

Introduction

Mark Frauenfelder of Make: magazine originally conceived this project. It is one of their most popular projects listed on the Weekend Project section of their website. It was also cross-marketed with Radio Shack as a part of their Radio Shack DIY / The Great Create project series. Links to all the source material can be found here:

Make: Link - <http://makezine.com/projects/monkey-couch-guardian/>

Radio Shack Link - <https://www.radioshackdiy.com/project-gallery/monkey-couch-guardian>

You Tube Video - <https://www.youtube.com/watch?v=WxTsudqfupc>

I think this is a great beginner project for budding Arduino enthusiasts and makers in general as it exposes you to the following skills:

- Arduino Programming
- Basic Circuit Layout
- Soldering
- Basic Tool Use
- Hacking / Modifying Everyday Objects

Note: While the source material above helped inform the following instructions, I discovered some issues with the source code available for this projects and some of the instructions gloss over some finer points I thought important to capture for this class.

Instructions

We are going to use an Arduino, a [passive infrared \(PIR\) sensor](#), and a cymbal clanging toy monkey to create an alarm. Throughout the course we'll discuss many of the individual components in further detail, but for now let's unpack and get making.

Step 1 – Verify Kit



Please verify you have the following:

1. Arduino Uno
2. Sunfounder Arduino Starter Kit
3. PIR Sensor
4. Toggle Switch
5. 9V Battery Snap Connector
6. 9V Battery
7. DC Power Barrel Connector, 5.5mm x 2.1mm, Male Plug
8. 2 AA Batteries
9. Magic Monkey Toy

During the introduction / primer portion of this course, you should have received some of this part listed above (#1 and 2, most likely). The other project specific parts (#3-9) will be waiting for you in Maker Central at your workbenches.

You will also find, along with the aforementioned parts, one additional part: a 5V DC SPDT 1amp Micro Relay. The part was sourced by Radio Shack and should be in a bag that looks like this:

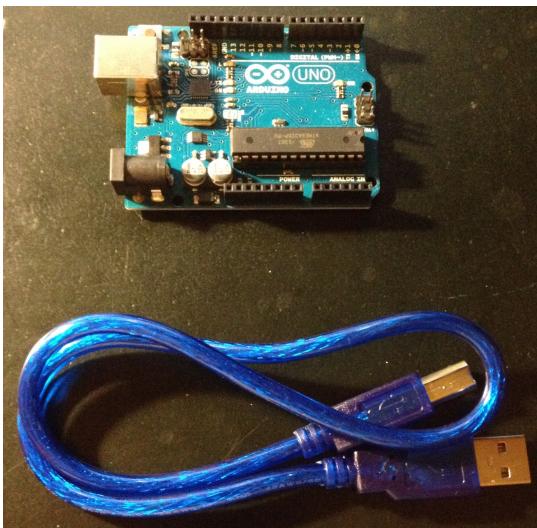


Lastly, the other necessary miscellaneous supplies (solder, 22 AWG wire, etc.) and tools required to complete this project will be provided. They are part of the available tools and supplies available to all Makers in Maker Central.

Step 2 – Prepare Arduino

Next, we are going to prepare our Arduino board for this project by plugging it into our laptop, opening the IDE and loading our sketch onto the board. These steps should be familiar to you from the earlier primer portion of the course.

1. Take the USB Cable (provided in Sunfounder kit) and plug into a free USB port on your computer
2. Plug USB Cable into Arduino Uno board.



3. Launch Arduino IDE



```
monkey_couch_guardian_04 | Arduino 1.0.5
monkey_couch_guardian_04.ino

#define DEBUG_ON 1

// pin 8 activates the relay which switches on monkey
// Note: old version used 13 which was a bad idea due to LED
// unintended consequence was always putting pirState in HIGH state
const int monkeySwitch = 8;

// pin 12 is input for PIR sensor
const int pirInput = 12;

// initialize variables
int pirState = LOW;

// *** Debug Mode Variables ***
int debugMode = 0; // 0 == OFF | 1 == ON

void setup()
{
    if(debugMode == DEBUG_ON)
    {
        Serial.begin(9600);
    }
    // initialize monkeySwitch as an output,
    pinMode(monkeySwitch, OUTPUT);
    // initialize pirInput 12 as an input.
    pinMode(pirInput, INPUT);
    // wait 5000 milliseconds to allow PIR sensor to settle down
    delay(5000);
}

void loop()
{
    //Read PIR value
    pirState = digitalRead(pirInput);

    //Check to see if PIR sensor sees action
    if (pirState == HIGH)
    {
        if(debugMode == DEBUG_ON)
        {
            Serial.println("You Have Awoken The Monkey!");
            delay(200);
        }

        //Turn on monkey
        digitalWrite(monkeySwitch, HIGH);
        delay(5000);
        //Monkey runs for 5 seconds
        digitalWrite(monkeySwitch, LOW);
        delay(10000);
    }
    else
    {
        if(debugMode == DEBUG_ON)
        {
            Serial.println("The Monkey Sleeps!");
            delay(100);
        }
    }
}

Done compiling.

Binary sketch size: 2,846 bytes (of a 32,256 byte maximum)
12
Arduino Uno on /dev/cu.usbmodemfa131
```

4. Ensure Serial port connection is made and Uno is connected to PC. In the Arduino IDE, click File ->

Author: Bob Berardino

Open and navigate to *{insert file name and path here}*.

5. We will eventually upload this sketch to the Arduino board, but this is a good time to set our Arduino aside and prepare our toy monkey.

