الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue

LABORATORY PROJECT REPORT 3B :
SERIAL COMMUNICATION (SERVO MOTOR)

MCTA 3203

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Abstract

This experiment explores the use of serial communication for controlling a servo motor, focusing on transmitting position data from a microcontroller to a servo motor. The setup enables precise servo positioning via serial commands, facilitating applications where exact movement control is essential. By implementing code to communicate positional commands, the experiment examines the servo's response accuracy, timing, and range of motion under various conditions. Additionally, the study analyzes the quality of serial data transmission, identifying potential issues like latency, interference, and signal degradation that may impact performance. This experiment provides insights into the practical considerations of using serial communication in motor control applications.

Introduction

The objective of this experiment is to establish and demonstrate effective serial communication between a microcontroller and a servo motor, allowing precise control over the motor's position through serial commands. Additionally, it involves implementing code to control the servo’s position via serial commands, evaluating the motor’s response time, accuracy, and range, and analyzing the data transmission quality to identify any issues related to latency, interference, or signal integrity.

Materials and Equipment

- Arduino Uno Board
- Computer with Arduino IDE and Python installed
- Jumper Wires
- Potentiometer
- Servo Motor

Experimental Setup

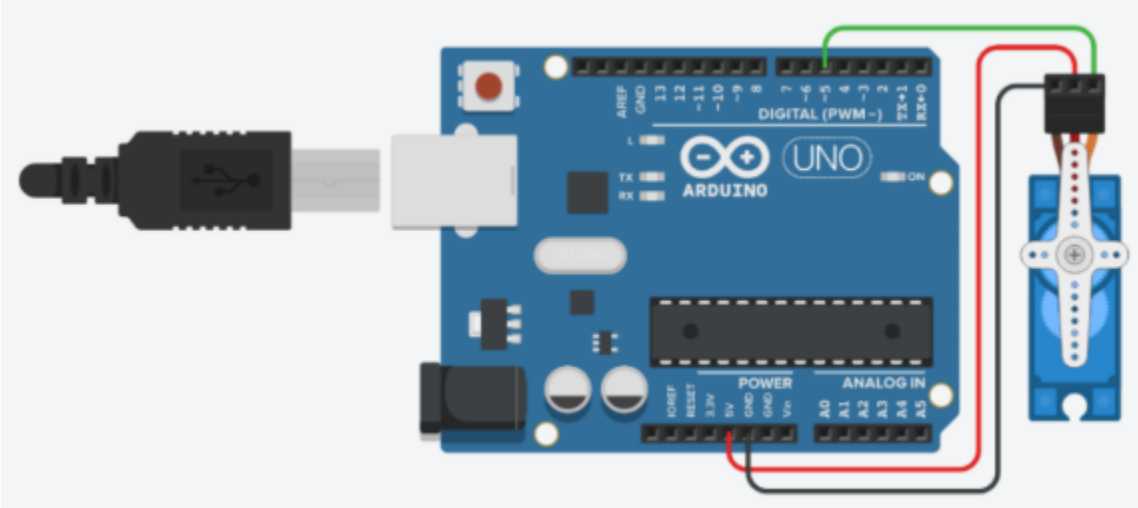

Figure 1

Circuit setup

1. Connect one leg of the servo motor to 5V on the Arduino.
2. Connect the other leg of the servo motor to GND on the Arduino.
3. Connect the servo's signal wire to a PWM capable pin on the Arduino, which is pin 5. An example of the circuit setup is shown in Fig 1.

Methodology

1. Setup for Arduino Board
    - Connect the Servo Motor as mentioned in experimental setup.
    - Connect the Arduino Board to the computer via USB cable

2. Software Programming Arduino IDE
    - Open a new sketch in the Arduino IDE.
    - Write Arduino code that reads angle data (90) from the serial port and moves the servo accordingly.
    - Include a function that asks the servo to reverse the angle data.
    - Upload the code to the Arduino Board.

