Lab 1: Getting to Know Your Esplora

Objectives:
- Get familiar with the Esplora
- Do some basic problem solving using the Esplora

Starting Point:
None needed.

Process:

Folder organization

1. Open the "Cygwin Terminal." ("Start>Cygwin>Cygwin Terminal"). For the moment, minimize this window. We will use it later.
2. Open Windows Explorer ("Start>Computer").
3. Click on X: drive in the new window.

     Important! Get in the habit of using your X: drive to save all of your files. The X: drive is network storage (5 GB) that you can access from any Windows computer in any Engineering lab on campus; the C: drive is cleared regularly and is only local to that one machine. You will need to routinely access past work no matter the PC. **Saving to the C: drive is unacceptable.**

4. Create a folder in your X: drive called *cpre185*
5. Double-click on *cpre185* to open it.
6. This is your home folder for work with Cygwin for the semester.
7. Create a new folder in *cpre185* named *lab1*.
8. Copy explore.exe to *lab1*. (Your TA will show you where to find it on BlackBoard)
9. Minimize this window.

Collecting Data

In this section, we will grab some data off of the Esplora to support your first homework. The Esplora has a 3-axis accelerometer on it that measures simultaneous acceleration values in three different directions. We will take the acceleration data off of the Esplora using explore.exe.

1. Your TA or mentor will go through connecting your Esplora to your PC.
2. Once paired with your Esplora, open a new Cygwin Terminal shell or use the one we opened before.
   To run explore.exe, you will use a command similar to:

   ```
   ./explore.exe -p COM? -t -a
   ```

-p is the serial port and may change depending on your computer. Ask a TA or peer mentor for help finding the COM port that Windows chose. (You can consult Windows Device Manager.)

3. Move the Esplora around to see how changing directions and orientations change some of the numbers. <u>Hit Control+C to stop the program</u>. Try holding the esplora level in different orientations and see how the numbers change.
4. Now, collect the following data samples (when you use '>' the data is being redirected to a file so you will not see it on the screen):
    a. Place the Esplora flat on the table and use the following to collect data for roughly 10 seconds.
        [1]`./explore.exe -p COM? -t -a > flat1.csv`
        Turn the Esplora over, and while holding the esplora level do another 10 seconds.
        `./explore.exe -p COM? -t -a > flat2.csv`
    b. Hold the Esplora such that the USB cable is pointing upward and record another 10 seconds.
        `./explore.exe -p COM? -t -a > front1.csv`
        Turn the Esplora over and do another 10 seconds. You'll have to do your best as the USB cable is in the way.
        `./explore.exe -p COM? -t -a > front2.csv`
    c. Choose some simple movement of the Esplora that is easy to reproduce. Collect 2 files of data as above using the same movement. Save as custom1.csv and custom2.csv

Save these files for your lab report. You do not need to turn them in with this lab, but be sure you save the files so you can use them later for graphs required in the lab report.

Calibrate the Joystick
In this section, you will work a formula to calibrate the joystick on the Esplora.
1. To start, collect the following:
    `./explore.exe -p COM? -j > filename.csv`
    a. 5 seconds of data with the joystick to the left and forward.
    b. 5 seconds of data with the joystick held to the right and back towards you.
    c. 5 seconds of data with the joystick held in the center
2. Create a linear equation for the horizontal axis that converts the joystick data given to a number between -1 (left) and 1 (right) using data sets a and b.

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[1] You may also use `./explore.exe -p COM? -t -a | tee flat1.csv` so that you can watch the data as it is written to the file.

3. Do the same for the vertical axis where -1 is the bottom and 1 is the top.
4. Given the third dataset, what would be the expression's output whenever it's in the center? Is it near 0? What's going on?

Be sure you have recorded all data requested before you leave the room.

Turn - In
Upload one .pdf file containing the following by the start of lab next week (Beginning of Lab 2). Homework is to be completed <u>individually</u> and <u>typed</u> (except base conversions which is handwritten, but scanned and included in the single PDF submission).
1. Completed homework below

Lab 1 Companion Homework

If you need help with spreadsheets, follow the tutorial at:
http://www.usd.edu/trio/tut/excel/index.html
You need not do the quiz on that website.

1. Old Computers
On the following page, you will find some of the historically important personal computers. Despite their obsolescence, all of the important modern day computing principles were present in them in one way or another. Not all computers are on this web site. You may need to do a google search for some of them. However, this URL will get you started.
http://www.oldcomputers.net/indexwp.html
For each of the following computers, describe their input/output devices, give the minimum and maximum amount of RAM (memory) available in the system in kilobytes as well as in bytes and bits, and tell me what CPU is used.
1.1 MITS Altair 8800
1.2 MOS KIM-1
1.3 Apple 1
1.4 IBM Personal Computer (PC) 5150
1.5 Apple Macintosh

2. Base Conversion

Learning binary and other numbering systems is an important skill for computer and software engineers. Write the following in decimal (base 10), binary, octal (base 8), and hexadecimal. Show your work **by hand** (don't forget to scan your work and put it in your PDF).

Decimal 1, 10, 42, 255
Hexadecimal F, DF, 81, 04
Binary 10010011, 111111

3. Exploration

Steps

1. Load your data from lab 1 (flat1.csv, flat2.csv) into a spreadsheet.
2. Do a scatter plot of the 3 right columns on the y-axis against the leftmost column on the x-axis for each file.
3. Do the same for front1 and front2 and then for custom1 and custom2.
4. Include all of these plots in your PDF, one per page.
5. You should have 6 pages of graphs.

Questions (The first few paragraphs of
http://www.dimensionengineering.com/info/accelerometers may help you out.)

1. What do you think each column of data represent?
2. What unit of measure are they in?
3. On each of your plots, explain what is going on. Try to understand why the graphs look like they do and then relate the graphs to what you did when you took the data. Label, by hand (scan and include in your PDF), parts of the graphs and then describe what is going on.

4. Joystick Calibration

1. What is your calibration equation for the joystick?
2. What did you find as the center point? Explain why it is/is not 0?
3. What could be the effect of the center not being 0?
4. What could you do to come up with a better method of calibration?

Upload this report as a single PDF file to Blackboard before the start of your next lab section.