KULLIYAH OF ENGINEERING

DEPARTMENT OF MECHATRONICS ENGINEERING

Lab Report

MCTA 3203

SECTION 1

GROUP E

EXPERIMENT 5

PLC Interfacing with Microcontrollers and PCs over Ethernet/IP: Understanding both software and hardware aspects of PLC interfacing.

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Abstract

Programmable Logic Controller or PLC is known as a specialized industrial computer used for automating processes, particularly in manufacturing environments. PLCs are programmable and can control a wide range of machinery and processes.For example, in a manufacturing plant, a PLC might be used to control the assembly line, managing tasks such as controlling robotic arms, monitoring sensors, and ensuring that each step in the production process occurs in the correct sequence.

Arduino refers to an open-source electronics platform based on easy-to-use hardware and software. It consists of a programmable circuit board (microcontroller) and a development environment, making it accessible for hobbyists, students, and professionals to create interactive electronic projects. Arduino boards are widely used for prototyping and building various electronic devices due to their simplicity and versatility.

In this modern world, we can interface the PLC with the arduino to create something useful for all. There are various applications of PLC with Arduino that we can do, and of it is by using OpenPLC software.

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Introduction

Arduino microcontrollers and programmable logic controllers (PLCs) are now essential parts of automation and control systems. They offer flexible platforms that enable the design and implementation of a broad range of applications, ranging from home automation to industrial automation, and they enable the control and monitoring of numerous devices and processes. By combining these two potent technologies, this experiment seeks to combine the advantages of PLCs and Arduino, producing a flexible and affordable solution for control and automation Tasks.

We are going to explore the benefits and features of both PLCs and Arduino in this experiment, as well as how they may complement one another to solve practical automation problems. We can take advantage of both the flexibility and programmability of the Arduino and the powerful industrial control capabilities of the PLC by linking these two components. This combination creates new and interesting opportunities for designing efficient, flexible control systems that are tailored to individual requirements.

Upon completion of this experiment, we will possess the skills and knowledge necessary to take on challenging automation jobs in a variety of industries and applications. We will also have a stronger understanding of how to construct advanced control systems that take advantage of the capabilities of both PLCs and Arduino. This integration is a significant advancement in the field of automation and control, making it a useful ability for technicians, engineers, and enthusiasts alike.

Materials and Equipment

Material needed:

1. OpenPLC Editor software
2. Arduino Board
3. 2 Push Button Switches
4. Jumper Wires
5. LED
6. Resistors
7. Breadboard

Equipment:

1. Computer with OpenPLC Editor software for ladder diagram construction

Experimental Setup

1. A ladder diagram was created as shown in Fig. 1.
2. All variables used have been specified in the ladder diagram.
3. The ladder diagram has been compiled and simulated in OpenPLC Editor.
4. The ladder diagram was uploaded to the Arduino board.
5. COM port number and all pin associations between the OpenPLC variables and Arduino board have been correctly ensured.
6. A circuit was built as shown in Fig. 2.
7. The functionality has been tested