3. Arduino Execution
    - Record the movement of Servo Motor, make sure the movement follows the angle that has been set.
    - Change the angle for a better result.

4. Python Execution
    - Write a program using python that includes input of an angle (0 to 180 degrees).
    - Press Enter so that the Python script will send the angle to the Arduino over the serial port.
    - Record the angle of servo that will be displayed in the python script.
    - Put multiple angles to see the servo move accordingly and compare it with Arduino IDE

Result

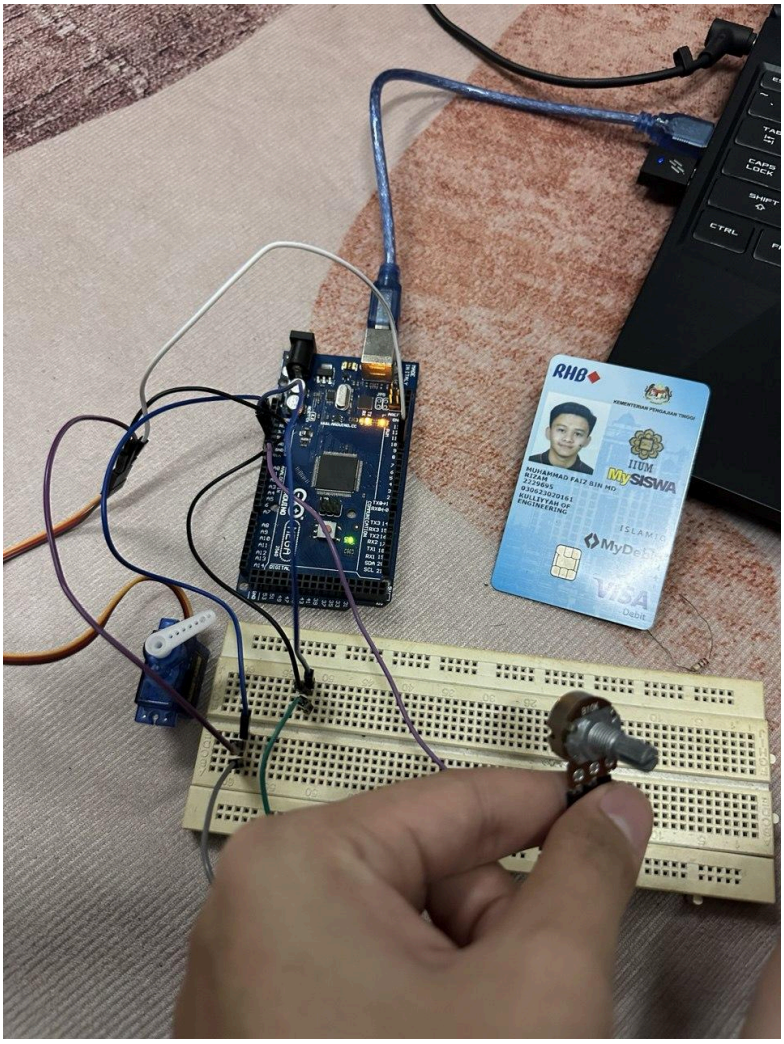

Figure 2

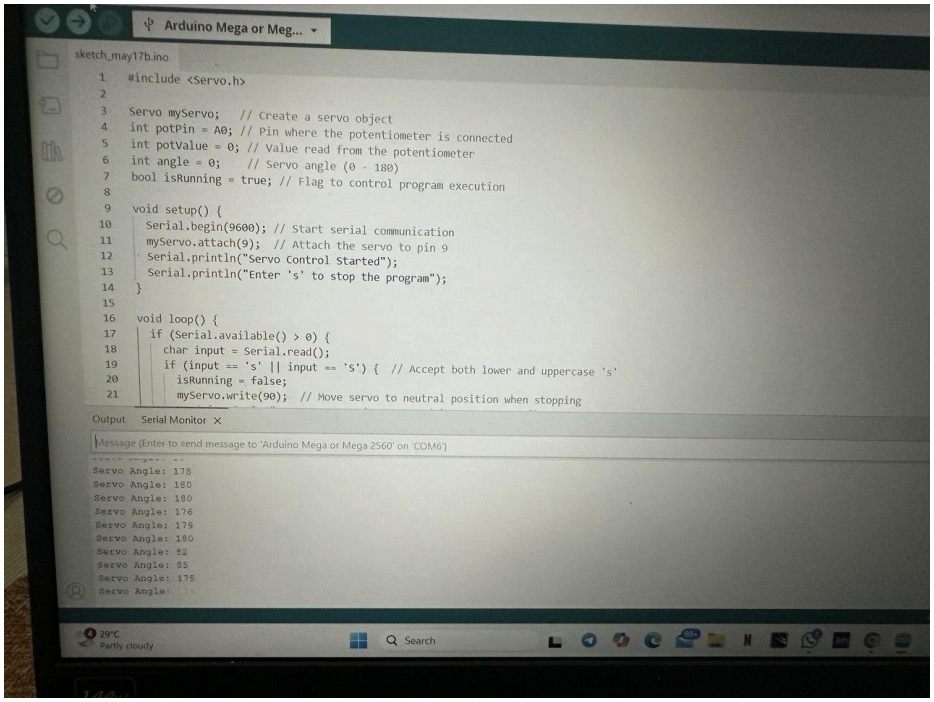

Figure 3

Discussion

In this lab, we investigated controlling a servo motor via serial communication between an Arduino and a computer. We divided the experiment into two phases. In the first step, the Arduino received angle data from a Python script and used it to command the servo motor to rotate at the specified angle. The second component had a potentiometer for controlling the servo angle in real-time. Both approaches illustrated different features of hardware control using microcontroller-based systems, highlighting the distinction between dynamic, sensor-based changes and programmed control inputs.

To allow the user to regulate the servo's position between 0 and 180 degrees, we established serial communication in the first experiment to transfer angle data from the Python script to the Arduino. This technology revealed how external data inputs from a computer interface can be utilized to influence hardware components by providing the servo with precise, programmable control. Maintaining consistent connection was critical, and this was achieved by balancing Python and Arduino baud rates, allowing for continuous data flow. This approach

demonstrated how automation might be developed, but it was limited to applications that needed to react quickly to changes in the environment due to the necessity for constant user input.

