Lab #1 – Introduction to Raspberry Pi and IO

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1. **Exercise 1**

   1.1 Statement of Completion:

   The TA verified the completion of this exercise.

   1.1 Summary:

   We set up the WiFi connection on the RaspberryPi and started an SSH connection with the desk computer using Visual Studio Code.

2. **Exercise 2**

   2.1 Statement of Completion:

   The TA verified the completion of this exercise.

   2.1 Summary:

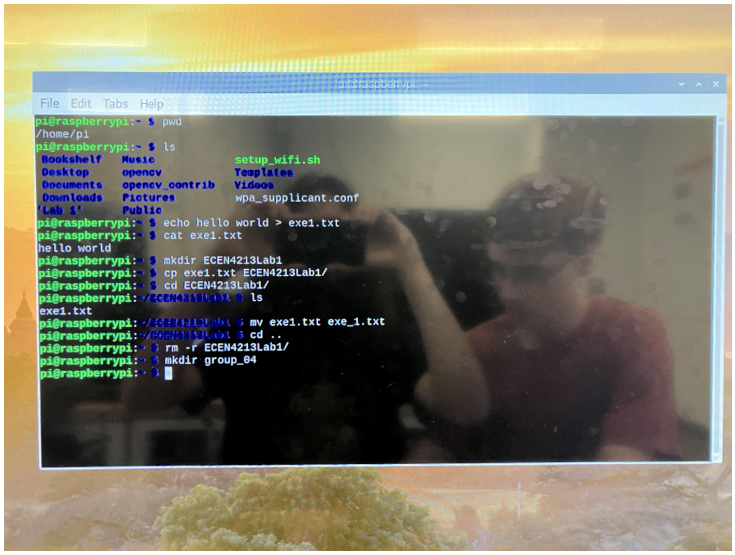

Figure 2.1.1 - RPi Command Terminal

   2.1 Summary:

   We used basic Linux commands such as mkdir, chmod, and sudo to create files and directories. This was to review the Linux commands as the RaspberryPi uses a Linux OS.

3. Exercise 3

3.1 Circuit:

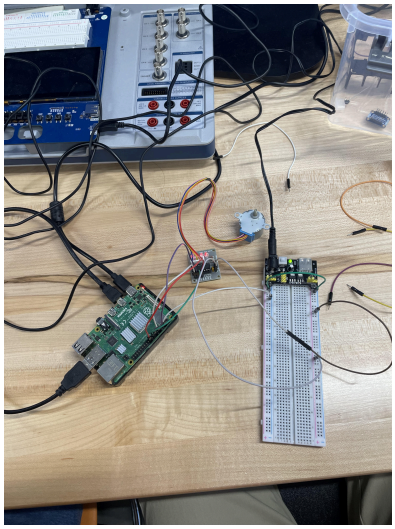

Figure 3.1.1 - Stepper Motor Circuit for 3.1

3.1 Summary:

In Exercise 3, we reviewed stepper motors. We used the internal mechanics of a stepper motor to make it spin 360° clockwise and counterclockwise. Using a digital write signal from the I/O pins, sections of the stepper motor were activated. These sections were activated in a specific order to spin the motor in the desired direction.

4. Exercise 4.1

4.1 Screenshots:

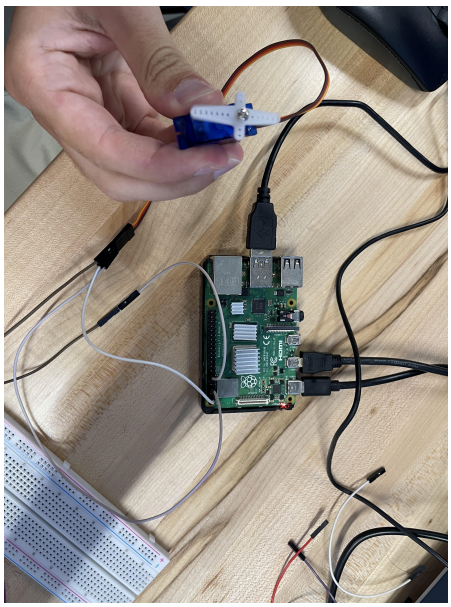

Figure 3.1.1 - Servo Connection to RPi4

4.1 Summary:

In Exercise 4, we reviewed servo motors. Using different pulse widths correlating to predetermined angles, we made a servo motor switch inbetween the minimum and maximum angles. To output the desired pulse width, we converted the angle into 0.1ms according to a formula, where 0° converted to 0.5ms and 180° converted to 2.5ms.

5. Exercise 5

5.1 Circuit

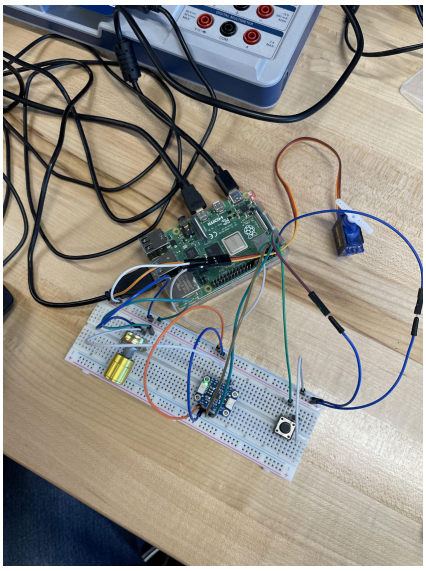

Figure 5.1.1 - ADC & Potentiometer Servo Circuit

5.1 Summary:

In Exercise 5, we reviewed an analog to digital converter, the ADS1015. Using a potentiometer, we changed the voltage of the AIN0 pin on the I2C ADC. In our C++ program, we converted that voltage to an angle for the servo motor plugged into the RPi. Using the conversion equations from before, that angle was converted to a pulse width that corresponded to our angle. Additionally, we had a button that reversed the direction of the angle, where high voltage went from large angle to small angle. While working with the I2C device, we reviewed the configuration codes for the ADS1015.

6. Supplemental Questions

1. Briefly summarize what you learned from this lab.

In this lab we reviewed important topics from ECEN 3213 that will be important for future labs in this course. We set up the RPi with our SD cards, reviewed basic terminal commands, reviewed stepper and servo motors, and used I2C devices to respond to inputs. While completing these tasks, we also reviewed C++ programming & compiling, RPi I/O pins & libraries, innterrupts, and ADC devices. All these topics are important to build upon in future labs.

2. What is the advantage of using interrupts?

Interrupts, as opposed to polling, allow other processes to happen while allowing inputs to affect the program whenever they happen. The program does not have to constantly check for the inputs. In C++, this would mean not relying on a “for loop” to continuously check the state of a I/O pin. The downside to interrupts is the accidental signals that can cause an unwanted interrupt.

3. Explain the differences between stepper motors and servo motors and DC motors.

Stepper motors are made to turn only a certain distance. This is done with four terminals being set up whenever the terminal receives a signal and the motor is in that direction, the motor will move until it is no longer connected with the terminal. This can be repeated at all four terminals to have a full 360° rotation.

Servo motors are made to go to a specific angle and remain at that angle. The servo motor does this through a pulse width modulation system, where a duty cycle and total pulse width is given and is converted to a designated angle

DC motors are basic motors that continuously run whenever a current is applied to the motor. The motor uses current and magnets to creat a foce that rotates the current filled wire. The wire flips and the current continues is the same direction due to a brush design. As current increases, so does the speed of the motor. If the current is reversed, the motor reverses direction.

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 person communication. I/We also certify that this assignment/report has not previously been submitted for assessment anywhere, except where permission has been granted from the coordinators involved.

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