KULLIYYAH OF ENGINEERING (KOE)

MECHATRONICS SYSTEM INTEGRATION (MCTA3203)

SEMESTER 1, 24/25

SECTION 1

PROJECT REPORT WEEK 5

TITLE : PLC INTERFACING

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ABSTRACT

This lab report describes how to interface PLCs with Arduino Uno microcontrollers using the OpenPLC Editor to simulate and install control systems. The tasks include creating ladder diagrams for applications such as LED blinking and Start-Stop Control Circuits, simulating their functioning, and uploading the settings to an Arduino microcontroller. Practical outcomes include investigating timer blocks with adjustable delays and push-button-based control circuits. This experiment demonstrates the value of PLCs in electromechanical process automation and lays the groundwork for designing and implementing automated systems in industrial applications.

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INTRODUCTION

This experiment uses the OpenPLC Editor to interface Programmable Logic Controllers (PLCs) with Arduino Uno microcontrollers to create automated systems. The lab explains the fundamentals of ladder diagram programming, simulation, and deployment on an Arduino Uno microcontroller. The main goal is to build basic control circuits, such as blinking LEDs and a Start-Stop Control Circuit, to demonstrate PLC automation ideas. These exercises provide students with hands-on experience with industrial control applications, such as the integration of software and hardware for real-world system automation.

MATERIALS AND EQUIPMENTS

1. Arduino Uno R3
2. Jumper Wires
3. Two Push-Buttons Switches
4. LEDs
5. Breadboard
6. Resistor
7. OpenPLC Editor software

EXPERIMENTS SETUP

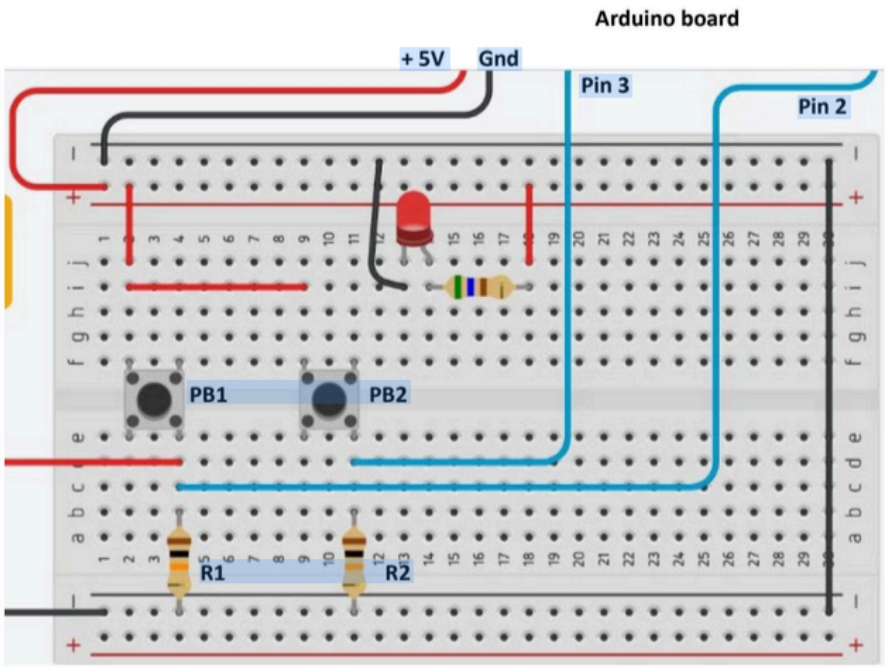

Fig. 6

METHODOLOGY

The OpenPLC software is used to set up and test a Programmable Logic Controller (PLC) interface with an Arduino Uno R3 microcontroller. The experiment is done by creating and simulating a ladder diagram that is able to replicate a simple LED blinking circuit, which is then used to construct a Start-Stop Control circuit.

