MCTA 3203

MECHATRONIC SYSTEM INTEGRATION

SECTION 1

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LAB REPORT 5:

PLC INTERFACING

GROUP 2

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ABSTRACT

This lab explores PLC programming using the OpenPLC Editor and Arduino microcontrollers. Students create and simulate a basic ladder diagram to control a blinking LED, then upload the program to an Arduino. The experiment also includes modifying the diagram to adjust the LED's blinking interval using timers and developing a Start-Stop control circuit. This hands-on exercise highlights the integration of PLC software and hardware in automation systems.

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INTRODUCTION

Programmable Logic Controllers (PLCs) are key components in industrial automation, enabling the control and monitoring of electromechanical processes across various applications, from manufacturing plants to complex machinery. The OpenPLC Editor is an open-source software that facilitates the design of PLC programs using ladder logic, a graphical programming language that mimics relay control circuits. This lab focuses on understanding the interaction between PLC software and microcontroller hardware by creating and simulating a ladder diagram in the OpenPLC Editor to control an LED connected to an Arduino.

In this exercise, the ladder diagram is first used to implement a simple LED blinking program, which is then transferred to the Arduino board for real-world operation. The lab further explores the use of timer blocks to modify the blinking interval, allowing for greater control over the timing functions. To enhance the learning experience, a Start-Stop control circuit is also developed, demonstrating how PLC programming can be applied to basic control systems. This lab provides insight into how PLCs can interface with microcontrollers, offering a practical foundation for understanding industrial automation and control systems.

MATERIAL AND EQUIPMENT

ITEM	AMOUNTS
OPEN-PLC EDITOR SOFTWARE	1
ARDUINO BOARD	1
PUSH BUTTON SWITCHES	2
SET OF JUMPER WIRES	1
LED	1
RESISTORS	1
BREADBOARD	1

