

## Physics 120B: Lecture 6

### 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

## Physics 120B Project Demonstrations

Mayer Hall Addition 3574 & 3544

Friday, March 22, 12:45 PM to 2:15 PM

Every year, the Physics 120B (formerly Physics 121) students come up with fun and innovative projects interfacing to the real-world. On Friday, 3/22, starting 12:45 PM, this year's batch will present their projects to the rest of the class, and we welcome interested visitors. Space may be a bit tight depending on turnout, but we can likely accommodate several dozen onlookers.

### Projects

This year's project titles are (in proposed order of presentation):

- Manav Singh & Mike Chu: **Darryl the Maglev Train**
- Devon Murphy and Zak Kmak: **Sketch an Etch**
- Chris Parzyck, Eric Cotner, Nara Fayzulina: **Killer Quadro-dactyl-copter**
- Jon Eliashiv and Minyoung You: **Dog on an Optical Leash**
- Priscilla Kelly and Sacha Casciato: **Marble Chromodynamics**
- Ben Hass and Matt Morales: **Triangulating Laser Tracker**
- Mark Kattus: **Rock Bottom Boulder Spotter**
- Lije Delorenzo: **Tilt, Aim, Fire!**
- Angelica Gilroy and William Lim: **Zoolander, the Lost Puppy**
- Melissa Dunn: **Don't Spill the Beans!**

### Friendly, Fun, Fantastic

We want to emphasize the *fun* aspect of the demonstrations, and support the students in what they have accomplished, even if some demonstrations fall short of ambitious dreams. So come with smiles on...

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## Physics 120B Project Prize Voting Form

Friday, March 22, 2013

### Two Categories

You are voting for two different awards. Both will be commemorated on a plaque for future generations to see. You can vote the same project for both prizes, if you see fit. Please resist the temptation to vote for your own project: if it's going to win, it probably doesn't need your help, and it distorts the process. Projects don't *have* to perform flawlessly to get your vote (unless you personally regard this as essential).

#### Most Awesomest

Pick the project that you think is most wicked, rad, bomb, or least ghetto. You just think it's a really cool idea and enjoyed watching it perform (or try to). This prize: it's about the project.

#### Most Impressive

Pick the project that garners the greatest respect for how much work, cleverness, technical prowess, or otherwise impressive traits were displayed by its creator(s). This is sort-of a hats-off vote: it's about the people.

### The Ballot

Place an X in the first column for the most awesomest, and another X in the right column for most impressive. It is okay to nominate the same project for both, if this is an accurate reflection of your thoughts. Again, resist the urge to vote for your own.

bomb	respect	Group and Project Title
_____	_____	Manav Singh & Mike Chu: <b>Darryl the Maglev Train</b>
_____	_____	Devon Murphy and Zak Kmak: <b>Sketch an Etch</b>

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## 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

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## 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

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## 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.)

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## 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?

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## 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

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## 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

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## 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
  - extra time to turn this in; proposal comes first

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## Due Dates

- Proposals are due by the end of 5<sup>th</sup> week; Feb. 7
  - 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. 11/12
- Will stick midterm sometime after these due dates

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## 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
  - do you intend to keep it afterwards?
  - will it be usable/useful in future student projects?
  - is it reasonably-priced?

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## Work Shop

- You have access to a workshop with power tools
  - dangerous: rule is **someone else must be in room** when you are operating the band-saw, drill-press, sander, or anything else that could be dangerous
- Keep it clean!
  - restock drill index after you are done
  - put away tools when you are finished
  - sweep up chips/dust/scraps

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## List of previously used devices/techniques

- Compiled by Fred Driscoll; • represent instances in past several years; ♦ represents Arduino-based
  - 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) •

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## Components, continued

- Analog In
  - potentiometer •
  - joystick ••
  - phototransistor •••♦♦
  - thermistor •
  - flex strip •••
  - accelerometer •♦♦♦♦
  - gyro ♦
  - weight •
  - audio bands ••••
  - coherent detection •
  - audio input (yes in past, no records) ♦
  - audio output (yes in past, no records)
  - 40 kHz ultrasonic ••♦

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## Components, continued

- Analog Out (PWM)
  - LED brightness control ••••♦
  - motor speed (drive; optoisolated) ••••••••♦♦♦
  - motor position (servo) ••••••••••♦♦♦♦
  - buzz ♦
  - signal conditioning (yes in past, no records) ♦♦♦
  - electromagnets/coils (yes in past, no records) ♦
  - ESC/brushless DC (no prior records) ♦

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## Components/techniques, continued

- Serial I/O
  - MIDI •••
- I<sup>2</sup>C protocol
  - Temperature •••••
  - blood pressure •
  - PC input ••
  - Camera •♦
  - Sound synthesizer •
  - USB
  - RF communications (yes in past, no records) ♦
- Parallel I/O
  - Liquid Crystal Display (LCD) •••
  - DAC •
  - 8 LEDs

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## Components/techniques, continued

- Timing
  - RPM ••
  - echo-distance ••♦♦
  - valve time •••
  - data logging •
- Time Slicing
  - 7-segment display •
  - keypad ••
  - touch-sensitive caps ••
  - remotes ••
- High Current or Voltage
  - kill switches ♦♦
  - power transistors ♦♦
  - opto-isolators ♦♦

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## Some Time Touring Old Projects

- <http://www.physics.ucsd.edu/~tmurphy/phys120b/projects/projects.html>
  - covers Arduino revolution, starting Winter 2013
- [http://nnp.ucsd.edu/Phy120B/tour\\_121/](http://nnp.ucsd.edu/Phy120B/tour_121/)
  - before 2013: 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

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