

ECEN 4213 Embedded Computer Systems Design

September 27, 2021

Lab #: 02

Topic: Motor Control with Interrupts and LCD

Final Report

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1 Introduction

Lab 02, "Motor Control with Interrupts and LCD", of ECEN 4213 is designed to introduce students to DC motor control and interrupt driven programming on the Raspberry Pi 4. Students learn to control numerous classes of motors through the GPIO pins of a Raspberry Pi. Furthermore, students learn to utilize interrupt driven software to detect and handle button presses. Students are given the following tasks to complete:

- Implement servo motor control
- Implement stepper motor control
- Implement brushed DC motor control
- Implement an LCD interface with push button input
- Implement brushed DC motor control with input from push buttons and LCD output

By the end of Lab 02, students will have learned to implement basic motor control on a Raspberry Pi 4 using the WiringPi library. These techniques will provide a framework to develop more complicated projects utilizing GPIO functionality of the Raspberry Pi family.

2 Exercises

Lab 02 is divided into three independent assignments. This section details the results of each assignment.

2.1 Exercise 1: Control a servo motor

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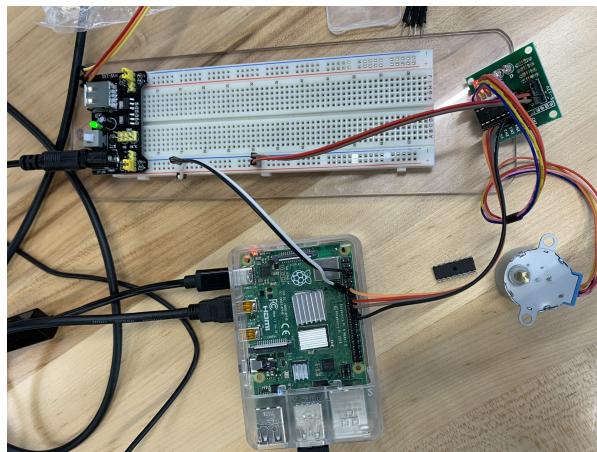


Figure 1: "Stepper motor configuration"

2.2 Exercise 2: Control a stepper motor

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2.3 Exercise 3: Control a DC motor

Commented code found in zipped file.

2.4 Exercise 4: Interact with an LCD through I2C

Commented code found in zipped file.

2.5 Exercise 4: Control a DC motor with an LCD providing feedback

Commented code found in zipped file.

