

- 1) From mycourses download this pdf.
- 2) The **objective** of this lab is to combine user input via the capacitive touch sensor with A/D-C acquisition and display. The lab consists of one part only.
- 3) For this lab install the capacitive touch sensor back on. To acquire on P1.0, leave the jumpers off, and connect the analog input signal to the jumper pin that connects to P1.0 – see LaunchPad schematic. Don't forget the ground connection! Be careful not to cause any shorts to adjacent pins!
- 4) **Part 1: Design, code, build, run, demonstrate, and debug fmlxxxx_Lab10_a1.asm or fmlxxxx_Lab10_c1.c code.**
- 5) You can implement this lab assignment in assembly only, in C only, or a combination of the two. You can split the code in multiple files to keep things organized and portable. Use what you learned in the lecture examples of mixing C and assembly, and how to distribute the code among multiple files.
- 6) The functionality of the program is described below:
 - a. After initial configurations, the program queries in a loop all five touch sensors. The result of the query is captured in one value, as you have done in a previous lab. Every time it detects the touching of a sensor it gives the user feedback by turning ON some LEDs until it senses another sensor. We assume an educated and polite user.
 - b. It is expected that the user touches the center sensor first (start). When the uC determines that it has been touched, it continues to look for a touch of the wheel up or wheel down sensors. Change the LEDs to let the user know the application is now looking for up/down.
 - c. If the wheel top is touched, the acquisition will consist of 20 samples at a rate of ~100 Hz.
 - d. If the wheel down is touched, the acquisition will consist of 20 samples at a rate of ~200 Hz.
 - e. Next, the uC is checking if the wheel left or right is touched. Change the LEDs to let the user know the application is now looking for left/right.
 - f. If the wheel left is touched, it will display each sample value for ~1 second.
 - g. If the wheel right is touched, it will display each sample value for ~2 seconds.
 - h. Next, the program is performing the acquisition, with the parameters as described and selected above.
 - i. Once the acquisition is complete, it will convert all samples to an 8-bit "leading 1, non-linear scale". Mask off the lower 2 bits of the 10 bit ADC result and then do the conversion as follows:
 - i. If the sample value is 0100 0011 01 → 0111 1111 or if
 - ii. The sample value is 0001 0010 11 → 0001 1111.
 - iii. This can be accomplished in several ways, one of which is by rotating left through carry and keeping track how many times you have rotated until the value of carry is 1. With this you

figure out in which bit position you have the most significant 1.
At this point you assign one of nine possible values.

- iv. Your Display should start with LED D4 as the LSB, and grow clockwise up to D8 as the MSB.
- v. Here's a table describing how to light up the LEDs. The x's are don't cares:

10-bit ADC result -> LEDs to light

0000 0000 xx	-> none
0000 0001 xx	-> D4
0000 001x xx	-> D4 and D3
0000 01xx xx	-> D4, D3 and D2
0000 1xxx xx	-> D4, D3, D2 and D1
0001 xxxx xx	-> D4, D3, D2, D1 and D5
001x xxxx xx	-> D4, D3, D2, D1, D5 and D6
01xx xxxx xx	-> D4, D3, D2, D1, D5, D6 and D7
1xxx xxxx xx	-> D4, D3, D2, D1, D5, D6, D7 and D8

- vi. If this "leading 1, non-linear scale" is not clear to you, DO NOT GUESS!! Ask your TA for assistance.
 - j. Finally, you display each sample value, one at a time, based on the parameters described and selected above.
 - k. The program continues to display in a loop until the center sensor is touched again and the whole loop repeats. You can either press the center button at any point during the display sequence to re-start the whole program, OR display 20 samples, and THEN do nothing else other than scan the center button to re-start, OR a combination of the two.
- 7) **Design the program using a flowchart and/or pseudo code.** Using paper and pencil is fine. Your flowchart and/or pseudo code should be in your report.
 - 8) Create a new project in your workspace named fmlxxxx_Lab10_a1 or fmlxxxx_Lab10_c1.
 - 9) Once the code compiles, apply a sinusoidal signal with a peak-to-peak amplitude of 1 V, a DC offset of +0.5 V, and a frequency of 10 Hz at the input.
 - 10) Once the code is debugged, try it with a saw-tooth signal and then a square waveform with all other characteristics identical. Make sure your signal does NOT go over 1V or below 0V!!! Check with an oscilloscope first, before connecting it to your MSP430.
 - 11) Demo your working design with the TA. Otherwise, take low resolution and ~25 second long videos of your display for all three waveforms. Upload these on myCourses too.
 - 12) Make sure you write the report and upload it along with your project archive on myCourses. Demo the intermediate steps to the TA.
 - 13) **Grading:**
 - a. Part 1 CAPTouch Sensor detection = 10 points

- b. Part 1 ADC acquisitions = 10 points
- c. Part 1 8-bit non-linear scale conversion = 10 points
- d. Part 1 Result display = 10 points.