Step 3 – Modify Toy Monkey

A popular trend in making and microelectronic exploration is [toy hacking](#). We are going to partake in some light toy hacking by modifying our toy monkey.

1. Unbox monkey – Get your monkey unwrapped and unboxed. I know how much you love unwrapping those pesky twist ties.
2. Open the battery case
3. Unscrew switch housing. Set the two screws aside. Once done, should look like below:



4. Drill two holes with a 1/16th bit on opposite sides of switch



5. Cut two 10-12" pieces of 22 gauge wire
6. Thread a wire through each drilled hole
7. Solder the wires into the metal contacts

8. Discard metal plate on plastic switch
9. Enclose the contacts and switch plate
10. Insert 2 AA batteries
11. Close latch.
12. Test by “hotwiring” your monkey. Touch wires together. Monkey should begin to clang and bang. You make even see a slight spark when touching the two wires together.

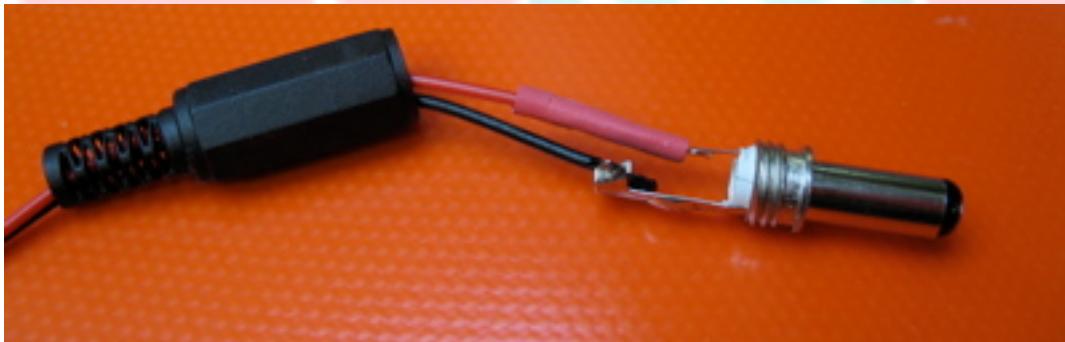
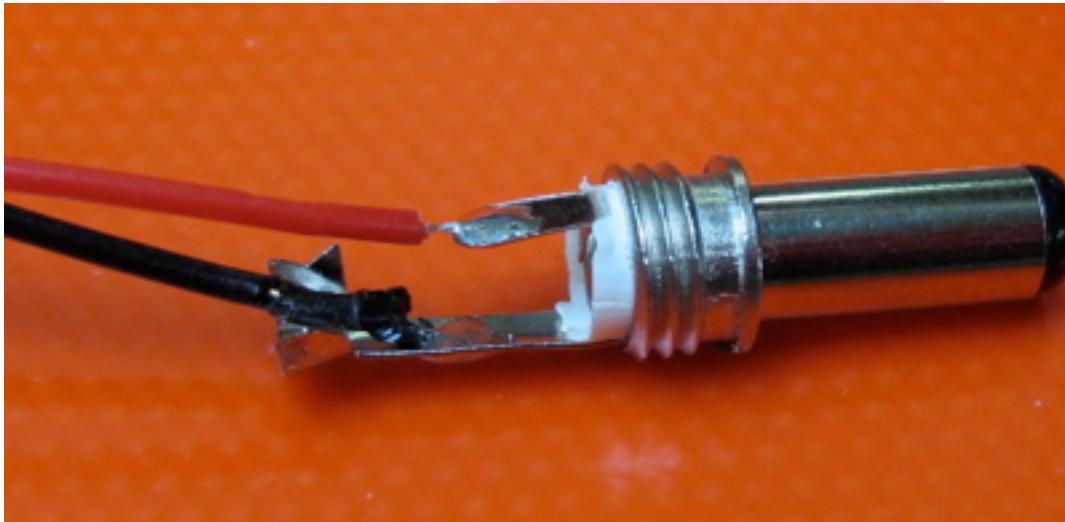


Step 4 – Build the Battery Adapter

Note: The steps and images used for this section on making a 9V battery adapter were taken from the learning section of the Arduino website. Link: <http://playground.arduino.cc/Learning/9VBatteryAdapter>