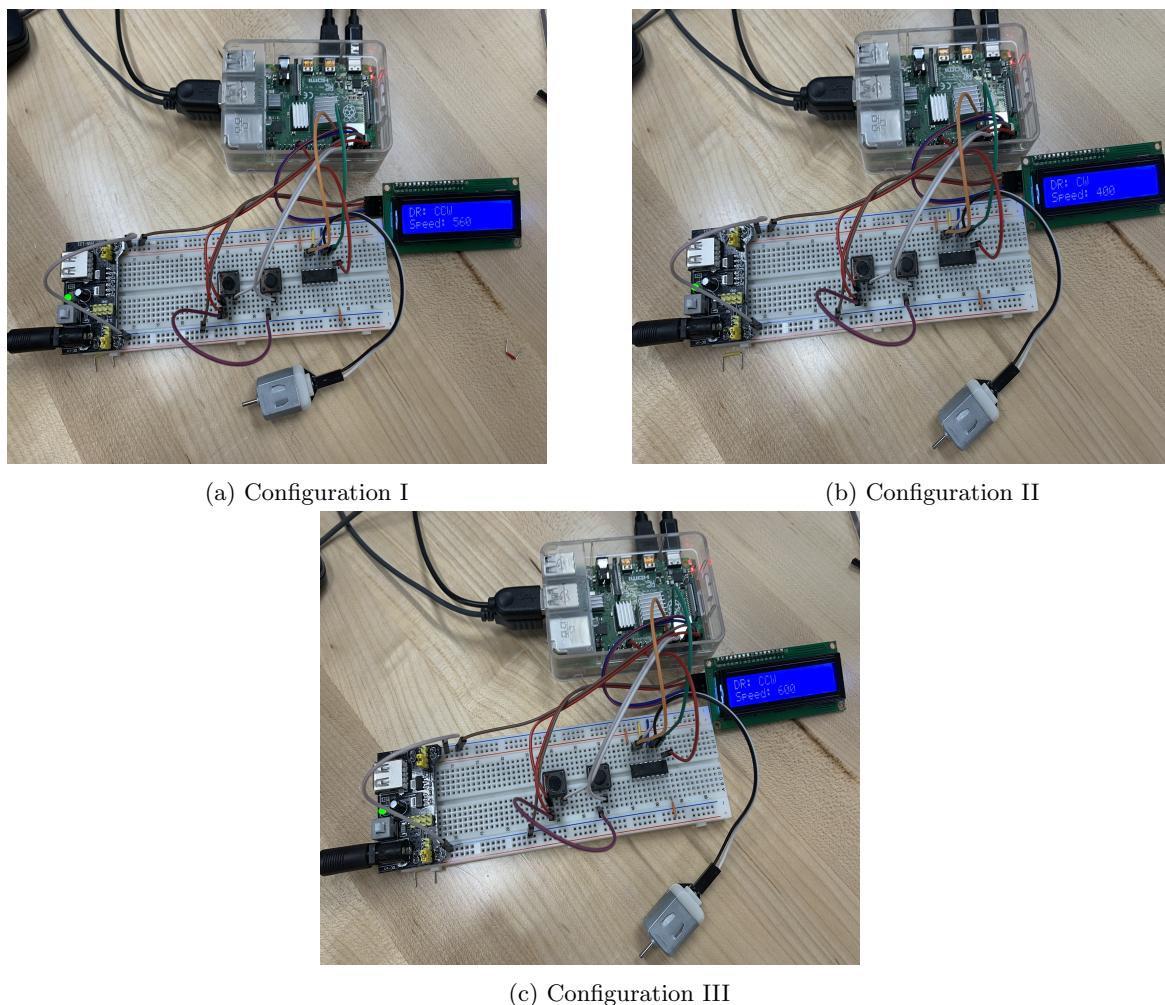


Figure 2: Varying outputs with motor and LCD setup

3 Supplemental Questions

1. Briefly summarize what you learned from this lab.

This lab focused on hands-on experience interacting with and controlling three common motors. A standard DC motor's speed and direction can be manipulated using simple digital outputs and a PWM signal through an H-bridge. The position of servo motors can be controlled directly through PWM. Stepper motors require extra circuitry in the form of a driver board to be manipulated.

As for differences between the motors, we confirmed our existing understanding through the lab. DC motors are easily speed controlled, but position control is more difficult. Servo motors are easily position controlled, but speed control and continuous rotation is difficult. Stepper motors allow for small, precise movements but offer less flexibility for continuous rotation applications.

2. What is the advantage of using interrupts?

Interrupts allow software to effectively wait for an event to occur without wasting process power checking for its occurrence. That's to say that after declaring an interrupt subroutine, the software can continue working. Once the event occurs, the interrupt's predefined callback function is triggered and *interrupts* the software's primary thread until completion. The alternative to an interrupt would be polling to check for the event, which wastes valuable processing time and power.

3. Assume you are going to build a 3D printer and have several options for controlling the movement of the three axes. Among a servo motor, a DC motor, and a stepper motor, which would be the most appropriate for this application. Why?

We would choose stepper motors for this application. A 3D printer requires highly precise and reliable movements of the extruder head. Stepper motors are well-suited to this task as they can be stepped in small, accurate increments allowing for better positioning and therefore higher quality prints.

4 Acknowledgments

I certify that this report is my/our own work, based on my/our personal study and/or research and that I/we have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I/We also certify that this assignment/report has not previously been submitted for assessment anywhere, except where specific permission has been granted from the coordinators involved.

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