EXPERIMENTAL SETUP

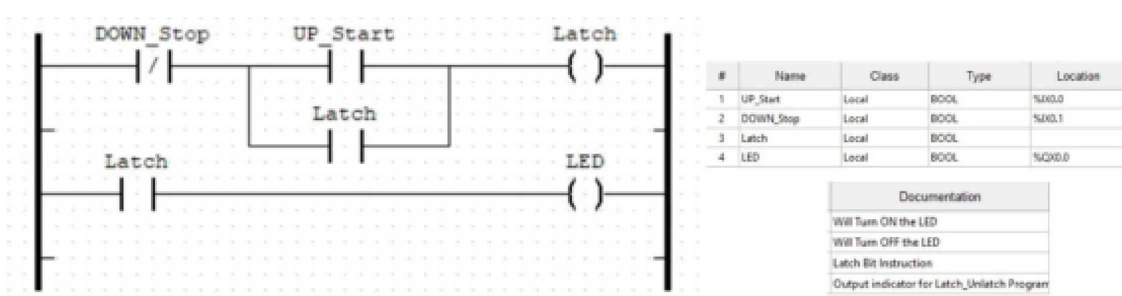


Fig. 5: Ladder Diagram for the Start-Stop Control Circuit

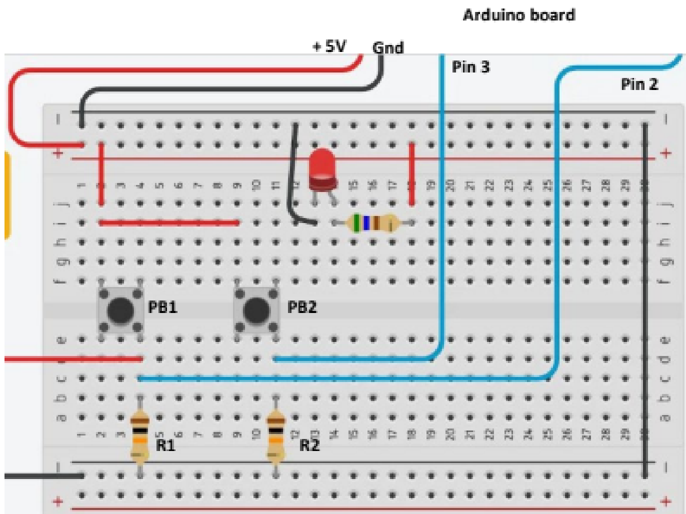
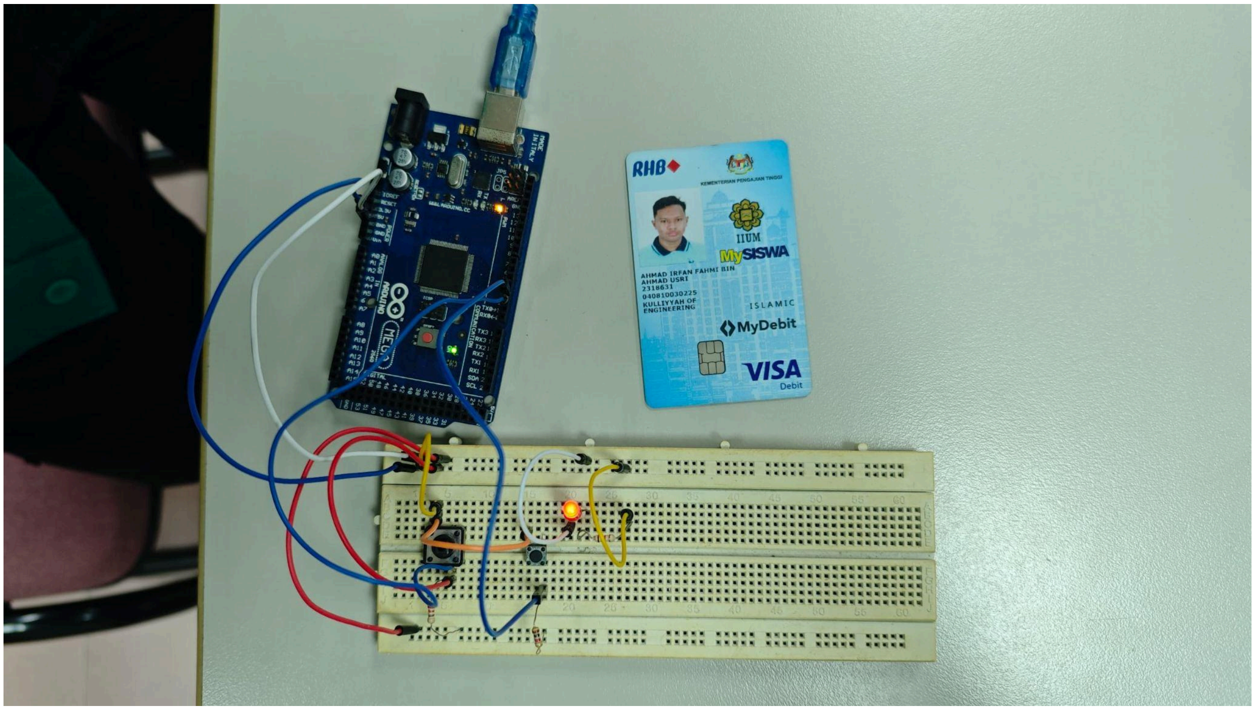


Fig. 6

METHODOLOGY

1. Create the ladder diagram shown in Fig. 5.
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. 6.
7. Test the functionality.

RESULT



VIDEO DEMONSTRATION:
https://github.com/Irfanf248/MSI-GROUP2-EXPERIMENT-Week5/blob/main/video%20exp5.mp4

DISCUSSION

The PLC-microcontroller interface experiment bridges theoretical automation principles with real-world electromechanical applications and provides a crucial investigation into the cooperation between software-based control systems and physical hardware. The exercise highlights the fundamental ideas of industrial automation—programmable logic, real-time control, and hardware integration—within an approachable, instructive framework by utilising the OpenPLC Editor and Arduino platform. Fundamentally, the experiment demonstrates how ladder logic, a mainstay of industrial PLC programming, can be modified for use with microcontrollers, democratising intricate automation techniques for small-scale systems and prototyping.

