UNC Charlotte, ECGR 4892/6090/8090, Spring 2004: Lab 4

Sensors: Accelerometers

Learning Objectives

This lab will have students examine the Analog Devices ADXL311EB accelerometer evaluation board to measure the acceleration of a wheeled vehicle down an incline.

General Information

The general steps for this lab are:

1. Create a new folder for lab 4. Copy your files from lab 3 into the new folder.
2. Generate a new project using the files you just copied. Name your new project Lab4.
3. Open and edit your main.c file to perform the lab functions.
4. Program the lab. Don't forget the necessary include files to get the correct functionality.
5. Compile the code into an .x30 file, and load onto the board.
6. Test the program and repeat steps 4, 5, and 6 until the program works as required.
7. Write your lab report.
8. Demonstrate for the professor and turn in your report.

Prelab Activity

What is the acceleration due to gravity? Will the device read anything when it is at rest?

Laboratory Assignments

You may use the PCs in Smith 347 or your own PC to do this lab experiment. The machines in Smith 347 already have the software tools loaded. In this lab you will be utilizing onboard timers, serial UARTs, and I/O ports of the Renesas board to read a Analog Devices ADXL311EB accelerometer evaluation board. You will record 8 seconds worth of measurements once the SW2 switch is presses, and then play them back via the RS-232 board.

Consider the situation when the toy is sitting on an incline, like shown below. The accelerometer will measure some portion of "g", depending on the x/y orientation such that $g \sin \Phi + g \cos \Phi = g$. It is an exercise for you to figure out which orientation is the cosine versus sine component.

Now assume the toy is released. The measurement in the x and y direction should change, but not to zero. When the toy reaches the bottom of the ramp (like in the figure below), the acceleration on the y-axis will change to g. The acceleration on the x-axis will start to decrease.

Eventually the toy will stop all motion, such that the x-axis measurement will be 0 and the y measurement will be g.

Steps

1. Modify the main.c file and include the appropriate files. Include commenting along the way.
2. Build your program slowly, testing along the way. Perform compiles and solve each requirement one at a time. Make sure comments are written as you progress.
3. Continue to build and test the program until all of the requirements have been met. Did we mention you should write your comments as you progress, not at the end?
4. If you run into problems, use the break point functionality of KD30 to step through the code until you find the problem.
5. Once all the requirements have been met, ensure that everything works.
6. Finish lab write-up and demonstrate for the professor.
7. Submit your report, C code (*.c) and .map files on a floppy disk, CD ROM, or email.

Requirements

Req. 1 – The code generated is written in C for the MSV30262-SKP
Req. 2 – The code is well commented and easy to follow
Req. 3 – Your lab report should include the final build output from the builder
Req. 4 – The serial communications with the PC should operate at 19200 baud 8,N,1
Req. 5 – HyperTerm will be used to transmit and receive characters.
Req. 6 – The Analog Devices ADXL311EB accelerometer evaluation board will be attached to the Renesas SKP and oriented such that the plane of the Renesas board is perpendicular to the plane of the ADXL311EB.
Req. 7 – The Renesas SKP will be attached to a wheeled toy vehicle such that the plane of the Renesas board is parallel to the ground when the four wheels of the toy are on the ground.
Req. 8 – The general operation of the system is that the toy, with board attached, will be rolled down an incline and roll to a stop on a level surface. The attached Renesas SKP and ADXL311EB will record the acceleration of the vehicle.

Req. 9 – The system will start recording the X and Y components of the acceleration when the SW2 switch is pressed. It will record 8 seconds of samples, once every 0.1 seconds, starting 0.1 seconds after the switch is pressed.
Req. 10 – The readings will be stored in a 80 by 2 word array. The acceleration data may be saved in any format.
Req. 11 – The incline will be at a 30 degree angle, and the distance from the start to the bottom of the incline is 3 feet.
Req. 12 – The system will be powered by a 9v battery.
Req. 13 – The system will be attached to a PC via a RS232 cable. When the letter "P" is sent from the PC to the system, the system should send back the values of X and Y in g forces, with the format:

```
Time          X          Y
0.1        x.xxx      x.xxx
0.2        x.xxx      x.xxx
```

Req. 14 – Use only integer values in the system. Do not use floating point.

Lab Report

Include in your lab report observations and procedure like the following:
The general learning objectives of this lab were . . .
Pre-lab question answers
The general steps needed to complete this lab were . . .
Some detailed steps to complete this lab were . . . .

1. *Step one*
2. *Step two*
3. *. . . .*

Code generated for this lab…
Some important observations while completing/testing this lab were . . .
In this lab we learned . . . .

Send the code the .map file, and the report to Dr. Conrad via email.