ECE 3710 Lab 5 – Fall 2018

Due Date: Week of October 15 at the beginning of your lab section

Objectives

The purpose of this lab is to gain experience interfacing the microcontroller with a 4x4 keypad using C.

Overview

For this lab, you will use polling to scan the 4x4 keypad and display up to 6 characters on the LCD.

Preparation

1. Come with the following:

    a. ECE 3710 Lab Kit

    b. STM32L476 Discovery Board

    c. Textbook

2. Read section 14.9 of the textbook.

Prelab

1. The 4x4 keypad used in this lab requires 8 pins (four row pins and four column pins). For this lab, a suggested set of connections between the keypad and the Discovery Kit is shown in the following table.

Row	R1 $\rightarrow$ PE10	R2 $\rightarrow$ PE11	R3 $\rightarrow$ PE12	R4 $\rightarrow$ PE13
Column	C1 $\rightarrow$ PA1	C2 $\rightarrow$ PA2	C3 $\rightarrow$ PA3	C4 $\rightarrow$ PA5

    All pins of the input port (C1, C2, C3, and C4) need to be pulled up to 3V via a 2.2KΩ resistor. Inside the processor, each GPIO pin can be pulled up via an internal resistor (between 20 and 55 KΩ, typically 40 KΩ). However, the internal pull-up capability is too weak and thus an external pull-up is required.

When looking at the front side of the keypad, the pins from left to right are:
R1 – R2 – R3 – R4 – C1 – C2 – C3 – C4.

The maximum current a GPIO pin can source or sink is 20 mA. **When calculating the value of external pull-up resistors, make sure that the current does not exceed 20 mA.**

$$\frac{3V}{2.2K\Omega} = 1.4 \; mA$$

On the STM32L4 board, all pins in the input port (PA1, PA2, PA3, and PA5) are connected to ground via a 100nF capacitor. Therefore, due to these capacitors, the voltage output on these pins won't immediately change to Vcc or ground. A very short delay should be added before reading the input port. Specifically, delays are needed between setting GPIOE outputs and reading GPIOA inputs.

2. Draw the schematic of how the keypad will interface to the Discovery Board. Include configuration specifications for all GPIOs you use.

3. **Prelab Pass-off:** Pass off your schematic to the TA **before** proceeding. **Serious board damage may occur if you wire the keypad of configure the GPIO lines incorrectly!**

Procedure

1. Develop pseudocode for a C program that will capture keypresses from the keypad and display characters on the LCD. All 16 keys must be handled. Include software de-bouncing. Determine how you want to handle long-duration key presses. After 6 characters are displayed on the LCD, no more input is accepted.

2. Show your pseudocode to the TA **before** proceeding.

3. Write, test, and debug your program.

4. Pass off your working system to the TA.

Documentation

Prepare your lab report following the same style and rubric that you've followed in previous labs.