ECE 271Lab Manual
Lab 3: Interfacing Keypad
Instructor: Prof. Yifeng Zhu
Spring 2015

Goals

1. Understand I/O matrix technique
2. Be familiar with keypad scanning algorithms
3. Software debouncing

Pre-lab Assignment

1. Read Chapter 14.7 Keypad Scan of Textbook
2. Complete the control register tables attached

In-lab Assignment

1. Use polling method to scan keypad and display the inputs on LCD
    a. When a key is pressed, its value is then displayed on the LCD. The LCD should be able to display up to four digits/letters.
    b. Software debouncing should be used.
2. Something cool. Example includes
    a. When a key is pressed for a long time, two options: either generate one input no matter how long it is pressed, or generate a periodical input with an interval of 3 seconds.
    b. Use the "*" key to delete the previous input. Pressing "*" key again keeps deleting the previous input.
    c. Use the "#" key to repeat the previous inputs.
    d. Detect and recognize if multiple keys are pressed simultaneously.
    e. Something really cool

Keyboard Interface

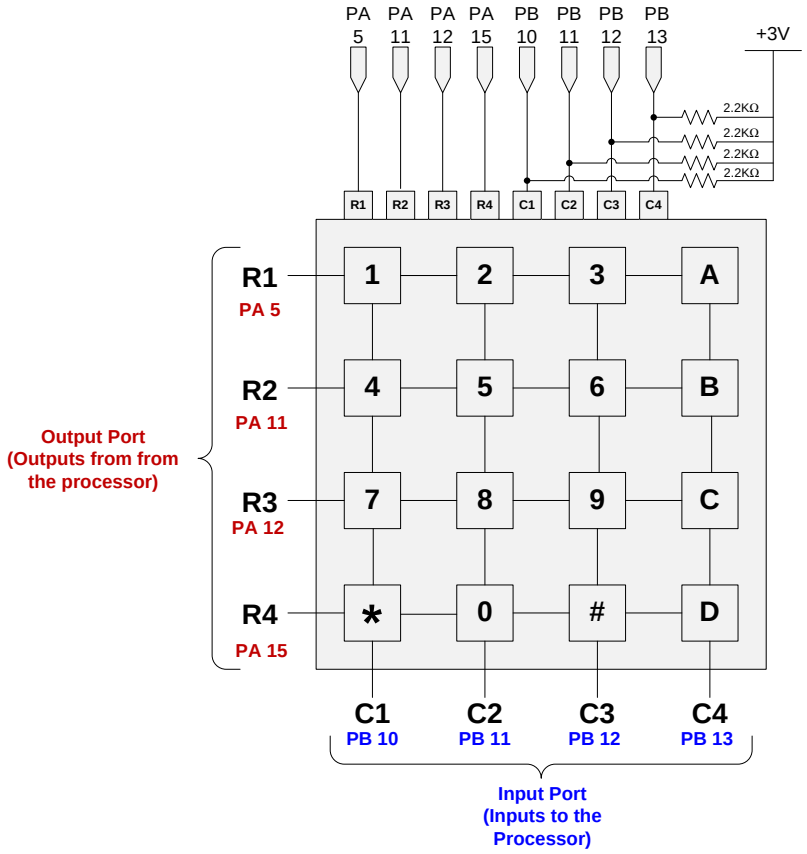
There are only five pins that are freely available to users on the discovery kits (PA 5, PA 11, PA 12, PC 12, and PD 2). However, the 4x4 keypad used in this lab requires 8 pins (four row pins and four column pins). In this lab, the connection between the keypad and the discovery kit is as the following table.

Row	R1 → PA 5	R2 → PA 11	R3 → PA 12	R4 → PA 15
Column	C1 → PB 10	C2 → PB 11	C3 → PB 12	C4 → PB 13

The GPIO pins PB 10, 11, 12, and 13 are used to control the 4th, 5th and 6th digits, as well as the bars of the LCD display on the STM32L discovery kit. Therefore, these three digits and bars are not usable in this lab.

All pins of the input port (C1, C2, C3, and C4) are pulled up to 3V via a 2.2KΩ resistor. Within the processor, each GPIO pin can be pulled up via an internal resistor (60KΩ). However, the internal pull-up capability is too weak and thus an external pull-up is required.

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



Note: Make sure that the keypad pin initialization is performed after the LCD pin initialization, so that GPIO pin PB 10, PB 11, PB 12, and PB 13 are override to work for the keypad, instead of for the LCD.

Pre-Lab Assignment
Lab 3: Interfacing Keypad

Student Name: _____
TA: _____
Time & Date: _____

Configure Port A: Pin 5, 11, 12, and 15 as Digital Output

GPIO Mode: Digital Input (00, reset), Digital Output(01), Alternative Function(10), Analog(11)

Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIOA MODER	MODER15[1:0]		MODER14[1:0]		MODER13[1:0]		MODER12[1:0]		MODER11[1:0]		MODER10[1:0]		MODER9[1:0]		MODER8[1:0]		MODER7[1:0]		MODER6[1:0]		MODER5[1:0]		MODER4[1:0]		MODER3[1:0]		MODER2[1:0]		MODER1[1:0]		MODER0[1:0]	
MASK																																
VALUE																																

GPIOA Mode Register MASK Value = 0x_____ (in HEX)
GPIOA Mode Register Value = 0x_____ (in HEX)

2. Configure Port B: Pin 10, 11, 12, and 13 as Digital Input

GPIO Mode: Digital Input (00, reset), Digital Output(01), Alternative Function(10), Analog(11)

Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIOB MODER	MODER15[1:0]		MODER14[1:0]		MODER13[1:0]		MODER12[1:0]		MODER11[1:0]		MODER10[1:0]		MODER9[1:0]		MODER8[1:0]		MODER7[1:0]		MODER6[1:0]		MODER5[1:0]		MODER4[1:0]		MODER3[1:0]		MODER2[1:0]		MODER1[1:0]		MODER0[1:0]	
MASK																																
VALUE																																

GPIOB Mode Register MASK Value = 0x_____ (in HEX)
GPIOB Mode Register Value = 0x_____ (in HEX)

Lab Demo
Lab 3: Interfacing Keypad

1. Do all digits (0-9) and letters (A, B, C, and D) show up on the LCD correctly?
2. What is your software-debouncing algorithm? How well does it work?
3. Explain to TA your keypad scanning algorithm
4. We do not use the internal pull-up in this lab. Instead, we pulled the pins up through external resistors. We said the internal pull up is too weak. What does it mean specifically?

Post-Lab Assignment
Lab 3: Interfacing Keypad

Write your answer to the post-lab assignment in the file Readme.MD and submit it to gitlab server.

1. When multiple keys are pressed, can the scan algorithm correctly detect all keys pressed? (Hint: ghosting, or ghost key)
2. What suggestions you would give to improve the experiences of this lab?
3. For the textbook, do you find any typos or have any comments or suggestions?