The experiment's second section incorporated a potentiometer as an analog input, enabling real-time control of the servo without the need for further computer input. We may establish a continuous and immediate feedback loop by mapping potentiometer readings to angle values and then adjusting the servo position in response to changes in the potentiometer's position. This technique enabled dynamic, manual control in situations that need responsive alterations, such as user-controlled robotic systems. Despite its ability to respond in real-time, the potentiometer was less programmable than Python, making it better suited for manual control but less flexible for automated activities that required an interface with external orders.

Conclusion

In Conclusion, this set of experiments demonstrates the concepts of serial communication between a computer and a microcontroller using Python and Arduino. By connecting a potentiometer and a servo motor to the Arduino, we investigated two fundamental characteristics of sensors and actuators in embedded systems.

The second experiment used servo motor control, which was based on angle input from a Python script to the Arduino. This conversation revealed an important aspect of PWM signals and how software can modify physical elements. Changing the angle using a potentiometer demonstrated how input devices may be used to influence outputs in a controlled way.

These experiments, in general, show the value of serial communication in bridging the hardware-software gap. After the projects are completed successfully, we will be prepared for advanced-level applications. This improves our understanding of microcontroller programming and data interchange in embedded devices.

Recommendation

Several proposals would improve the experiment's reliability and effectiveness. First, double-check the connections before powering on the circuit, as incorrect wiring might result in poor functioning or damage. Next, the lab must provide a multimeter to examine voltage levels at various locations, which could reveal the source of problems in the power supply or improper resistor values. It is critical to ensure that the resistor values are accurate. Erroneous values will result in a dull display or damage. Use the resistor required to prevent the LED from being overpowered.

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

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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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