troubleshooting proved crucial during testing. Debugging involved tracking signal timing discrepancies and interpreting unexpected behaviour that sometimes stemmed from timing mismatches or data loss between the devices. Integrating error handling in the software made it easier to identify where faults occurred in the communication pipeline.

This experiment provided valuable insight into the compatibility and flexibility issues that can arise when interfacing different control systems, underscoring the importance of comprehensive knowledge in both hardware and software aspects. By addressing these complexities, we gained a stronger foundation in control system design, paving the way for more robust applications in automated and industrial environments.

Conclusion

In conclusion, this experiment successfully implemented the integration of a PLC with a microcontroller to realize the Start-Stop Control Circuit. This allowed us hands-on experience in learning the basics of PLC programming and interfacing it with a microcontroller. The experiment has proven the effectiveness and practicality of using ladder logic in control processes and the versatility of Arduino in handling programs based on PLC. The Start-Stop Control Circuit worked just fine, and the Arduino responded to the simulated start and stop commands with high accuracy. Overall, this exercise gave a very clear understanding of the software and hardware aspects of PLC-microcontroller interfacing and further solidified the potential of the PLCs in the automation tasks while introducing low-cost means of prototyping industrial control systems.

Recommendation

Enhancement of ladder diagram complexity by breaking down the ladder diagram into smaller, reusable modules or subroutines. This approach can simplify troubleshooting and allow for easier expansion of the control system in future experiments. Besides, we can utilize more advanced simulation features within the Open PLC Editor to test complex scenarios and ensure the ladder diagram behaves as expected under various conditions. Students need to ensure all electrical connections are secure and insulated to prevent short circuits or accidental disconnections. Use appropriate protective equipment when handling electrical components.

Acknowledgment

A special thank you to Dr. Wahju Sediono and Dr. Zulkifli Bin Zainal Abidin, my teaching assistant, and peers, for their outstanding assistance and support in completing this report. Their advice, input, and expertise have had a significant impact on the quality and comprehension of this work. Their time, patience, and dedication to my academic progress are deeply appreciated.

References

Weekly Module - Google Drive. (n.d.). Google Drive.

https://drive.google.com/drive/folders/1rq0wLF6mA7jEoNsPWyAbWR9n0X3SQsQz?usp=sharing

Student's Declaration

Certificate of Originality and Authenticity

This is to certify that we are responsible for the work submitted in this report, that the original work is our own except as specified in the references and acknowledgement, and that the original work contained herein have not been untaken or done by unspecified sources or persons.

We hereby certify that this report has not been done by only one individual and all of us have contributed to the report. The length of contribution to the reports by each individual is noted within this certificate.

We also hereby certify that we have read and understand the content of the total report and no further improvement on the reports is needed from any of the individual's contributors to the report.

We therefore, agreed unanimously that this report shall be submitted for marking and this final printed report has been verified by us.

Name : Muhammad Faiz bin Md Rizam

Matric Numbers : 2229695

Signature :

Read	Understand	Agree
/	/	/

Name : Isma Asyraf bin Mohd Hafidz

Matric Numbers : 2210105

Signature :

Read	Understand	Agree
/	/	/

Name : Muhammad Arief Zulkarnain bin Abdul Rahman

Matric Numbers : 2217275

Signature :

Read	Understand	Agree
/	/	/