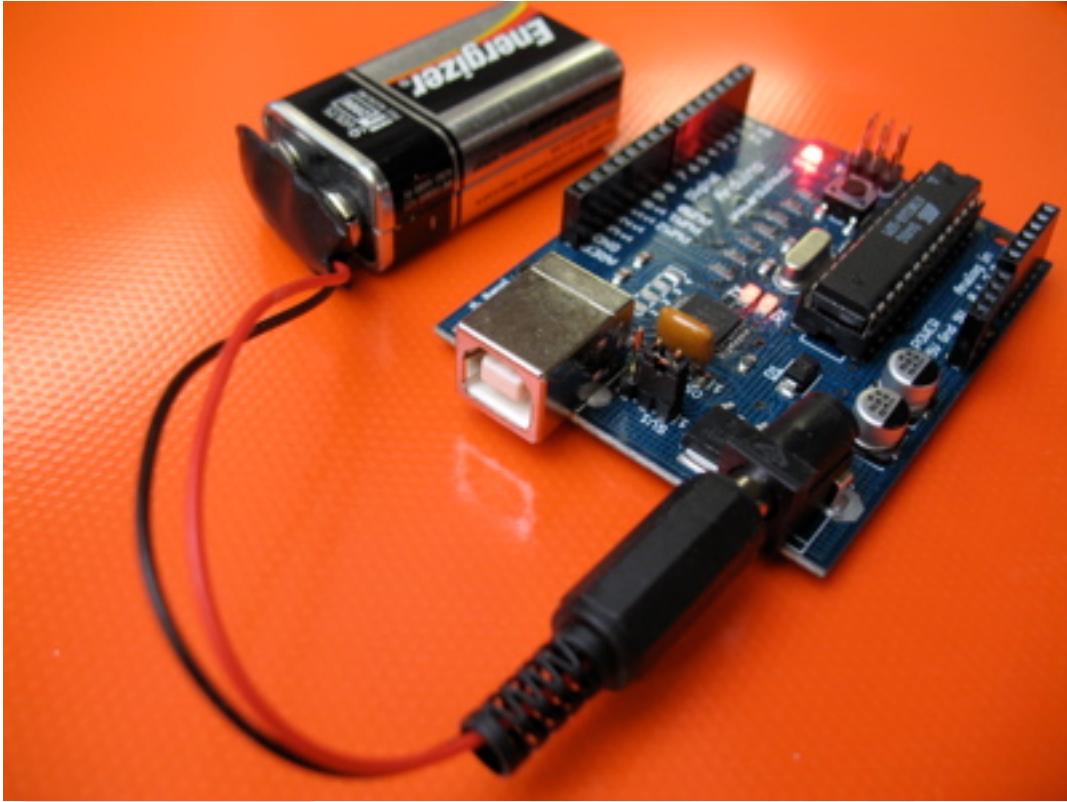


First, slide the outer shell of the plug over the battery clip's wires. Optionally, slide a piece of heat-shrink tubing over the red (+) wire to protect the positive connection. Next, solder the battery clip's black (-) wire to the outside connection of the plug. Then solder the battery clip's red (+) wire to the center connection of the plug. If you choose to add the heat-shrink tubing, slide it down over the center connection.



Once the wires are soldered, slip the heatshrink over the positive connection and gently crimp the wires in place with the small metal tabs. Add some hot glue (not shown) over the connection area for further reliability.

