To: Arduino Course, 2014

From: Mars Gralia

Subject: Proposed “Project”: Switched Line Cord

# Introduction

The goal of this paper is to propose a “project” for the Arduino Course 2014.

Thanks to Jim Bogard for advice and counsel based on his experience with this technology.

## Overview of a Project

A “project” is hereby defined to be the part of the Arduino Course that:

1. Occurs after all students have been through the Main\_Track portion of the course
2. Is about 60 minutes in duration.

Estimate: the budget for a single “project” is $30/student, including shipping, handling and taxes.[[1]](#footnote-1) It is understood that the amortized unit cost will be normally decrease with quantity, but that is ignored herein because I estimate little savings given an expectation of ten (10) students + TAs for any given project.

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# Switched Line Cord (Gralia), 1/1/2014 7:52 PM

### Pitch

Want to control a “normal” plugged in electrical device with an Arduino? Maybe you want to turn on the coffee maker when you stagger into the kitchen on a dark morning and slowly bring the light from barely-on to full brightness. Or maybe you want a ceiling fan to operate only when you are in the room. Or maybe you want to turn on the basement radiant heater and gaming system when you open the door to the basement. Perhaps you want to control your “SMT reflow plate”. Then the “Switched Line Cord” is the project you need to regulate that coffee maker, fan, man cave, or plate.

The key component of the project is an “extension cord” with an embedded switch. Further, that switch is readily controlled by an Arduino and any of the sensors you choose.

The student will construct a push-button controlled night light, using the knowledge gained in the Main\_Track portion of the course.

The tangible take-aways from this project will be a specialized “extension cord” with its internal switch, a high-quality manufactured unit, and the knowledge to use it with a variety of sensors and “loads”.

### Proposal

To amplify on “the Pitch”, above, the student will be enticed to develop a prototype electric light that is controlled via an increasingly complex set of sensors and logic.

The primary goal of the project is to have the student leave with the knowledge that she can control almost any line-powered device by using the specialized extension cord with any of a myriad of sensors options and any logic.

A “line”, in this context, is a cable that carries the ubiquitous 110vac electricity. A “load”, in this context, is any device that draws power from the “extension cord”.

Throughout this, there will be no formal tutorials, directions, wiring diagrams, or software provided. Instead, the student will need to rely on her previous knowledge to advance into the world of sensors and control.

The student will be provided with the following in addition to the material obtained during the Main\_Track.

1. A “switched line cord” in which the output power is controlled by a relay.
2. A “night light” to demonstrate the “switched line cord”.

The student is encouraged to use an alternative to the night light, but she must provide it. Furthermore, the alternative device must present no hazards.

A typical explorative sequence the student might use during the evening is:

1. Demonstrate Arduino control of a line device using the “extension cord”, in which the “load” on the cord is a night light. The state of the night light might be time – e.g., 5 seconds on, 10 seconds off.
2. Demonstrate a simple sensor to control the night light: a push-button switch in which the light is on when the push-button is held.
3. Demonstrate a more complex logic in which the push-button is provides “alternate action”: the first push turns the light ON, the second push turns the light OFF, the next push turns the light ON, and so forth.
4. Demonstrate the night light can be dimmed by using the pulse width modulation capability of the Arduino.
5. Demonstrate motion sensor operation, such as under what conditions it produces a digital output. This would not involve the extension cord or night light, but needs some indicator of the sensor operation. The adjustment on the board will set the threshold.
6. Demonstrate an apparatus consisting of the motion sensor[[2]](#footnote-2), the extension cord and the night light. This includes the program to flip the light ON and OFF.
7. Demonstrate more complex logic, governed mostly by the student’s initiative. E.g., the addition of a push-button switch that is a manual ON/OFF control. And integrate that with the response of the motion sensor[[3]](#footnote-3). E.g., if the motion sensor commands the light ON, what stimulus (stimuli) will cause the light to go OFF?

### Creativity and Potential for Impact

The student’s creativity will be exercised as she invents and implements the sensing and logic that switches the night light.

This project introduces the student to a safe and easy way to control electrical power to most common electrical devices such as automatic door openers, fans and outdoor lights. The impact will extend to all devices operated by “line voltage”.

### What is the course/lab format (length and number of sessions)?

The project will be hands-on by the student for one session of perhaps 60 minutes.

### Why would a greater staff understanding of this area benefit our sponsors?

The departing student would understand that a small computer, such as the Arduino, can control devices which use much more energy than that supplied by a simple battery pack. While the lab involved control of “line voltage”, other power sources can also be directed, such as high-pressure air, 48volts for aircraft systems and hydraulic fluid.

### Requested Funding

Total: $27, quantity one.

#### Specialized Extension Cord



#### Night Light



### Comments

(This was added to SharePoint “projects” summary spreadsheet as “110vac \_relay” on 12/28/2013 9:23 PM but was renamed “Project Switched Line Cord” about 1/1/2014 8:28 PM.)

