Final Project

So far in the course, we have completed 9 weekly labs focused on sensors, instrumentation, and measurement. For these labs we have provided a fair amount of guidance in how you should make the measurements, what sensors you should use, and often provided the circuit that you needed to analyze and build. For the final 3 weeks of the course, you will work in pairs on a lab of your own choosing. Below we provide some topics from among which you can choose, but you will need to design and build your system, decide how you will test the system, and decide how your final experiment should be run. The general guidelines for the final phase of the course are as follows.

Teams

- You will work in pairs. A few teams of three are allowed to round out odd numbers.
- Your **team must all be in the same lab section** and you must continue to come to your lab class. Please don't ask for an exception to this. By having teams from the same section we continue to keep the sections all about the same size and know that the team will be in class together at the same time. It's only a three week project; you can survive without your BFF for that time.
- You can select your own lab partner - we will not be assigning you.

Project ideas

You can select from the following list of projects that we have seen work and know are reasonable for the time you have. In lab, we can also provide resources and ideas to get you started on how each of these may work.

1. **Electronystagmogram (ENG)**; http://en.wikipedia.org/wiki/Electronystagmography . This test can be used to measure eye movements.
2. **Pulse oximeter**. http://en.wikipedia.org/wiki/Pulse_oximetry In lab 5 you measured your pulse using light. Using those same finger probes, you can also build a system which measures the oxygen content of your blood. The pulse oximeter is regularly used in hospitals for patient monitoring. The system works by comparing the difference between red and infrared light which passes through the finger.
3. **Tubidity sensor**. This system would measure the clarity of water samples by comparing the relative amount of transmitted and scattered light through the sample.
4. **Calibrated BCG**. In the BCG experiment we only received a qualitative signal which related the change in your scale reading to the heart beat. Here you would attempt to get a quantitative measure of the change in force.
5. **Salinity sensor**. In lab 6 you built a system to measure glucose concentration. Here you would build a system to measure salt concentration.

6. **Auditory localization**. In lab 9 you build a system to measure the time delay between an emitted and received signal after a reflection. Using two receiver microphones you can also localize a sound in the same manner your ears do.
7. **Color sensor**. Using LEDs and photodiodes you can construct a system which senses color.
8. **Metal detector**. Always wanted to get rich finding precious buried treasure in parcel B?

We are also open to new ideas that you may have. If you suggest a different idea than above, we will need to approve your choice so that we believe the project is appropriate for the course and manageable in the time you have to work. If you want to propose your own idea it must follow these general guidelines.

1. The idea must fit within the spirit of the course (Instrumentation, sensors, and measurement). No robots. No control projects. No input devices for video games. No radios.
2. The project must be manageable with given time and resources. No capacitive touch screens.
3. The project can't rely on specialty sensors that we don't have, are expensive, or have long shipping times.
4. The project must have some measurement and calibration aspect.
5. The project should not rely on circuits that are very different than what we have studied – we want you to design your circuit, not just copy some complex thing that you found online.
6. It must be awesome.

Supplies

We will order all parts needed for the electronics during the first week. After we get a sense of what teams are working on we will order a large stock of parts needed to execute the projects in addition to a general supply of resistors, capacitors, op-amps, instrumentation amps, etc. If you need additional parts, talk to us. We will either order for you or you can purchase directly and get reimbursed.

Timeline

We have three weeks. One week before Thanksgiving and two weeks after. During each lab section, the instructors will spend time with each team. The first week we will talk with you about your project selection and help get you started. In the two weeks after thanksgiving we will want to see your progress. We would expect that your lab work would be done by the last day of class (Dec 11) and then you would have one week to synthesize your findings. Your final lab report is due during our allotted final exam time: **December 18 – By noon.**

Final report

Your lab report should be more extensive than your previous ones, but it need not be long. Things you should include are

- Some short introduction to your problem, what you are trying to, and the basic principles involved.

- A description of your final circuit and system. This description should include detailed diagrams (such that someone else could replicate it) as well as qualitative description of the function of the different elements in the system. A functional block diagram to accompany the circuit diagram would be a concise way to explain your system.
- Results and analysis of your circuit testing. In order make sure that your circuits are working as designed, typically in previous labs we had you do things such as test with square wave inputs, sine waves inputs, or create Bode plots. You should have some element of your report which demonstrates in a concise manner that your system is functioning as designed.
- Final results of your experiment. This section of your report will be similar to what you have included in all your lab reports this semester. Associated with the results you should typically have some calibration curve, i.e. in our previous labs we had tests for different glucose concentrations, time delay as a function of distance to a wall, voltage as a function of mass on the beam, etc. For projects such as the ENG or Pulse Oximeter, a quantitative calibration curve may not be possible.

You should discuss with the instructors and/or Ninjas what you plan to include in your final report before you actually submit it.