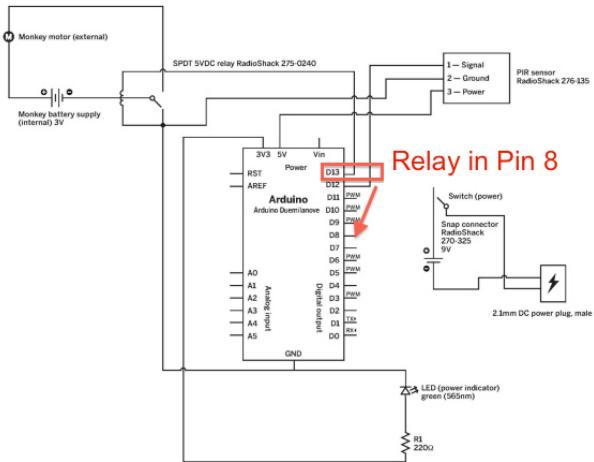


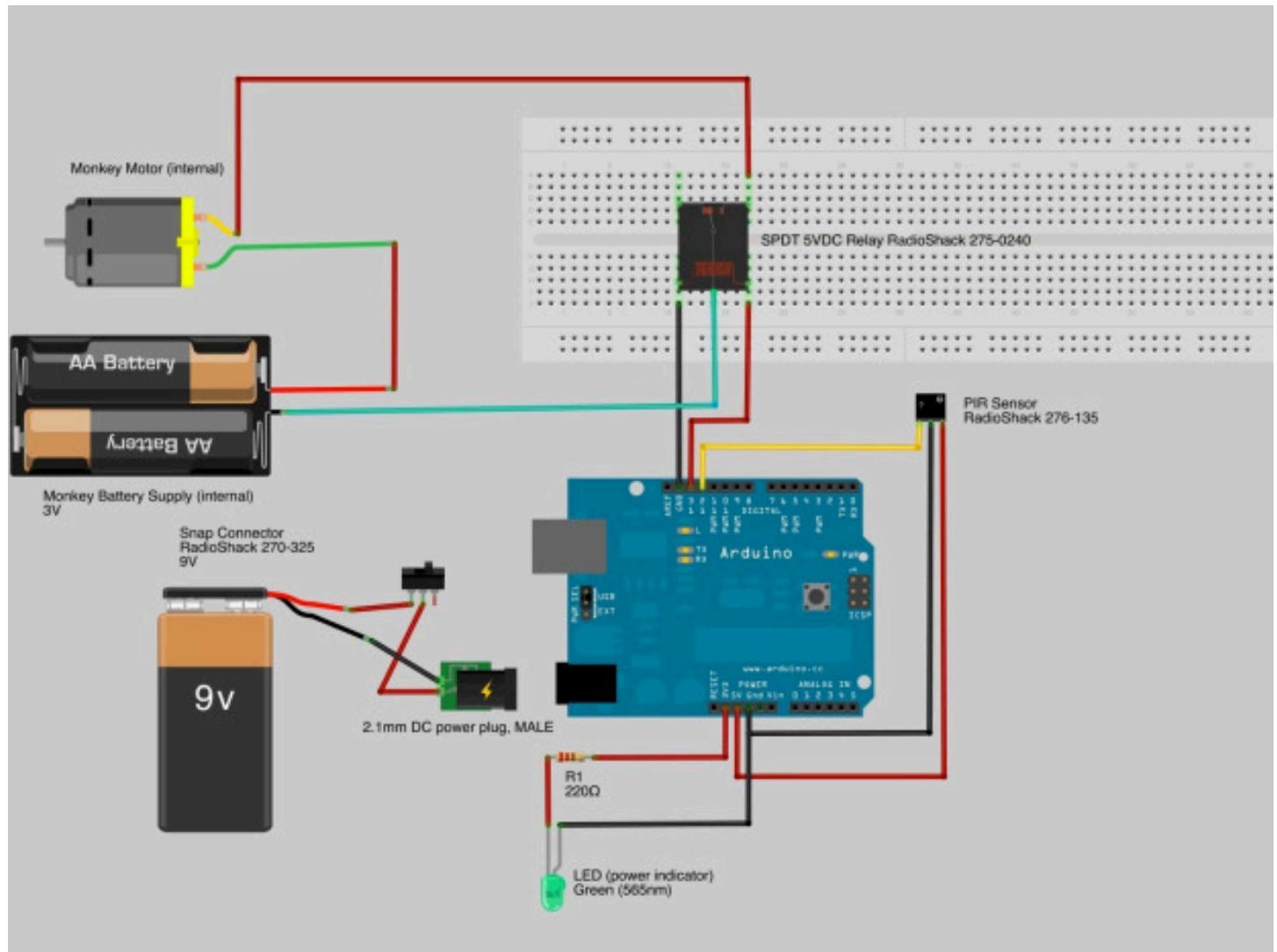


Step 5- Build the Circuit

Note: Where schematics indicate plugging Relay into pin 13, we are going to use pin 8. The diagrams show a motor and a 3V battery supply. Both of these are inside the monkey.

Here's a schematic diagram that gives you an overview of the circuit, along with a layout diagram that shows how it's breadboarded. Both diagrams were made in [Fritzing](#); the schematic is redrawn here for clarity.



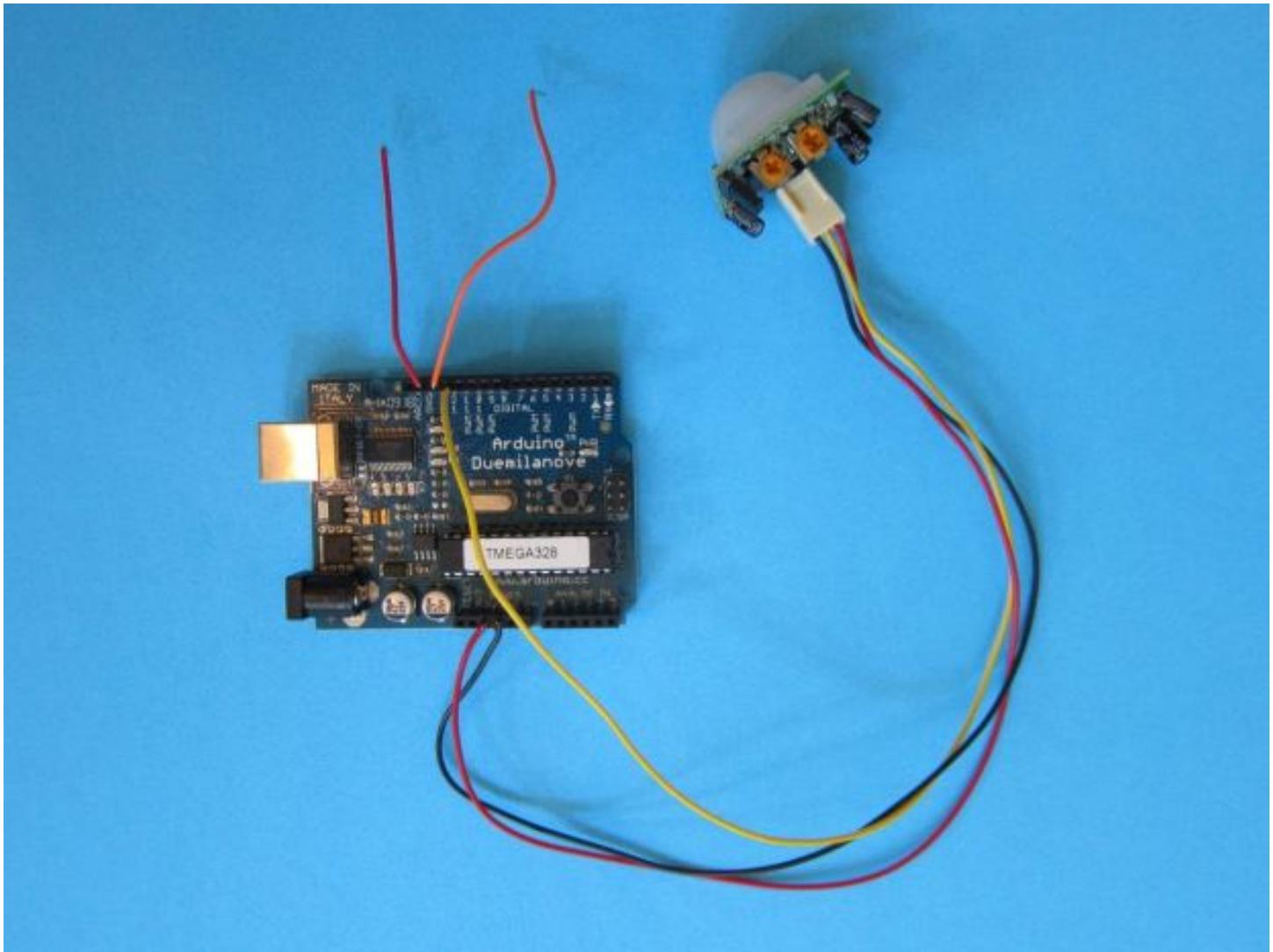


The relay on the breadboard replaces the switch on the monkey. Remember, you took apart the switch on the monkey in order to connect wires to it.