The experiment uncovered the workflow of designing, simulating, and deploying ladder diagrams. The OpenPLC Editor acts as a virtual testing ground, allowing users to model logic and confirm functionality before physical implementation. This simulation phase not only mitigates errors but also reinforces the importance of iterative design in automation engineering. Transitioning from simulation to hardware deployment via Arduino introduces critical considerations such as variable-to-pin mapping, addressing conventions (e.g., %QX0.0 for digital outputs), and microcontroller compatibility. These steps emphasize the precision required in translating abstract logic into hardware behavior, where even minor misconfigurations (e.g., incorrect COM port selection or grounding issues) can disrupt system performance.

Additionally, the project sheds light on more general automation concerns like scalability and reliability. The use of timer blocks to modify LED intervals, for example, is similar to real-world applications where timing functions control safety delays or machinery cycles. Similar to this, the start-stop circuit exercise, however simplified, mirrors industrial safety procedures by showing how logic may enforce user inputs and operational states.Together, these activities show how PLC concepts which were previously limited to industrial panels are becoming more and more important in the development of robotics, IoT, and smart devices

In the end, the experiment fosters a dual competency in software logic and hardware interfacing, equipping learners with problem-solving skills to troubleshoot integration challenges. By merging the abstract (ladder diagrams) with the concrete (circuit assembly), it demystifies automation systems, preparing students to innovate in fields where control, precision, and adaptability are paramount. This hands-on approach not only demystifies industrial PLC applications but also underscores the growing convergence of microcontroller versatility and PLC reliability in modern engineering solutions.

CONCLUSION

The PLC interfacing experiment with microcontrollers exemplifies the critical intersection of software logic and hardware execution in modern automation systems. By employing the OpenPLC Editor and Arduino platform, the exercise demonstrated how ladder logic—a cornerstone of industrial PLC programming—can be adapted to control physical components like LEDs and push-button circuits. This hands-on approach illuminated the workflow of automation engineering: from designing and simulating ladder diagrams to deploying and testing programs on microcontroller hardware.

Key takeaways include the necessity of precise variable-to-pin mapping, the role of simulation in preempting errors, and the adaptability of PLC principles to microcontroller environments. Tasks such as adjusting timer intervals for LED blinking and configuring a start-stop control circuit underscored the importance of timing functions, latching logic, and fail-safe design—elements vital to real-world industrial applications. The experiment also highlighted the challenges of hardware integration, such as addressing conventions and signal stability, reinforcing the need for meticulous troubleshooting.

Ultimately, this exercise bridges theoretical automation concepts with tangible implementation, equipping learners with skills relevant to robotics, IoT, and smart manufacturing. By merging the abstract logic of ladder diagrams with the physicality of circuits, it underscores the growing convergence of PLC reliability and microcontroller flexibility, preparing students to innovate in an era where automation and precision are indispensable.

RECOMMENDATION

To manage complexity in ladder diagrams, it's effective to break them into smaller, reusable modules or subroutines. This modular approach makes troubleshooting more efficient and allows for easier upgrades or expansions in future experiments.

Utilizing the advanced simulation features available in the OpenPLC Editor enables testing under a variety of conditions, helping ensure the control system operates reliably in real-world scenarios.

In addition to design improvements, safety remains essential. Students must ensure all electrical connections are properly secured and insulated to avoid short circuits or accidental disconnections. The use of appropriate personal protective equipment is also critical when working with electrical systems.

REFERENCES

1.https://autonomylogic.com/
2.https://control.com/technical-articles/plc-ladder-logic-on-an-arduino-introduction-to-openplc/
3.https://control.com/technical-articles/plc-ladder-logic-on-an-arduino-building-a-start-stop-ircuit/

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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.**

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