ECGR 4101/5101, Fall 2018: Lab 5

Using an LCD and an Accelerometer

Version 1.0 – 10/24/2018

Learning Objectives:

The main objective of the assignment is to show a ball "rolling" around on the Tiva LCD 128 x 128 pixel screen that reacts to the orientation of the board's tilt. The tilt is measured using the accelerometer on one of the system boards.

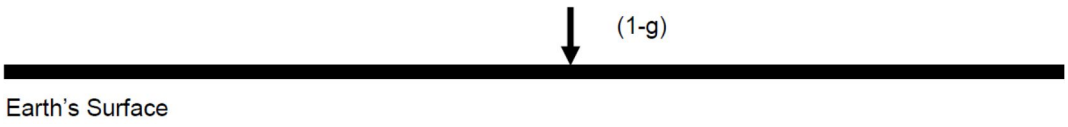
Using an Accelerometer

Part of this lab will be to identify the angle of the board compared to the surface of the earth. The accelerometer data sheet provides information on the specifics, but keep in mind that if the board is sitting on a table, the X- and Y-axis measures should show no forces acting in it (gravity will be our only force). Therefore, column 5 shows what the voltages (and hence the digital readings) should show. Obviously, if the board is then rotated to a 90 degree angle to the table, one of the axis will go from 1.65 to either 0.99 or 2.31 volts (this depends on what axis is rotated, and in what orientation).

Although there is a formula for the angle of accelerometer compared to the voltage, you can easily handle this by measuring the values when the board is flat and when it is 10 degrees and build a table for each axis.

Static X/Y/Z Output Response versus Orientation to Earth's surface (1-g):

Position	1	2	3	4	5	6
Diagram					Top Bottom	Bottom Top
X	1.65 V	2.31 V	1.65 V	0.99 V	1.65 V	1.65 V
Y	2.31 V	1.65 V	0.99 V	1.65 V	1.65 V	1.65 V
Z	1.65 V	1.65 V	1.65 V	1.65 V	2.31 V	0.99 V
X-Polarity	**0**	+	**0**	-	**0**	**0**
Y-Polarity	+	**0**	-	**0**	**0**	**0**
Z-Polarity	**0**	**0**	**0**	**0**	+	-



Helpful References

- The board accelerometer: http://kionixfs.kionix.com/en/datasheet/KXTC9-2050%20Specifications%20Rev%202.pdf
- Here is TI support forum where some had same issue and expert told to remove those two resistors: https://e2e.ti.com/support/microcontrollers/msp430/f/166/t/453698

- Here is video how to remove and Dr. Valvano explained why we need to remove it: https://youtu.be/MWIX7wgS9PM
- Code examples from Dr. Valvano's web page: http://edx-org-utaustinx.s3.amazonaws.com/UT601x/ValvanoWareTM4C123.zip
- Another good source that explains how to set up communication and data registers for the driving chip to the LCD screen on the booster pack https://forum.crystalfontz.com/showthread.php/7394-Connecting-the-small-CFAF128128B-0145T-TFT-to-an-Arduino-Uno-or-SparkFun-RedBoard

Requirements:

Req. 1. The system will consist of the Texas Instruments Tiva C Series TM4C123G LaunchPad and the Educational BoosterPack MKII.

Req. 2. The system must be programmed in C and use Code Composer Studio (NOT Energia).

Req. 3. A "ball" (colored in circle – or as close to a circle as you can get) will move around the LCD screen depending on the tilt of the board.

Req. 4. The ball will have a "diameter" of 3 pixels (can be 3 x 3).

Req. 5. When the system is started and sitting flat on the table, the "ball" will be in the center of the screen.

Req. 6. When the system is oriented such that the board surface is at a 10 degree angle (or more) in the Y-axis while the X-axis is horizontal, the "ball" will "roll away" from the center of the screen towards to lower side of the screen.

Req. 7. When the system is oriented such that the board surface is at a 10 degree angle (or more) in the X-axis while the Y-axis is horizontal, the "ball" will "roll away" from the center of the screen towards to lower side of the screen.

Req. 8. The ball location shall work similarly as specified above in the X and Y dimension if both the X- and Y-sides of the screen are tilted 10-degrees (or more).

Req. 9. When the system is made flat after it has been tilted, the ball will stop moving and remain in position

Req. 10. The movement of the ball shall be smooth and may not change more than one pixel every 50 milliseconds.

To Demonstrate and Submit:

Have the demonstration sheet below printed off. Demonstrate your working (or partially working) code to the TA. After the demonstration, the TA will take your demonstration sheet and save for grading.

ONE of the lab partners should submit a single file with your code as a .c file. All code should be in this single file, with the main file (with the main function) at the top. **REMEMEBR BLOCK HEADER COMMENTS!!!** Also, if you used code you found online, you need to cite the source of that code at the beginning of the code blocks.

Advanced Embedded Systems Lab Demonstration Validation Sheet

This sheet should be modified by the student to reflect the current lab assignment being demonstrated

Lab Number:	Lab 5 – LCD and Accelerometer
Team Members	Team Member 1: emailID: Team Member 2: emailID:
Date:	

Lab Requirements

REQ Number	Objective	Self-Review	TA Review
	A “ball” moves around the LCD screen depending on the tilt of the board.		
	The movement of the ball is smooth and does not change more than one pixel every 50 milliseconds.		
	When the system starts and is sitting flat on the table, the “ball” is in the center of the screen.		
	When the system is oriented such that the board surface is at a 10 degree angle (or more) in the Y-axis while the X-axis is horizontal, the “ball” will “roll away” from the center of the screen towards to lower side of the screen.		
	When the system is oriented such that the board surface is at a 10 degree angle (or more) in the X-axis while the Y-axis is horizontal, the “ball” will “roll away” from the center of the screen towards to lower side of the screen.		
	The ball location shall work similarly as specified above in the X and Y dimension if both the X- and Y-sides of the screen are tilted 10-degrees (or more).		
	When the system is made flat after it has been tilted, the ball will stop moving and remain in position		