

ECE 3710 Lab 5

Due: Week of November 6, 2017 (20 points)

Overview:

In this lab, you will use the LCD/touch panel as a 3-button array to turn on or off corresponding LEDs on your breadboard. The week 1 lab is configuring and writing to the LCD screen. During week 2 you will program the resistive touchscreen. Read through the entire lab writeup before beginning, and refer to the “Notes and Tips” section frequently.

Preparation

- The LCD/touch panel uses Serial Peripheral Interface (SPI). You should become familiar with how SPI works. Note that SPI is referred to as Synchronous Serial Interface (SSI) in the TM4C123GH6PM data sheet. SPI and SSI are used interchangeably in this document.
- Read over the ILI9341 datasheet. This is the controller for the LCD display.
- Read over the XPT2046 datasheet. This is the controller for the resistive touchscreen.
- Read about PLL (phased-locked loop).

Hardware

- Tiva™ C Series TM4C123GH LaunchPad Evaluation Board
- ILI9341/XPT2046 LCD touch screen
- 3 LEDs (1 red, 1 green, 1 yellow)
- Jumper wires

Overall Lab Requirements:

1. Three buttons—one red, one green, one yellow--shall be drawn on the LCD.
2. Each button should be drawn as a colored outline initially. When pressed, the button should fill in with the respective color. When pressed again, the button should return to a blank outline.
3. The red, green, and yellow LEDs should light up when their corresponding button is selected on the LCD. They should turn off when the corresponding button is deselected.
4. The screen refresh rate must be acceptably fast. Find out what clock rates the ILI9341 controller can handle. Consider using PLL to speed up the clock and increase refresh rates.
5. Touching outside the buttons must have no effect on the buttons or LEDs. Debouncing shall be properly implemented.
6. Touching and holding a button shall not toggle the button state until the button is released.

Notes and tips:

- The order and size of the buttons is not specified in the requirements. Do what you want.
- Remember that the LCD screen and the touch panel use different controllers that are interfaced separately. The physical device contains both.
- Freescale SPI is used for the LCD screen. Two important parameters that change freescale are SPO and SPH. Use the TM4C and ILI9341 datasheets to determine what settings are best fitted to the LCD screen and include these values in your report.
- To power the board, connect one of the 5V pins to a 5V source and one of the 3.3V pins to a 3.3V source. There is no need to power both 5V pins or both 3.3V pins.

- Be sure to wire the RESET pin on the LCD. The pin is active low, so it must be held at a logical “high” (3.3V) voltage in order to be active.
- The LCD and touch panel communicate via the same SPI pins. There are two possible methods to communicate with both. One option is to use one SSI port for the LCD and another for the touch panel. Another option is to use one port for both modules.
- Consider waiting for SPI to finish writing data before exiting the writeCmd/writeData functions.
- In this case, debouncing refers to handling small finger movements unnoticed by humans but sensed by the touch panel. Consider reading multiple (x,y) positions from the touch panel and averaging them.
- The XPT2046 uses the Touch Panel Interrupt Request (TPIRQ) pin to indicate that it is receiving data. The touch panel pulls that pin low when it detects a touch. It is recommended to use an interrupt to handle this request.
- Discuss in your report how you handled various touch scenarios, such as touches outside button boundaries, partly-in-partly-out touches, touch and holds, debouncing, and so on.

Checkoff: Week 1

At the end of week 1, you should initialize and configure the LCD screen. A skeleton project is provided on the wiki. It will test your configuration functions. Use it to verify that you are correctly configuring SPI communications with the LCD. When that is working, you will write your own functions for writeCmd() and writeData(). Your functions should replace the function from the skeleton project. At the end of the week you should be able to draw the filled/unfilled boxes using only the functions you wrote.

Checkoff: Week 2

At the end of week 2 all requirements should be fulfilled and demonstrated to the lab TA.

Figures and tables:

Figure 1: LCD button example

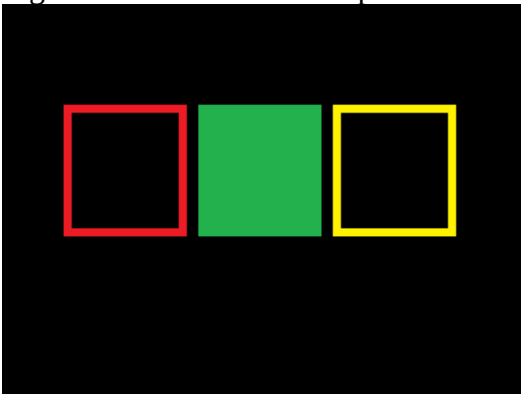


Table 1: LCD Module pin placement, as seen from back of LCD screen.

2	1
4	3
6	5
8	7
10	9
12	11
14	13
16	15
18	17
20	19
22	21
24	23
26	25

Table 2: LCD screen wiring listing

PIN #	SYMBOL	DESCRIPTION
1, 17	3.3 V	3.3V power input
2, 4	5 V	5V power input
3, 5, 7, 8, 10, 22	NC	Not connected
6, 9, 14, 20, 25	GND	Ground
11	TP_IRQ	Touch panel interrupt
12	KEY1	Key
13	RST	Reset
15	LCD_RS	LCD instruction control, instruction/data register selection
16	KEY2	Key
18	KEY3	Key
19	LCD_SI/TP_SI	SPI data input of LCD/touch panel
21	TP_SO	SPI data output of touch panel
23	LCD_SCK/TP_SCK	SPI clock of LCD/touch panel
24	LCD_CS	LCD chip select, active low
26	TP_CS	Touch panel chip select, active low