You can power the Arduino with USB power, with an AC adapter, or with battery power. I recommend battery power, as it makes the system portable. We are going to use the 9V battery adapter we just made to power the project once completed.

Step 6 – Wire the PIR Sensor

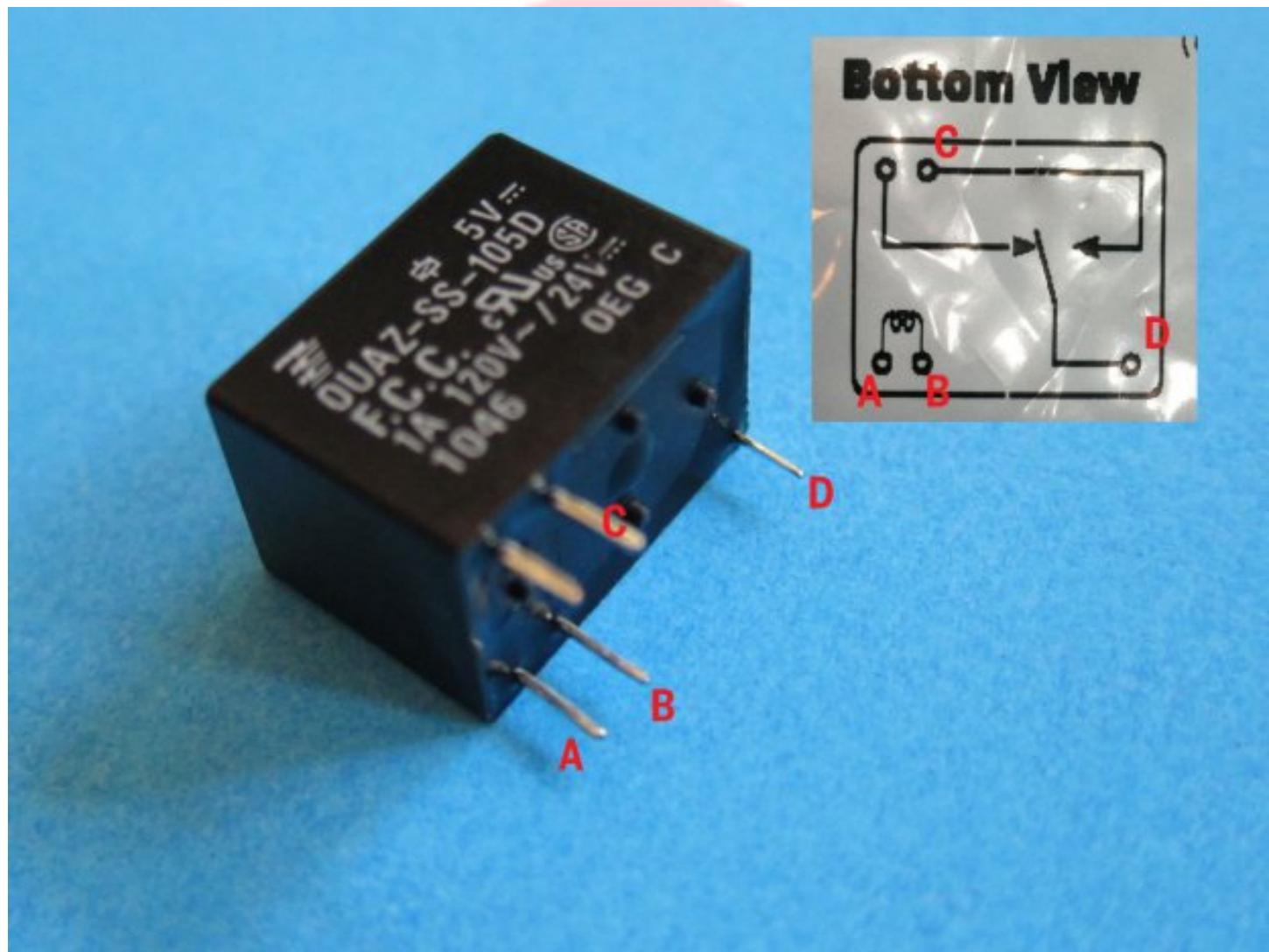
The PIR sensor has 3 pins that fit a standard 3-wire servo extension cable. Please connect the cable to the PIR board. After that connect the PIR sensor to the Arduino as follows:



