EMG Workshop

Materials

- Arduino software & code (from bCourses)
- Processing software & code (from bCourses)

- EMG Sensor: Either 1) SpikerBox (with orange cable connector and paperclip) or 2) MyoWare Sensor
- USB2 cable (most are grey, one is blue)
- Electrodes (you will be given 2-3 depending on your setup)

Methods

1. Connect the sensor to the Arduino
    a. Red/orange (+) wire to the 5V pin
    b. Black wire to the GND next to the 5v pin
    c. White wire to the A0 pin
    d. *Check your set up with the figure below (Figure 1).* ***Ask the professor or GSI to check your setup.***

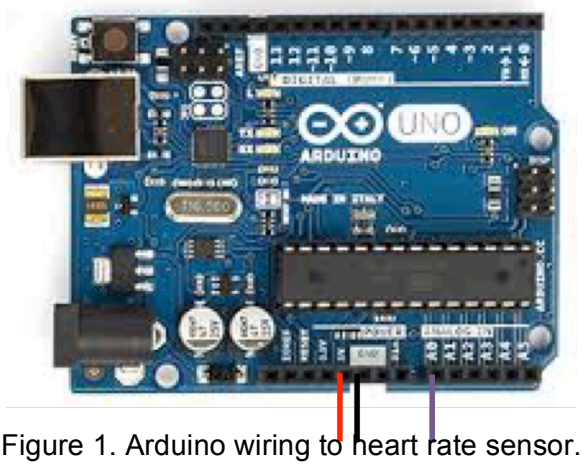

Figure 1. Arduino wiring to heart rate sensor.

2. Connect the Arduino to a laptop using the USB2 cord.
3. Connect the EMG sensor to a muscle (e.g., biceps or triceps).
    a. For the Spiker Box, the black wire needs to be connected to a paper clip that you hold onto or tape to yourself. You will also need to turn on the speaker (large black wheel), which will complete the circuit and send the signal to the computer.
    b. For the MyoWare, you will need to connect the third (black connector) to a 3rd point on your arm (ground).
4. Open the BrainBox.io code on Arduino available on bCourses.
5. Upload the code to the Arduino by hitting the upload button (Figure 2 – red circle).

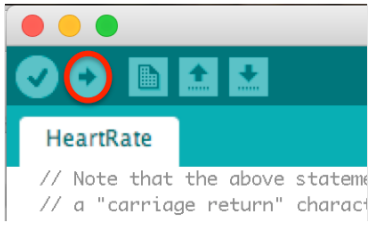

Figure 2. Arduino screenshot.

a. If you receive an error when uploading the code, it may be due to the port not being automatically recognized. To change the port go **Tools > Serial Port**

6. Once the Arduino code is uploaded to the Arduino, check your readout on the Serial Monitor (in Arduino). **Tools → Serial Monitor**. The values may be difficult to read but it should look like the values are fluctuating. If the values look like they are fluctuating (i.e., not constant), close the Serial Monitor and open Processing.
    a. If you are using the SpikerBox and are not seeing signal fluctuations with muscle movement, make sure that you can hear signal fluctuations through the speakers.
7. The Arduino does not have memory on the microcontroller; therefore, you must use Processing to save the collected data readout from the Arduino. Open **Processing**.
8. Open the Processing code provided on bCourses (save_sensordata.pde). *Be sure to change the name of the .txt file on Line 12 to save your data in a new file (Figure 3 – red box).* Each time you run the software it will save over the existing .txt file, so you must change the file name before re-running.

