Final Project Ideas:

1. **Robots:** The goal is to improve Boe Bots from Lab 7 by replacing old-school STAMP microcontroller with Arduinos. In addition, you will add one or more sensors and actuators to achieve one or more functionalities below.

    a. Enable robot to navigate more complex track with obstacles (i.e. walls). You can use ultrasound transmitter and receiver to measure the distance between the robot and the obstacle and make robot turn when it is near the obstacle.

    b. Enable remote control of the robot using simple IR (infra-red) remote controller (similar to those you use with your TV) and IR photodiodes.

    c. Control the robot using WII Nunchuck or some other game controller. This can be wired or wireless (e.g. using IR sensors from previous step).

    d. Have robot follow the laser beam or flashlight. Light-sensors on robot will pick up the reflection of the beam from the floor and then the robot will follow it. This is a neat way to make your own electronic pet that is on light-leash ☺.

    e. Robot-train: Each robot in the train has additional transmitters and receivers to communicate with robots before and behind it.

    f. Mind control robot: http://shop.oreilly.com/product/0636920021780.do This book is available in the lab and also as an e-book through Safari Books On-Line

    g. Extra fun: Add all kinds of sensors (cameras, sound, heat) and actuators (motors, claws, etc) to have robot do fancy stuff and collect the data for example. For ultimate fun, use Android: http://www.instructables.com/id/Android-G1-Serial-To-Arduino/

2. **Lasers**

    a. **Laser light show:** using motorized mirrors scan the laser beam to write messages and project different patterns on the wall or in the smoke (think parties… ☺). Simplest way to do this is to mount mirrors on servo motors that are and controlled with Arduino. Alternatively, speaker coils can be used to bounce the beam – this is inexpensive and fun way to bounce laser beam around. For some ideas see following videos: http://www.instructables.com/id/Arduino-Laser-Show-with-Full-XY-Control/ http://hackaday.com/2011/03/16/laser-light-show-features-full-xy-control-via-homemade-galvanometers/

    b. **Laser guns:** Use WII Nunchuk (or some other joystick) to control the laser beam (using mirrors attached to motors, as described above) and "shoot" the objects projected on the wall (computer+ projector). Turn this into a 2-player game by using two different laser colors. The winner is the first person who shoots 5 objects (Camera + computer + MATLAB can be used to figure out the winner – very simple image processing).

    c. **Music via laser beam**: Similar to Lab 6 but this time for real - in stereo and over long distance. The goal: transmit music across the Harvard Yard! For added functionality, you can use motorized stages to align the detector to the laser beam and track it to achieve the strongest reception.

    d. **Laser harp:** The following video summarizes this nicely. This is really near project, though a bit involved. http://hacknmod.com/hack/create-techno-with-a-laser-harp/ http://www.stephenhobley.com/blog/laser-harp-2009/

3. **Games**

    a. **Memory game:** Push the buttons (5 of them) in order in which LEDs (5 of them) turn on. LEDs turn on randomly and with increasing speed. The game will also have additional buttons to allow choice of level: beginner, medium and expert.

b. **Arduino-Up classic Mr. Mouth game**: Do you remember good old Mr. Mouth game? (http://www.youtube.com/watch?v=D-RZB8W--cU). Well, now you can teach your Arduino to play it! You can use servo + pulley to catapult the flies into the frog's mouth. You will have to train Arduino of course, that is adjust the position of servo so that flies get into the mouth every time. Also, Arduino needs to know when to catapult the frog (when is its turn to play). This can be done by gluing small reflective surface close to the mouth and detect it using IR LEDs for example. Challenge your friends to beat the Arduino! ☺ Even better if there are 2-3 teams doing this we can have Mr. Mouth Arduino face-off ☺

c. **Digital Etch and Sketch**: Use Arduino to make digital version of this fun toy. You can display the "sketch" on the computer screen or for more complexity attach LCD display to Arduino.