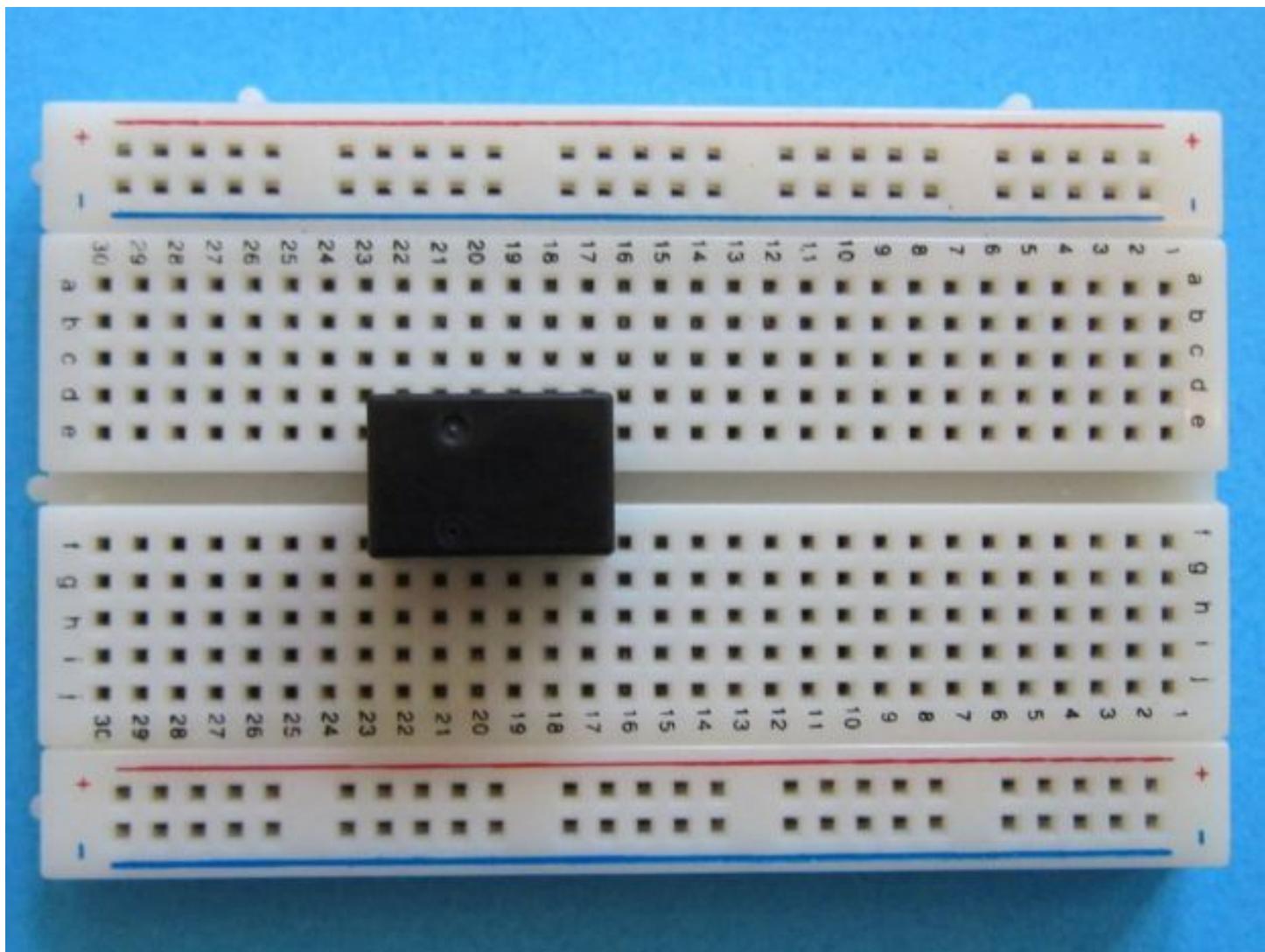
- Connect the red wire to the 5V power header on the Arduino, and connect the black wire to Ground in the same block of power pins.
- Connect the yellow signal wire to pin 12.
- Add an orange jumper wire (jumper wires found in your Sunfounder kits) to Arduino pin 8 (I know the picture above shows it in 13, but please use pin 8) and a black jumper wire to the Ground pin in the same row.

Step 7 – Mount the Relay

This is the SPDT 5V DC relay that came in separate Radio Shack bag. It has 5 pins on it. You'll only be using 4 of them, which are marked A-D in picture above.