CODING

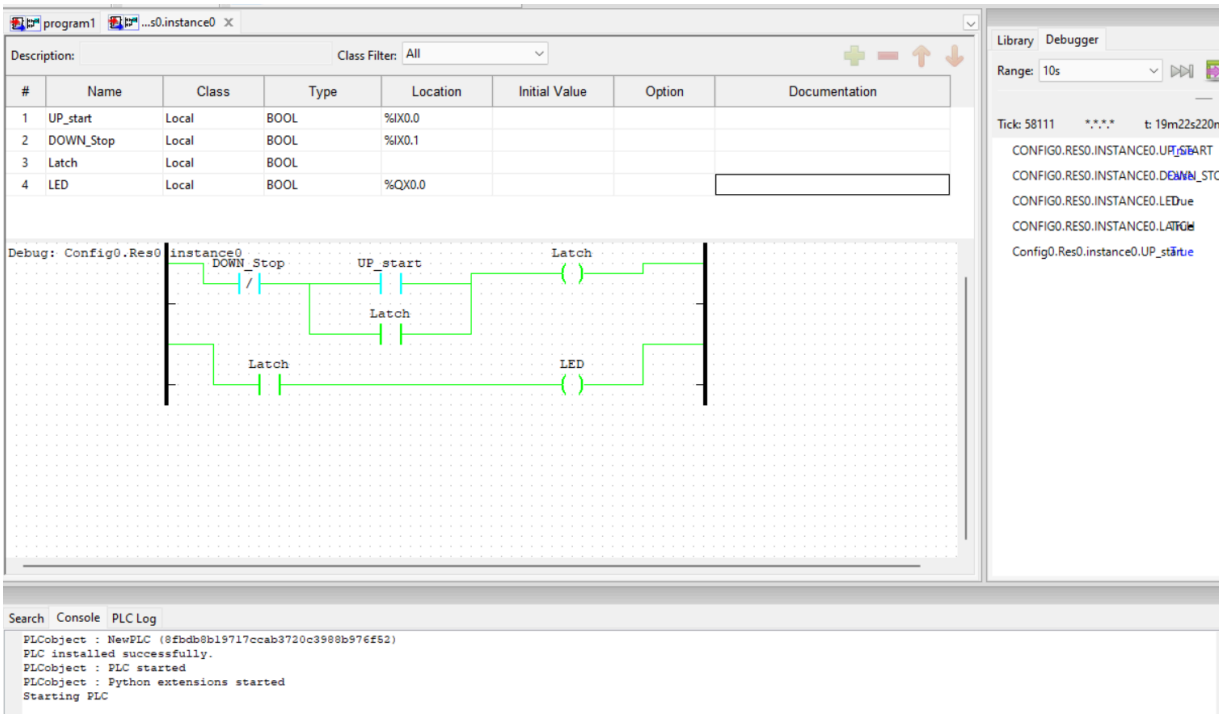

Fig. 7: Ladder Diagram

The ladder diagram and variables are to be set up as the following. This will replicate a Start-Stop control circuit where pressing the UP_start button will only light up the LED, while the DOWN_Stop button will turn off the circuit and LED.

PROCEDURES

1. The circuit is set up as shown in Fig. 6.
2. A ladder diagram is created on OpenPLC Editor as shown in Fig. 7.
3. Once all variables are specified, the ladder diagram is simulated to ensure the experiment setup is correct.
4. The Arduino Uno R3 is then connected to the laptop, and then the ladder diagram is compiled and uploaded to the Arduino Uno R3 via the COM port.
5. The circuit tested on the breadboard must be the same as the simulated circuit in the PLC.
6. The circuit is observed by pressing and releasing the UP_Start and DOWN_Stop pushbuttons.

RESULTS

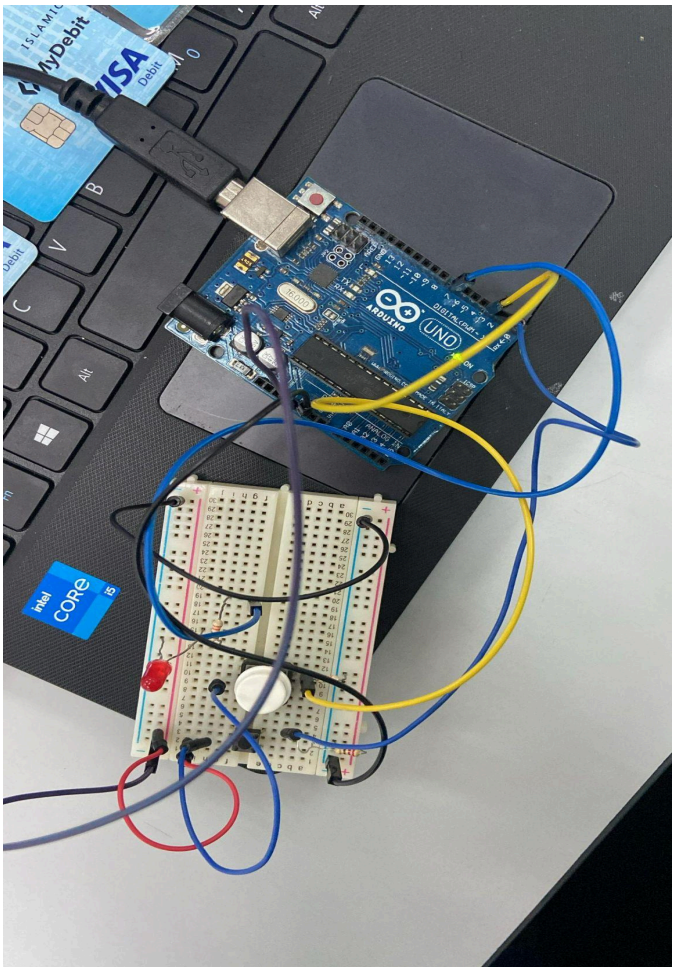

Fig. 8.: Start-Stop circuit.

