EE361 Microcomputer-Based Digital Design

Fall 2008

Semester Lab Project

The purpose of the semester lab project is to put together all you have learned of the use of microprocessors in digital design so far and to exercise your skill in oral and written presentation of your work. The project grade constitutes 15% of the course grade and will be graded out of eight points. Of this, four points will be based on the report of your project and four points will be based on your 15-minute oral presentation and demonstration to the class.

The project needs to be complex enough to demonstrate your mastery of the material but not so hard that finishing it is impossible. Projects are eligible for up to two bonus points on the eight-point scale: you could score 10 points out of eight if your project is particularly ambitious or imaginative, as long as it is well done, too.

I will assign presentation slots using a more-or-less random process later in the semester. All written reports are due not later than 1600 on Tuesday, December 9, 2008.

Your first deadline is to submit a one- or two-paragraph proposal to me by the start of class on Friday, October 17. The proposal must explain what you are going to build and roughly how you are going to build it. Following this paragraph are some guidelines for your project. Your proposal must provide specific information to address the ones marked in the right margin with a :

- You must use a PIC16F884 processor in your project.
- There must be one or more inputs to the PIC processor, not counting the reset signal. Of these, at least one must be analog and at least one must be digital.
- There must be one or more outputs from the PIC processor. These may be digital, analog (via a low-pass filter), or both.
- You must use at least one interrupt-driven process in your design.
- Your project must be substantially different from the labs you have already done and from projects being done by others in the course. This does not mean I will prohibit two projects to build, say, a thermometer. However, the two projects must not follow the same approach. The best way to achieve this is to keep your proposal confidential until you have submitted it and had it approved.

- It must be possible to demonstrate your project in such a manner that an onlooker can see at once what it does and that it works correctly. It is not sufficient to point at it and claim that it is calculating cosines successfully unless you can show that it is doing so.

- You may work singly or in pairs, but not in teams with more than two members, except as specified in the next paragraph. If you work in a partnership, both members of the partnership must participate in a meaningful way in presenting the system.

- You may collaborate with another team on a joint project if you would like your projects to communicate with each other, say using a serial or a parallel interface. For example, it would be permissible for one team to devise a PIC-based system that acquires multiple analog inputs and for another team to display one of them at a time under operator control in another PIC-based system, obtaining the digital values from the first system via a communications interface. However, each team needs to be prepared to demonstrate that its project works even if the other team fails to get its part of the joint project to work.

- The written report and oral presentation both need to set out similar information, although the written report will of necessity have more details. They should include the following items:

  - The purpose of the project,
  - The underlying mathematics used in its design. For example, sampled data systems are sampled at some frequency f_s. Explain mathematically how you get the PIC to perform the sampling at the required rate.
  - A schematic drawing of the circuit. This needs to show how the PIC is connected to all the components. See the example written reports at `http://www.usna.edu/EE/ee361/Labs/` for guidance.
  - The program listing (not the `.asm` source file, but the `.lst` listing file.) Follow the documentation standards posted at

    `http://www.usna.edu/EE/ee361/Labs/`.
  - How the PIC program causes the circuit to meet the objective. The code should have enough comments to make its operation clear and the written report should elucidate the program and the circuit design fully.
  - The results actually obtained. These should include measurements where appropriate, along with comparisons to the expected performance and hypotheses explaining any discrepancies.
  - Conclusions you may have drawn based on the observations you make on the system and your experience in getting it to work.

  Some suggested ideas:

- A Dual Tone Multi-Frequency generator like the ones used in touch-tone phones.
- A drawbridge.
- An elevator.
- A temperature-controlled oven or refrigerator.
- A sonic range-finder.
- A system to measure the interval between successive hand claps.
- A system to measure the duration of a hand clap.
- A tachometer.
- A weighing scale.
- An electronic game such as Simon Says.
- An LCD display with a keypad for entering data.
- An alarm clock.
- A stop watch.
- A digital thermometer.
- A light organ, such as those commonly used by musicians.
- A digital calculator.
- A random noise generator.
- A random number generator.
- A device for corrupting data with a user-selectable bit-error probability.
- A digital voltmeter, ammeter, ohmmeter, or wattmeter.
- A burglar alarm.
- A device to launch a ping-pong ball from a standstill, race down field, stop, and catch the ping-pong ball again.