### Details

1. The student will use a sensor of her choice from the parts supplied in the Main\_Track.
   1. But see below for potential self-funded extensions.
2. The instructor will need to provide 110vac at each students’ desk.
3. Consider upgrade of project: a “smart room light”. The additional capabilities might include the following.[[4]](#footnote-4)
   1. A human-directed ON/OFF control.
      1. Sensor options
         1. E.g., §**Error! Reference source not found.**, Passive Infrared; $3; 12/14/2013 4:16 PM
         2. A consideration, if an IR detector: what does the controller do if the IR sensor does not report motion? E.g., assume the human has left the room and should command OFF? E.g., Stay ON using the assumption the human is engrossed in a book and is not moving?
      2. A consideration: how does the controller know that the human has left the room?
         1. When the human says OFF.
         2. But what if the human just walks out of the room?
   2. Addition of a photocell to measure the ambient light?
      1. A consideration: what if the human commands ON, but the room is well lit?
   3. A “learning” capability in the sense that if the human commanded ON at 5pm for the last 5 days, then the light will come ON at 5pm the next day if the human doesn’t command otherwise.
      1. Consideration: what if the human didn’t command exactly “5”, but was, say 5pm±20minutes? What about 5pm±40minutes?
   4. I considered adding “§2.3.4.3.4.2, Data Logger, $20, 10/22/2013 7:52 PM”, but the total cost would have been $60.07, over the $50 budget. 1/1/2014 8:27 AM.
   5. I considered adding “§2.3.4.3.1.5, Distance Sensor, Infrared, $12; 12/19/2013 10:00 AM”, but the total cost would have been $67.10 (SWAG), over the $50 budget. 1/1/2014 8:49 AM
   6. I considered adding § **Error! Reference source not found.**, “Clap” Detector, $5; 12/10/2013 11:45 AM, but that resulted in a total cost of about $60 (SWAG), over the $35 budget allowed for a project. 1/1/2014 11:39 AM. Oh, it also needed a cable from the acoustic sensor into the Arduino. This is $10 loaded (SWAG), per §**Error! Reference source not found.**, Cables, Header, $3; 1/1/2014 5:00 PM. 1/1/2014 11:09 AM
4. Other applications
   1. Resistance heater for:
      1. sous vide cooker, rice cooker,
      2. pottery kiln, furnace,
5. Options for controllers other than the “relay” options include are:
   1. A relay driven by a BC548 NPN transistor. But verify transistor can handle the current required by the relay.
   2. “RELAY8: 8-Channel Relay Driver Shield”; $35; 12/28/2013 9:48 PM.[[5]](#footnote-5)
   3. "Relay Shield for Arduino"; $15; 12/28/2013 10:19 PM[[6]](#footnote-6)
   4. Other products from PowerSwitchTail.com.[[7]](#footnote-7) E.g., an electro mechanical relay for its robust capabilities; but loss of a “dimming” capability.

(fini)

1. **From:** Echlin, Tara K.; **Sent:** Monday, January 06, 2014 09:14; **To:** Ballard, Bruce L.; Berardino, Robert A.; Bogard, James J.; Esiely-Barrera, Hadi A.; Koontz, Ken; Soriano, Zaza; Summers, John E.; Taylor, Brian T.; **Cc:** Gralia, Mars J.; Pikas, Christina K.; Magorian, Daniel F.; **Subject:** RE: Arduino Course Project Ideas [↑](#footnote-ref-1)
2. No motion sensor will be given to the students. Our budget won’t allow that. But the student can simulate the motion sensor by using a push button. [↑](#footnote-ref-2)
3. No motion sensor will be given to the students. Our budget won’t allow that. But the student can simulate the motion sensor by using a push button. [↑](#footnote-ref-3)
4. This list is a subset of the author’s file “Arduino\_Ledger\_2013\_eg.docx”. A corollary is that there are citations to sections which are not in this document. Sorry. [↑](#footnote-ref-4)
5. <http://www.freetronics.com/collections/all-products/products/relay8-8-channel-relay-driver-shield>; found 12/28/2013 9:48 PM [↑](#footnote-ref-5)
6. Beware: DFRobot, so not much documentation and specs hard to understand. [http://www.robotmesh.com/relay-shield-for-arduino?gclid=COyjttm71LsCFeg-MgodURwAlA#](http://www.robotmesh.com/relay-shield-for-arduino?gclid=COyjttm71LsCFeg-MgodURwAlA); found 12/28/2013 10:20 PM [↑](#footnote-ref-6)
7. <http://www.powerswitchtail.com> Ref: email from Adafruit, 12/28/2013 8:46 AM, where Adfruit says PowerSwtichTail.com is supplies Adafruit. 12/29/2013 5:20 PM [↑](#footnote-ref-7)