Physics 120B: Lecture 7

Projects

The Rubric, Once Again

- Sense some real-world quantity
  - input: analog or digital
  - sensor or user input (switches, keypad)
- Process the information
  - code in software
  - analog processing could play a role
- Do something externally
  - in reaction to the input and processing
  - LCD display at simple end; controlled motion on the other

Getting Ready

- Find a partner
  - not committed to stay in initial group
- Bat around project ideas
  - useful to have several in mind, if you can
  - could be based around a sensor, a technology, an action
  - we'll look at a variety of examples from the past
- Create a written, detailed proposal so that
  - we can evaluate the feasibility and level-appropriateness of the project
  - we can suggest expansions or reductions, easier alternatives, or come up with fallback de-scope options
  - you think through what the project needs in advance

Proposal Contents

- Motivation and overall concept
  - the big picture: why and what
- Functional definition
  - more detailed description of what the thing should do, and how it will react to all foreseeable operating states/stimuli
  - when you code the behavior, it is this section that defines what you are trying to do
- Sensors
  - what input devices are you going to use
  - how do they behave and how are they to be used

Proposal, Continued

- Mechanical Considerations
  - this is where things can get janky
  - it's easy to wave this off as not a big issue, but can be the hardest part in getting the project to work well
  - how is the device supported?
  - how are elements attached?
  - what custom pieces will have to be made?
  - out of what material?
  - do we have the necessary materials on hand?
- Electrical Considerations
  - what elements are needed, and how are they hooked up?
  - analog electronics needs/functions
  - circuit diagram
  - wiring (mechanical aspect: what wires, connectors, etc.)

Proposal, continued

- Interface
  - what (presumably) Arduino unit?
  - what pins/inputs/outputs are needed?
  - what communications?
- Software
  - how will the programming go?
  - what are the tricky parts?
  - what libraries might you use?
  - what new capabilities do you need to explore?
- Testing
  - how easy is it to test performance in the lab?
- Safety
  - flame, sharp objects, high velocity, high voltage, chemicals, etc.
  - how will you manage safety if these things are involved?

Proposal, continued

- Parts and Reusability
  - what parts do you need?
  - what parts are on hand?
  - what new parts are needed?
  - which parts will be consumed vs. reusable by future projects?
  - are there long lead-time items on the list?
- Expansion Options
  - what enhancements might you consider if things are going very well?
- De-scope Options
  - what ambitions might you shed if things are tough
  - fallback positions defining minimum capability

Proposal, continued

- What you will turn in
  - a brief section of the proposal explaining the contents of the report you expect to hand in at the end
  - a well-written proposal can serve as 70% of the final report

- Why all the work?
  - proposals are a key part of science
    - a spear with which to chase down Mammoth (NSF, NASA, DoE)
  - proposals focus the mind to clearly think through a project
  - the proposal becomes a template or guide to your work
    - helps organize/prioritize actions
  - gives a chance to sync up to class expectations

A Template Proposal

- For the fourth-week lab, we will switch gears a bit and make a mini-project following a proposal-form write-up
  - light-tracker with optical collision sensor/interrupt
  - you get a good example of what a proposal contains
  - you learn more about what a project takes to accomplish, on a smaller scale
  - you are turned loose to apply the skills acquired in first few weeks of the course
  - look for e-mail announcing release of “proposal”
    - replaces lab instructions for fourth week

Due Dates

- Proposals are due by the end of 5th week; Feb. 8
  - Gives us weekend to read and offer feedback next week
- You will have about two weeks to work on both the project proposal and the mini-project
- Don't worry about a complete report for the mini-project
  - usual functionality check by TA/prof
  - turn in code
  - paragraph about contributions
- Mini-project due Feb. 12/13
- Will stick midterm sometime after these due dates

Equipment Needs

- We have an amazing array of useful junk/parts
  - start here
- Stuff we don't have, you either purchase yourself, or UCSD buys
  - will it be used in future student projects?
  - is it reasonably-priced?

List of previously used devices/techniques

- Compiled by Fred Driscoll; • represent instances in past several years
  - I'm not clear on what all these things refer to
- Digital Out
  - many LEDs •••
  - Relay/Valve/Solenoid •••
  - AC power control (relay) ••••
  - Stepper motor ••
- Digital In
  - pushbutton •••••
  - light break (photogate) •••
  - magnetic sensor (present or not) •
  - IR proximity ••
  - Passive IR (thermal) •

Components, continued

- Analog In
  - potentiometer •
  - joystick ••
  - phototransistor •••
  - thermistor •
  - flex strip •••
  - accelerometer •
  - gas sensor ?
  - weight •
  - audio bands ••••
  - coherent detection •
  - 40 kHz ultrasonic ••

Components, continued

- Analog Out (PWM)
  - LED brightness control ••••
  - motor speed (drive; optoisolated) ••••••••
  - motor position (servo) ••••••••••••
- Timing
  - RPM ••
  - echo-distance ••
  - valve time •••
  - data logging •
- Time Slicing
  - 7-segment display •
  - keypad ••
  - touch-sensitive caps ••
  - remotes ••

Components/techniques, continued

- Serial I/O
  - MIDI •••
  - I^2C Temperature (?) •••••
  - blood pressure •
  - PC input ••
  - Camera •
  - Sound synthesizer •
  - USB
- Parallel I/O
  - Liquid Crystal Display (LCD) •••
  - DAC •
  - 8 LEDs

Some Time Touring Old Projects

- http://nnp.ucsd.edu/Phy120B/tour_121/
  - lots of images, and brief descriptions
- Should also be past project reports to thumb through (in lab 3574, rear bookshelves)
  - more complete descriptions and how they were done