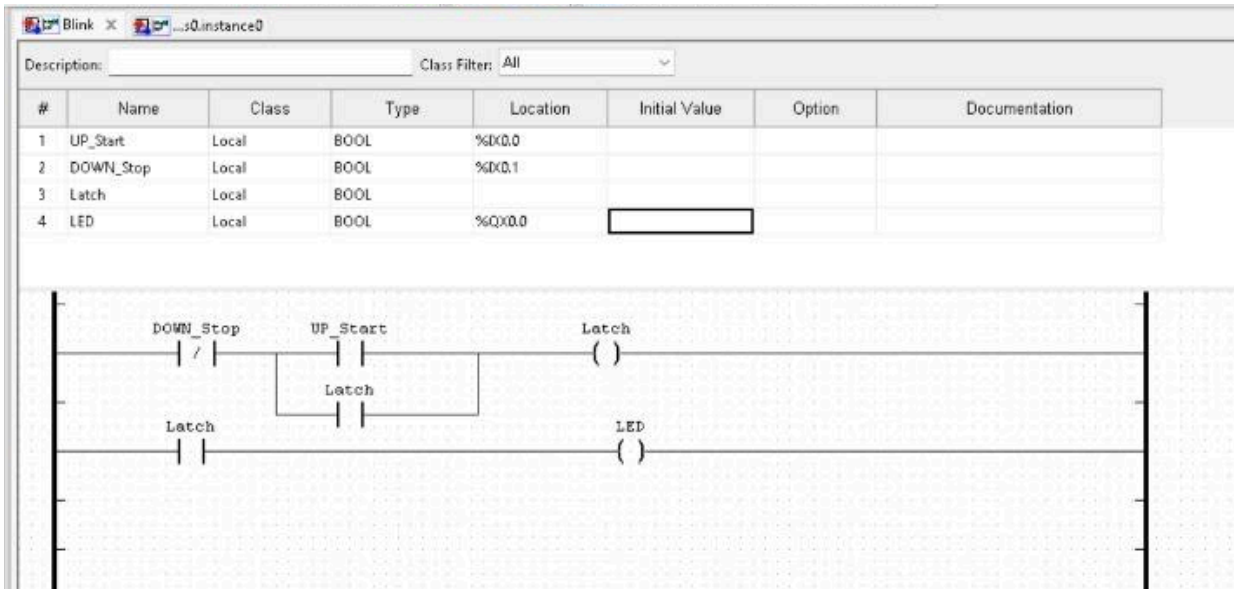

Fig. 1

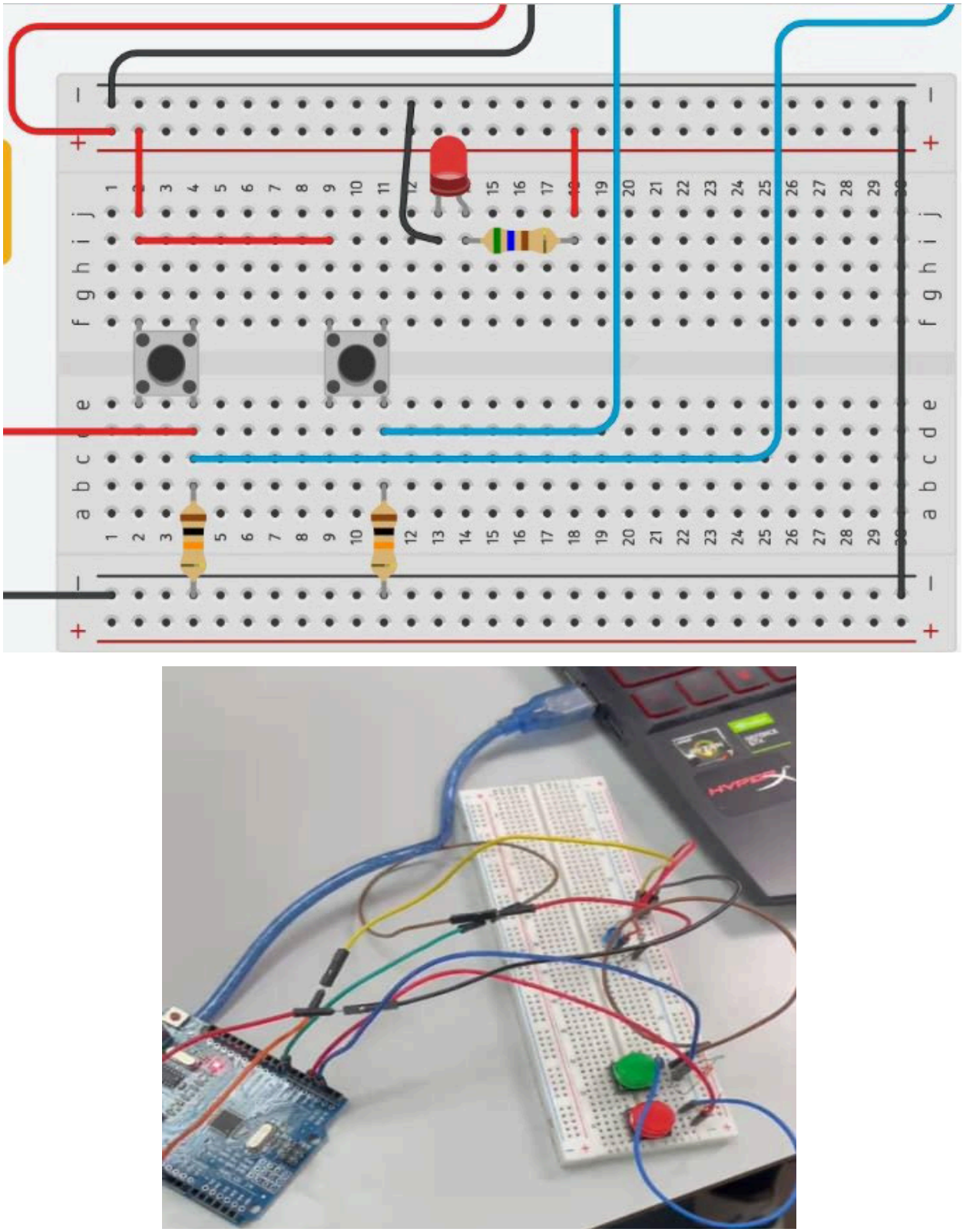

Fig. 2

Methodology

Procedures:

