

Arduino Pop-Up – Instructor Notes

Background:

I posted fliers about a week before the class. Class was scheduled for 2 hours.

I set up 6 plastic shoeboxes with assorted stuff in them, for 6 groups of 2 students to use (class limited to 12). Partial parts lists are below.

Students were expected to bring their own laptops **and have the Arduino IDE already pre-loaded**. I had experienced students help to make sure this actually happened.

Most – but not all - students had taken one Intro level programming class. Most – but not all - had had one intro Electronics class. I had a handout on how breadboards work available for students who had not had any electronics experience.

Equipment:

I borrowed the following from the general physics department resources:

- half dozen Fluke DVMs with leads (one per group)
- half dozen bench power supplies (one per group)
- various patch cords and alligator clips – just some, to have around

Each student shoebox contained:

- Arduino Uno
- breadboard 830 point (Amazon)
- small breadboard jumper wire kit 140 piece (Amazon)
- USB cable for Uno
- half dozen assorted LED's, various colors
- a few each 220, 330, 1k, 2k, 10k, 100k ohm resistors
- two pushbutton switches (Sparkfun COM09190)
- piezobuzzer (Adafruit PS1240)
- CdS photosensor (Sparkfun SEN-09088)
- 2N3904 NPN transistor (Sparkfun)
- PN2222 NPN transistor (Jameco)
- 1N4002 rectifier diodes

I had an Instructor Box which contained a full set of all the student box's stuff with several extra backups for the buzzers (which seem to break), and additionally:

- 7-Segment Dot Matrix and Bar Display Grab Bag (Jameco)
- 2 Gearmotors (Sparkfun ROB-11696)
- 2 Gearmotors (Sparkfun ROB-13302)
- Light to Frequency Converter (Sparkfun SEN-09768)

these additional items gave the students who whipped through the regular exercises lots of other things to try. Jameco's grab bag of displays are fun because students have to look up the data sheets and figure out how the displays work, which can be quite a challenge.

Class Structure:

I handed out Arduino-Handout1.pdf immediately, and talked for maybe 5 minutes with students about it's contents. In this brief intro I:

- stressed the low power output of the Arduino in an attempt to have them not fry the outputs drawing too much current.
- asked who had not installed the IDE and pulled them aside to help first (or set an experienced student to do so).
- discussed the suppliers listed on the third page since many students end up wanting to continue on their own, and they have no idea where to buy electronics stuff.
- asked who had NOT used breadboard and got them immediate help (student or handout or both)

Then I handed out the shoeboxes and Arduino-Handout2 and turned them loose. I spent the next two hours flittering around helping with wiring, C, etc. I made no attempt to force them to do things in order or in any systematic way. Most groups go off to do some crazy addon they think up on the fly, which is great.

Follow-Up class:

Some students just wanted to come back and do more tinkering. That's fine.

Some students wanted to play with the extra stuff in my instructor box (displays, motors, relays). That's fine too.

Other students wanted to work through my third handout, which is how to actually run 110V AC powered devices using an Arduino to turn them off and on. For this, I built several setups so they did NOT have to do any house-wiring electrical work on their own. The circuit is given in Arduino-Handout3.pdf. I enclosed the relay into a standard 2-gang electrical junction box; it served to switch a double electrical outlet mounted in one of the two sides of the box. I put a switch plate on the face of this which had the relay wires run out of the switch's hole and the electrical outlet cover on the other side. See photo. This object allowed them to play with an Arduino and SAFELY switch the electrical outlet on and off. I had a huge room-size fan on a stand plugged into this – students seemed very impressed to be able to switch on this big fan with just an Arduino. Many muttered about their stereo at home....

I thought it was important that students learn that an Arduino can switch heavy loads, but also important that they not actually mess with the house wiring themselves.

These boxes used a PN2222 transistor to drive enough current to push a Sparkfun COM-10924 SPDT relay (20A) or a Sparkfun COM-00100 SPDT relay (5 A). I built some with one type of relay, some with the other.