d. **Tic-Tac- Toe:** http://www.instructables.com/id/Arduino-and-Touchpad-Tic-Tac-Toe/

4. **Scientific:**

a. **Computerize Loncar Lab experimental setups** ☺. Use Arduino to control (real!) lasers, detectors and mechanical stages used in in one experiments in Loncar Lab. Right now, computers, D/A and A/D converters are used to run our experiments. This is bulky, expensive and not cool. Arduino would be much better solution!

b. **Smart (sunflower) solar cell:** realize solar cell that tracks the light, and adjusts its position to maximize the generated electricity. This is rather simple project, in fact: it may be sufficient to position solar cell on the servo and write a code for it. But it would be fun and important.

c. **Reaction time hardware and software (**e.g. for experiments in experimental psychology). Display a test word or pattern on a screen (or simply turn one LED in an array on) and measure how long does it take a subject to respond. You can couple brain-wave monitor to this to check out the brain activity during this experiment.

d. **Data logging:** measure different physical (and chemical) properties of environment, including temperature, humidity, pressure, CO_2 concentration (or concentration of another gas), strength of wireless and/or GPS signal, brain activity, for extended period of time. Store the data using flash memory (SD cards), and then send them to computer via USB cable. Write a code (MATLAB) to plot the data.

e. **Detecting seismic waves**: http://hackaday.com/2011/12/11/detecting-seismic-waves-with-a-piezo-element/

5. **Fun**

a. **Smart home:** Control your room lights, stereo and various appliances using Arduino. You can do this from the computer, or from your smart phone. You can use remote-controlled sockets (http://www.amazon.com/Remote-Controlled-Switch-Socket-3-Pack/dp/B001AS4NQS), make your own switches (http://www.oomlout.com/a/products/sesw/), or do something else. This is much simpler than you may think! For inspiration, you can check video shown by IDEO guys http://www.youtube.com/watch?v=Y_Cp_gWIBQ8&feature=related

b. Electronic drum kit: http://inivent.com/ardrumo/

c. Old-school CRT oscilloscope as vintage-looking display: http://www.youtube.com/watch?v=s1eNjUgaB-g.
You can also turn it into a clock (http://www.instructables.com/answers/how-do-i-make-an-analog-clock-with-an-arduino-and-/) or music visualizer http://www.youtube.com/watch?v=J1ylMJwfLmM&feature=related

d. **LED Cube**: http://www.youtube.com/watch?v=U0R9AdIxCq0&feature=fvst
http://www.hownottoengineer.com/projects/lc.html

e. **The Magic Clock:** http://www.themagicclock.com/home
f. **Musical stairs** similar to those in museum of science http://www.youtube.com/watch?v=ZB59JkSVABo. Not that hard. You can use IR sensors and maybe piezzo transducers (similar to those used in electronic drum kit)
g. **(Awesome) music sound machine:** http://www.the-product.org/soundmachines. Not too hard and clearly does not have to look this fancy. We can use pulse generators as sources of music (or even some simple integrated circuits), servos to control the periodicity of the beat, etc.
h. Arduino blimp: http://www.youtube.com/watch?v=SIxTLM3inWo
i. Wearable electronics: http://www.youtube.com/watch?v=0X-hPEZWWo8&feature=related. Also, check out following paper by MIT team: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCUQFjAA&url=http%3A%2F%2Fhlt.media.mit.edu%2Fpublications%2Fbuechley_CHI_08.pdf&ei=xSeCT47AB9Gp0AGy-aDfBw&usg=AFQjCNEBmaksV2GuinMiD1eV_mvhX1Bjxw&sig2=yTJEtrSRSxIcL8VC0NjI6g
j. http://www.youtube.com/watch?v=Oi3dmSMpjsU&feature=BFa&list=SPDE23FAC8A681FA46&lf=list_related, and MANY others from "Colin's Lab"!

If this is not enough, then check out:

http://hacknmod.com/hack/top-40-arduino-projects-of-the-web/

http://www.instructables.com/technology/arduino/