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**LABORATORY REPORT**

**MECHATRONICS SYSTEM INTEGRATION MCTA 3203**

**SEMESTER 2 2023/2024**

**WEEK 5**

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**GROUP: 6**

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Abstract

This project explores the development of a Start-Stop control circuit utilizing ladder logic programmed through the OpenPLC environment and executed on an Arduino Mega 2560. The system incorporates basic control elements such as start and stop push buttons, a latching relay coil, and an LED output. The process involves setting up input and output variables, simulating the ladder diagram within OpenPLC, and uploading the compiled logic to the Arduino. The hardware circuit is then assembled on a breadboard with appropriate pin mapping. This experiment offers hands-on experience in applying PLC concepts to embedded systems, illustrating relay latching behavior, circuit control, and digital I/O handling using Arduino hardware.

Introduction

In the rapidly advancing domain of industrial automation, Programmable Logic Controllers (PLCs) are essential for managing and automating complex electromechanical processes. This project investigates the integration of PLCs with microcontrollers, focusing on the interplay between hardware and software. Using the OpenPLC Editor in conjunction with Arduino, the project highlights key skills in designing, modeling, and implementing ladder logic diagrams for specific control tasks. The experiment involves creating a Start-Stop control circuit, offering practical experience in PLC programming by configuring digital inputs and outputs, assigning physical pins, and analyzing circuit performance. The outcomes underscore the utility of PLCs in diverse automation scenarios, especially when combined with microcontroller platforms to deliver cost-effective and reliable control solutions.

Materials and Equipments

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

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 to select correct COM port number and all pin association between the OpenPLC variables and Arduino board.

6. Build the circuit as shown in Fig. 6.

7. Test the functionality.

Task

Develop a Start-Stop Control Circuit by using ladder diagram created in OpenPLC, compile,

simulate and transfer the ladder diagram program to Arduino Board.

Results

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Data Analysis

Based on the recorded data:

1. When the Start push button (UP\_Start) is pressed, it generates a TRUE signal, enabling current flow through the circuit. This activates the latch and turns the LED ON.
2. After releasing the UP\_Start button, the input no longer remains TRUE. However, due to the latch mechanism, the LED stays ON. This is because the latch provides an alternate current path, maintaining the circuit state without needing the Start button to be continuously pressed.
3. When the Stop push button (DOWN\_Stop) is pressed, the circuit is interrupted or the latch is deactivated, which turns the LED OFF. This action stops the current flow and resets the system state.

Discussion

The experiment successfully demonstrated the practical use of ladder logic for controlling microcontroller-based systems. Both the blinking LED and Start-Stop circuit operated correctly, validating the application of PLC programming principles to simple automation tasks. This project showcases how Arduino, when paired with OpenPLC, can serve as an effective platform for implementing basic control systems.

This approach is scalable and relevant for broader industrial contexts, especially in scenarios where cost-effective automation solutions are needed. However, some challenges encountered include issues with COM port selection and incorrect pin mappings during setup, which could affect communication and circuit performance. Addressing these potential errors is crucial for ensuring reliable operation in real-world applications.

Conclusion

The experiment demonstrated the successful application of OpenPLC software to create, simulate, and implement ladder logic control on an Arduino microcontroller. Both the blinking LED and Start-Stop circuit functioned as intended, confirming that Arduino can be programmed using PLC logic for simple control tasks.

The results highlight the potential for using low-cost microcontrollers in small-scale automation systems, managed through standard PLC methods. This experiment provides a foundational step toward integrating PLC programming into IoT-based environments, where microcontrollers and PLCs can work together to manage smart systems. Overall, it emphasizes the practicality and adaptability of combining traditional control logic with modern embedded hardware.

Recommendations

To enhance the functionality and usability of the system, it is recommended to incorporate additional visual indicators, such as a Status\_LED, to reflect the current state of the latch. This LED would illuminate whenever the latch is active, providing immediate visual feedback regarding the system’s operational status.

Such an addition can be especially useful for operators or maintenance personnel, as it allows for quick diagnosis of the system without the need to monitor the UP\_Start or DOWN\_Stop inputs directly. Implementing status indicators can improve both the reliability and user-friendliness of control systems in practical applications.

Acknowledgements

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Declaration

We hereby declare that the work presented in this report is entirely my own, except where otherwise acknowledged. I affirm that I have adhered to the principles of academic integrity and have not engaged in any form of plagiarism or unethical conduct in the completion of this project. All sources of information and assistance used in this work have been properly cited and acknowledged.