1. Started a new project (File → New → New Folder and named it → Selected Folder)
2. The project was named in the Create a new POU pop-up window, and the language was selected as LD (ladder diagram).
3. We pressed the button  to create a new variable and name it. (Class Filter was set to local and Type was BOOL).
4. We started creating the Ladder Diagram by right-clicking and choosing Add.
5. The Left the Right power rails, Contact (negated), and Coil were created as shown in Fig.2.
6. Once the ladder diagram was created, it was compiled by clicking the icon  .
7. The blinking-led simulation was now seen in the editor.
8. The variables that were created in the Ladder Diagram were associated with the LED pin on the Arduino board. You can check the associated pin between open PLC variables and various types of microcontrollers from the OpenPLC Editor website. On the Documentation menu, I chose OpenPLC Runtime and then Physical Addressing. The correct microcontroller type and digital out pins were referred to.
9. Using an Arduino Mega board, the LED was connected to pin no. 14, the associated Digital Out pin on the OpenPLC Editor was %QX0.0. This needed to be typed into the Location of the variable in the editor.
10. The Arduino board was connected to your laptop and the COM port number was noted.
11. Once connected, the ladder diagram program was compiled to the Arduino board by clicking the icon  . A window popped up, I selected the correct board, typed in the correct COM port number, and proceeded by pressing the Transfer to PLC button.
12. The LED was now blinking according to the written ladder diagram program.

Results (Observation)

Once the ladder diagram program is compiled to the Arduino board, the LED will blink according to the button pressed. If the left button is pressed, the LED will turn on and if the right button is pressed, the LED will turn off.

Link for the video:
https://drive.google.com/file/d/1-W2y0N0557VkMqipbylo9aZ508gwKQ4W/view?usp=drive_link

Discussions

Effective functioning was shown by the OpenPLC-designed and simulated start-stop control circuit in both the Arduino board and the simulation environment. The logic needed to start and stop a process was faithfully depicted in the ladder diagram that was made with OpenPLC.

It was discovered after close inspection that the Arduino board's start-stop control circuit reacted quickly to both real and simulated button pushes. For applications needing exact control over the start and stop of operations, this responsiveness is essential. The implementation of the ladder diagram on the Arduino platform demonstrated the control logic's versatility and dependability.

A noteworthy feature of the conversation is the contrast between simulation and real-world application. Although the simulation environment offered a regulated environment for testing the ladder logic, switching to the Arduino board raised new issues including hardware limitations and delays in the real world. Understanding any discrepancies between simulation and real results helped us better understand the behaviour of the circuit and identify possible areas for improvement.

Conclusion

To sum up, this experiment demonstrated how to use a ladder diagram in OpenPLC software to implement a start and stop control circuit in a realistic way, highlighting its use in industrial automation. We now know more about how to combine PLC hardware and software components with microcontrollers. The built-in circuit, designed to control an LED, responded to the On and Off buttons reliably. When the On button was pressed, the linked circuit was successfully latching, causing the LED to light continuously until the Off button was pressed, which caused the circuit to disengage and leave an open circuit on the breadboard.

The experiment also highlighted important aspects of electronic integrated circuits, such as feedback mechanisms and reaction times. The circuit's dependability for real-time control applications was shown by its quick reaction time. Furthermore, timers were used in previous studies to demonstrate how the OpenPLC software functions, enabling users to reset them in accordance with experimental results. Short-duration timers demonstrated how quickly and in real-time the program can handle received data. The push buttons' successful operation highlighted the Arduino, circuit, and software's efficient integrated feedback mechanism.

Recommendations

We can investigate adding a wider range of components to our ladder system in order to increase the effectiveness of our experiment. Our programmable codes may be made more capable by adding more components like servo motors, switches, resistors, and numerous LEDs. With this upgrade, we will be able to create a more complex system that can mimic real-world events, such as pedestrian crossing signals, traffic light simulations, and automatic doors with lights and sensors, reflecting useful uses in our everyday lives. In addition, we may advance our experiments by using the PLC software to simulate increasingly complicated systems and circuits in order to investigate more advanced and complex PLC applications.

References

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3. PLC ladder logic on an Arduino: Building a start-stop circuit - technical articles. Control. (n.d.). https://control.com/technical-articles/plc-ladder-logic-on-an-arduino-building-a-start-stop-circuit/

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 acknowledgment, and that the original work contained herein has 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.

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

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