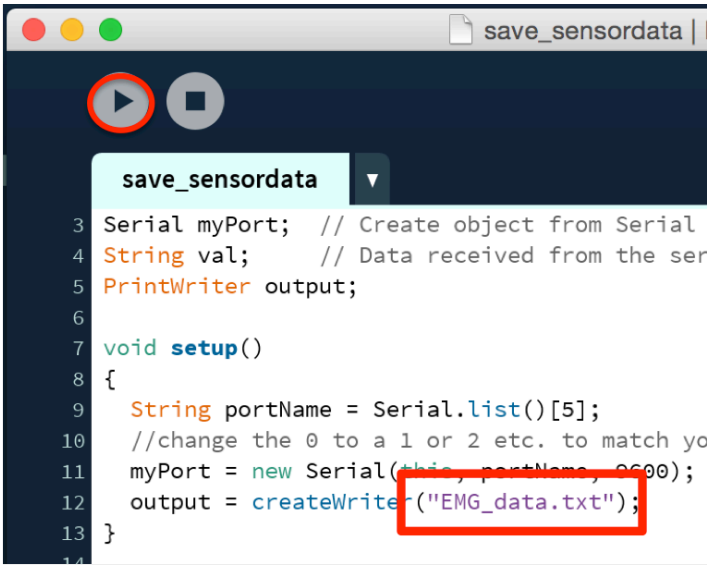

Figure 3. Processing code.

9. Run Processing code to save data collected from the Arduino (Figure 3 – red circle).
10. First run a test to make sure you are correctly collecting data. Run the Processing code to collect data for 15-20 seconds. Then press any key to kill the code (*mac*) or close the small grey window that popped up when you ran the code (*PC*).
11. Open your data by opening the *.txt file in Excel.
    a. ***Mac.*** Right click the *.txt file in a Finder window → "Open with …" → Excel. The file should automatically open in Excel with only one column of data showing.
    b. ***PC…***. Right click the *.txt file where the file was saved on your PC → "Open with …" → Excel. The file should automatically open in Excel with only one column of data showing.
12. Plot your data using a Smooth Lined Scatter Plot
    a. ***Mac.*** Select the A column. Then under the "Charts" Tab, select Scatter → Smooth Lined Scatter. A small figure should pop up with the data shown.
    b. PC… Select the A column. Then under Insert → "Charts", select Scatter with Smoothed Lines". A figure should pop up with the data shown.

13. You may have some noise that can be filtered out of your code. This is particularly important for the SpikerBox (e.g. values near 0 or over 4000). An example of raw output data from performing two pushups is provided below. Note the initial spike in the readout data.

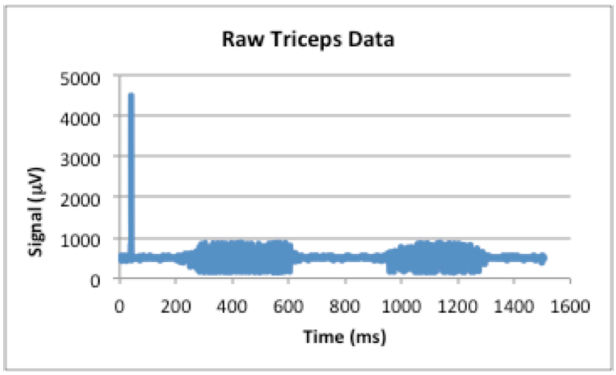

Figure 4. Default Excel graph for raw

14. ***Normalize Data***: You will also need to normalize the data. In Figure 4, the baseline data readout (i.e., when the muscle is not active) is near 500 μV. You should subtract this value from your raw data. See the cleaned data in Figure 5.

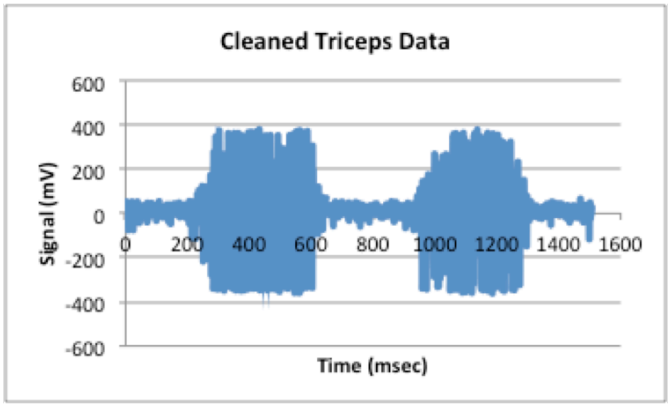

Figure 5. Cleaned data from triceps during pushups.

15. ***Test conditions:*** Test multiple variables with the EMG to write up for the team report. Perform 3 runs for each test so you can average your results for data analysis.
    a. biceps curls with 5 lbs versus 15 lbs
    b. biceps activity versus triceps activity
    c. BrainBox vs Myoware (you will need to swap equipment with another team)