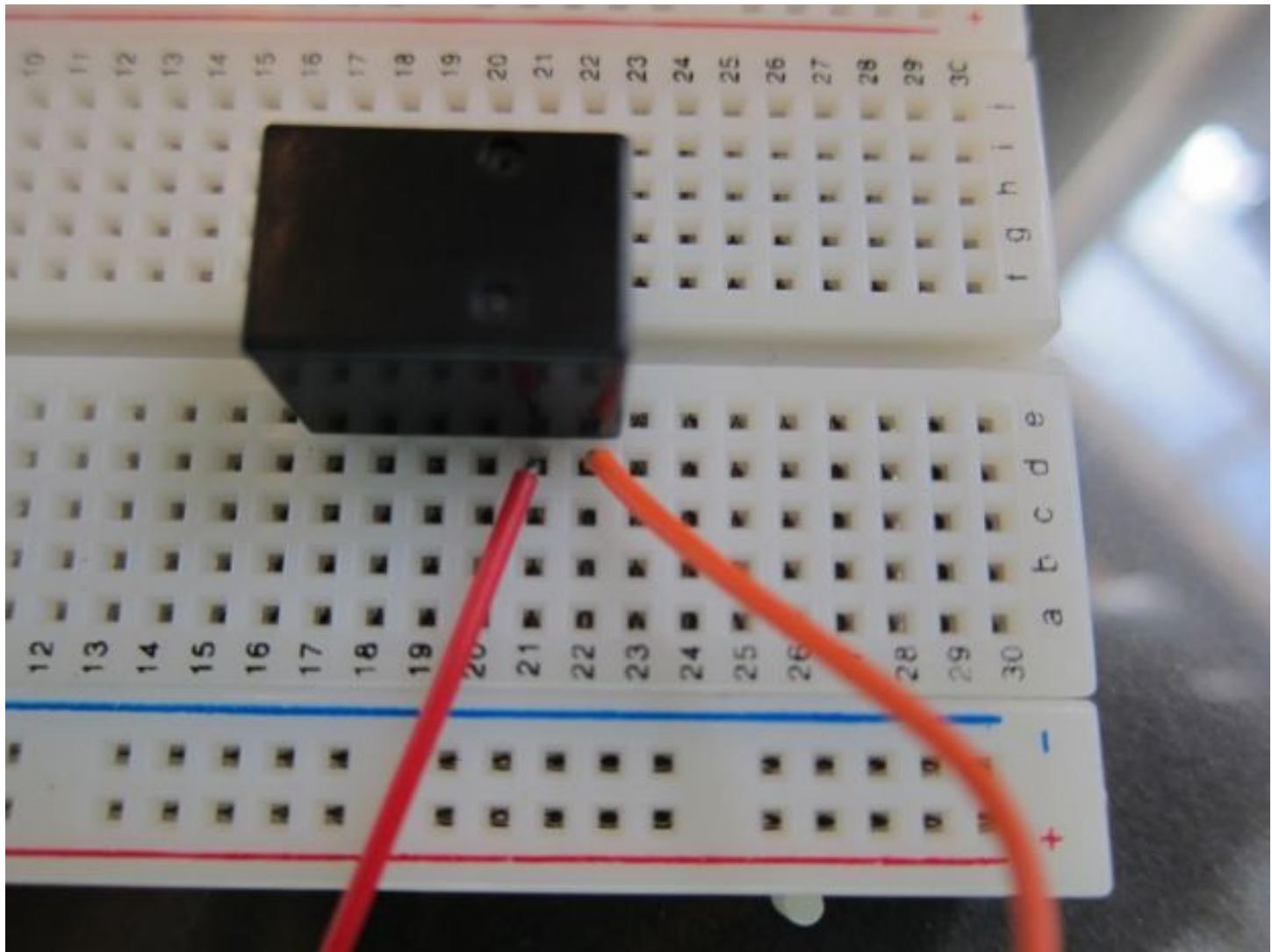


Insert the relay into a solderless breadboard (Breadboard shipped with Sunfounder kit), straddling the center trench. See example below:

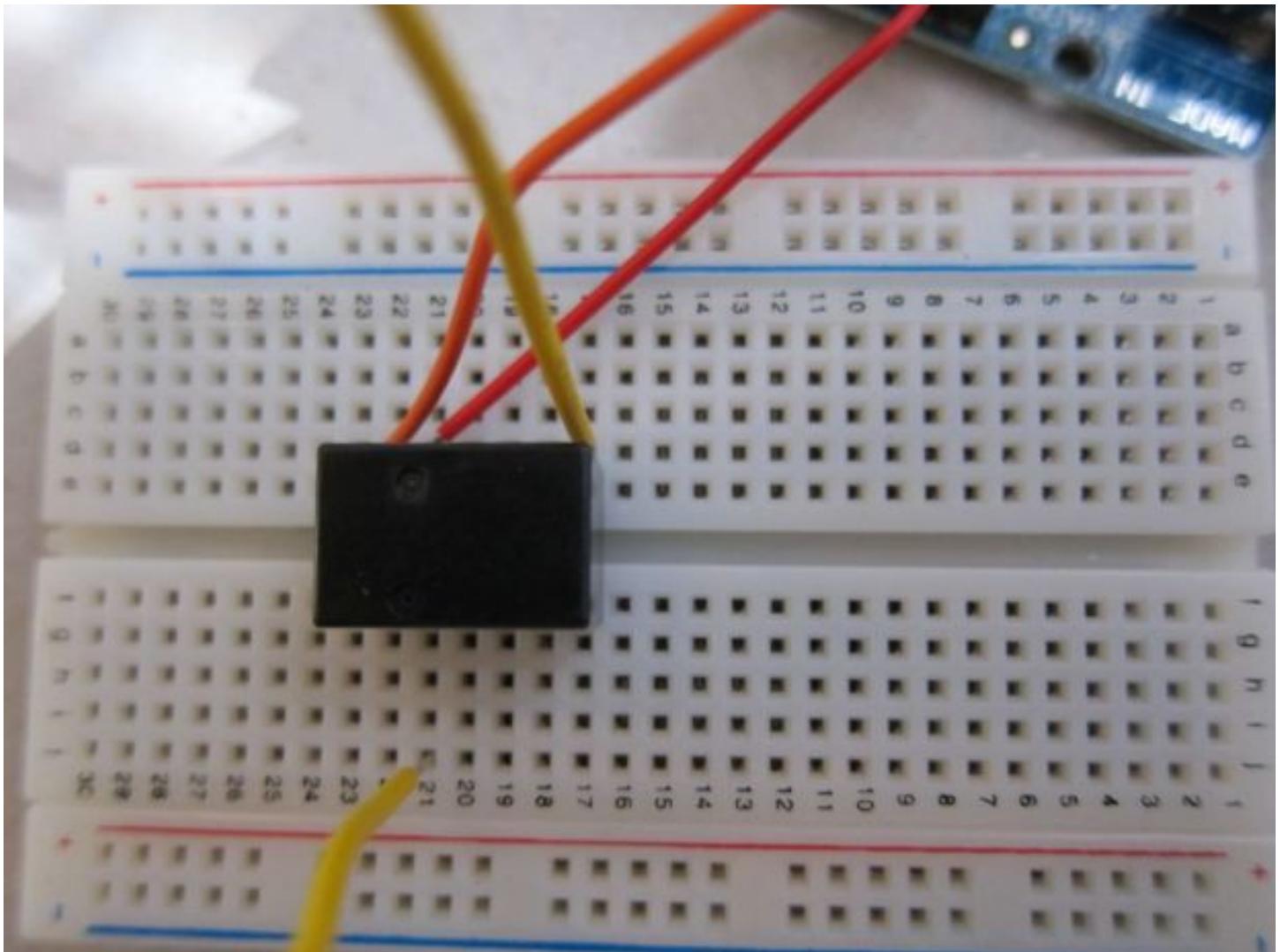


On the breadboard I'm using here, pin A goes into hole e22, pin B to e21, pin C to f21, and pin D to e17.