Fig. 8. shows the Start_Stop circuit. In this experiment, pressing the UP_Start pushbutton activates the LED. The latching feature keeps the LED on even after releasing the pushbutton. When the DOWN_Stop pushbutton is pressed, the circuit and LED turns off.

DISCUSSIONS

- **Software**

The Start-Stop control circuit was developed by creating a ladder diagram in OpenPLC Editor, based on the design shown in Fig. 5. All necessary variables were specified, and the diagram was successfully compiled and simulated in OpenPLC. The compiled ladder diagram was then uploaded to the Arduino, ensuring the correct COM port was selected and the OpenPLC variables were properly mapped to the corresponding Arduino pins. The circuit was built according to the diagram in Fig. 6, and after testing, the Start-Stop control system functioned as expected.

- **Electrical**

The circuit shows that the PB1 and PB2 are connected to pins 2 and 3 on the Arduino Uno board. Pulldown resistors linked to the pushed button act to ensure that the input pins read a steady LOW when the button is not pressed. When the buttons are pressed, they operate as digital input devices, sending HIGH signals to the respective pins. The resistor in series with the LED inhibits excessive current flow, which protects the LED and circuit components from overheating and damage.

· **Hardware**

The Start-Stop control circuit worked as expected, but to improve reliability, it’s recommended to use high-quality switches and relays, as these can wear out over time. Adding debounce circuits for the switches could reduce noise and prevent false triggers. Using sturdy wiring and connectors will ensure stable connections. Additionally, using optical isolators could help protect the system and improve performance, especially in industrial environments.

Questions:

Develop a Start-Stop Control Circuit by using ladder diagram created in OpenPLC, compile, simulate and transfer the ladder diagram program to Arduino Board. The circuit with pin configuration is shown in Fig.4 below

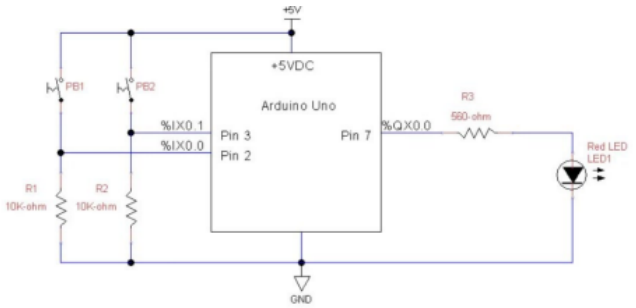

Fig. 4: Start-Stop Control Circuit

Answers :

Firstly, we assembled the Start-Stop Control Ciruit, following the layout in Fig. 4 that connects various components like push-buttons, resistors, and an LED to an Arduino Uno microcontroller. The circuit setup included connecting two push-button switches: one is configured as the start button to light up the LED while the other as the stop button to break the circuit which turns off the LED. The LED is an indicator if the circuit is active or inactive, and the Arduino Uno serves as the controller, coordinating the start-stop actions based on the ladder logic program from OpenPLC editor. The resistors were used to prevent any fluctuations of current flowing through the circuit.

CONCLUSION

In this experiment, we successfully established an interface between a Programmable Logic Controller (PLC) and an Arduino Uno microcontroller, using the OpenPLC software as the programming and simulation environment. The goal was to create a basic electric circuit, which is a start-stop control circuit diagram. In experiment 5, we mainly focused on designing and implementing a simple start-stop control circuit. Using OpenPLC, a ladder diagram representing the start-stop control logic was constructed and configured the necessary input and output variables. The setup includes two push-buttons, one to start the circuit while the other to stop the circuit. The experiment provided in the manual is to understand how PLC interfacing with a microcontroller.

RECOMMENDATIONS

For future projects, explore the advanced functions in the OpenPLC. This is because it can be used to further build more versatiles control applications on the microcontroller and understand the control deeper. Beside this, enhance and clarify the documentation and diagram clarity, when working with complex projects add more labels and comments for each step to help with troubleshooting, especially when collaborating or revisiting the project.

ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. Wahju Sediono, Dr. Ali Sophian, Dr. Zulkifli Bin Zainal Abidin, for providing the necessary resources and facilities to conduct this and support throughout the duration of the project. Additionally, we extend our appreciation to all individuals who contributed to the success of this lab report through their valuable insights and feedback.

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 that no further improvement on the reports is needed from any of the individual contributors to the report.

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