PHYS 235 — Final Projects
Spring 2009

Assignment

Your job is to design and construct an electronic circuit that incorporates both analog and digital elements to perform some "useful" function. In addition to demonstrating a working circuit you must also write a manual that describes how to use the circuit and how the circuit works. Your project should be bigger in scope than any individual lab exercise in this course (except perhaps for the analog-to-digital converter), but a good final project can be based entirely on circuit components that you have already used in lab and fit on one Proto-Board. (It's ok to incorporate a few new circuit elements, but I don't want you to be pushing very far beyond principles and components that we have already covered.) Projects are to be completed by teams composed of two students.

The best projects will:

- include some analog and some digital circuit elements;
- include some original design work (that goes beyond copying somebody else's schematic diagram);
- be completely understandable by someone who has successfully finished this course.

Schedule

- **Friday March 27: Selection of Teams & Project Title**
  It would be also be good to have collected some references on how to achieve your potential project goals at this time.

- **Friday April 3: Initial Proposal.**
  This proposal should state the goal of the project and give a preliminary circuit diagram (or block diagram with statement of principles); specific components are not absolutely necessary at this time. It is strongly advised that you discuss preliminary ideas for your proposal with Marty Ligare, or Jay Strother as soon as possible. Part of the grade on your project will be based on your proposal, so put some thought and effort into it. (You will be allowed to deviate from your proposal if, after discussion with the instructors, it is deemed necessary.) The best proposals will be based on something that you are confident that you can achieve, with possibilities for more challenging extensions.

- **Wednesday April 8: Draft of circuit diagram and parts list.**
  This should be a more developed design than that submitted with your initial proposal. It may still have "block" components, but it should be complete enough that you can submit a parts list. The parts lists will give us an idea of what basic components we need to have in stock, and if there are any special components that we might not ordinarily have we can start to identify specific part numbers and sources for them.

- **Final Design and Construction.**
  You will have the lab periods between April 14 and the end of class to work on your projects. You can also use the lab room at any other time.

- **April 28: Circuit Demonstration**
  You will sign up for a time during the last lab period to demonstrate to the instructors that your circuit works. Manuals must also be submitted by 5:00 p.m. on this day.

Grading

- **Operation of the circuit.** (10 pts)
  - Does the circuit work?
  - Does the circuit work reliably?
- **Documentation/Manual.** (10 pts)
  - Is the goal of the project clear?
  - Can a user who is totally unfamiliar with the project make the circuit perform its intended function?
  - Does the manual include a functional block diagram?
  - Does the manual include a complete schematic diagram?
  - Does the manual include a diagram that makes the physical layout of components clear (so that it would be possible to debug or repair the circuit)?
  - Can another student in PHYS 235 who is totally unfamiliar with the project understand how the circuit works?
- **Circuit Design & Circuit Construction/Organization.** (10 pts)
  - Is the final circuit design appropriate for the intended function?
  - Was the initial proposal done carefully and developed into a final design in a timely manner?
  - Is the circuit laid out on the proto-board in a clear well thought out manner?
  - Is the wiring neat enough that the circuit could be debugged or modified for other purposes?
- **Degree of Difficulty.**
  This will be multiplicative weighting factor of $1.0 \rightarrow 1.5$ The weighting factor rewards challenging projects whose design, construction, and debugging is more difficult. Carefully consider the difficulty of the project you choose: although choosing a more difficult project will result in a higher weighting factor, such a choice presents the risk of project that doesn't work. The weighting factor will be determined by the project you complete, not the project you propose. A good strategy is to choose a project that has a simple basic core that can be embellished with more difficult additions.

Project Ideas (from previous years)

- Electronic toy or game (e.g., a reaction time game, dice game, logic game, etc.)
- Transducer based project — device that detects some physical quantity and does something with the measurement. (Digital thermometer with a visible LED scale; differential thermometer which measures temperature differences; automatic plant waterer that detects moisture in soil; pH meter and automated buffer preparer, . . .)
- Clock based project — digital alarm clock, sports scoreboard, stop watch or programmable timer.
- Electronic lock
- Sound activated or proximity-activated device
- Capacitance meter with digital readout
- Capacitance touch-dimmer switch for turning on/off an electric lamp or other device
- Stay-awake alarm for cars. Every 30 seconds, the thing beeps. The driver then has to press a button. If the driver fails to push button in 5 seconds or so, it beeps again, but louder. Keeps getting louder until button is pressed.
- A "remote control" composed of a transmitter (using an infrared LED) that sends different sequences of pulses (depending on the button pushed), and a receiver that does different things depending on which button was pressed.
- Quiz-show buzzer system (determines who "buzzed in" first and locks out other buzzers). Maybe include a score-board along with this.
- Traffic light controller. (Perhaps using sensors to detect metal cars, allow for pedestrian crossing, etc.)
- Flashing lights displays (perhaps displaying messages, etc.).
- Function generator (perhaps with a digital display)
- Noise generator or random number generator
- Music-related item: fuzz box, tone generator, cheesy organ, funky audio effects device, metronome.
- Electronic calculator with ability to enter two numbers and perform an operation displaying result.

- Electronic musical instrument.
- Simple optical spectrometer.
- Audio graphical equalizer display.
- Simple radio.
- Sonar range finder.
- Digital sound recorder.
- LED writing tablet.
- Automated tracking system.

Project Titles from 2008

- 2-bit Simple Simon Game
- Digital Alarm Clock
- "Quick Draw" Reaction Game
- Electronic Lock with Disabling Mechanism
- Random Number Generator (with bounds checker)
- Break-in Detector with Digitally Recorded Response
- Audio Sound System with Mixer
- LED Optical Writing Tablet
- Incoming Call Detector for Cellular Phones
- "Don't Forget Your Keys" (Ultrasound Proximity Detector)
- Automated Tracking System for Reflected Laser Spot
- Digital Pedometer
- pH Meter and Automated Buffer Preparer
- Electronic Dice