Step 8 – Connect Arduino to Relay

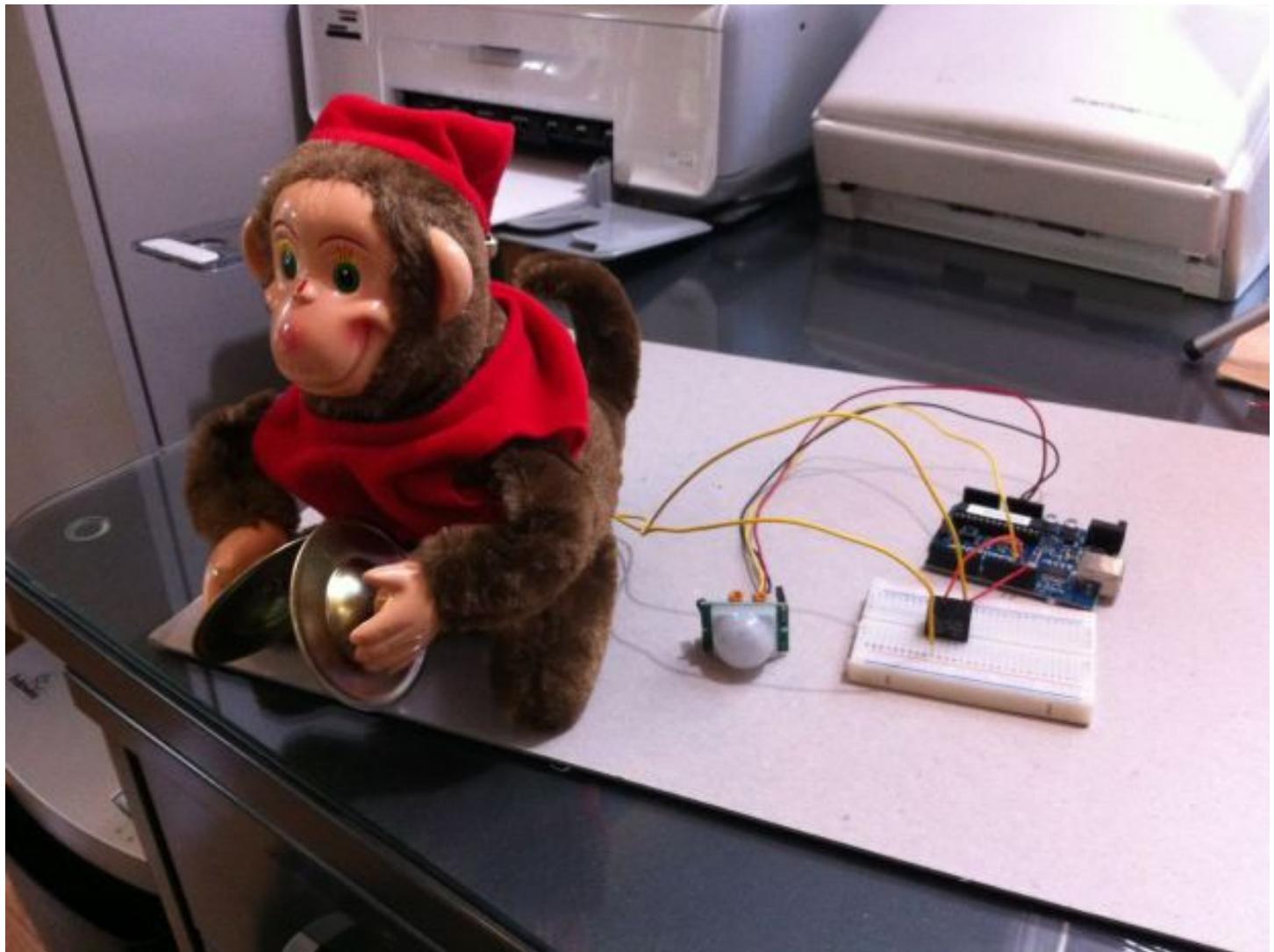


- Connect the Ground jumper wire (red here) to hole d21 on the breadboard (relay pin B).
- Connect pin 8's jumper wire (orange) to hole d22 (relay pin A).

Step 9 – Connect Monkey to Relay

Attach one of the wires coming from the monkey (picture above in yellow) to breadboard hole j21 (relay pin C), and the other to d17 (relay pin D). It does not matter which goes to which.

Step 10 – Test Your Monkey



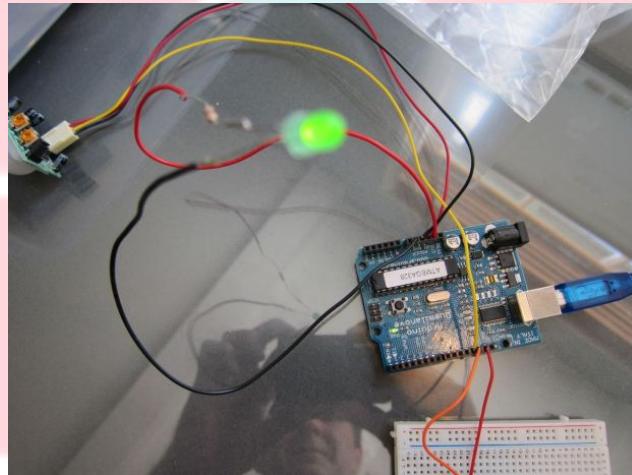
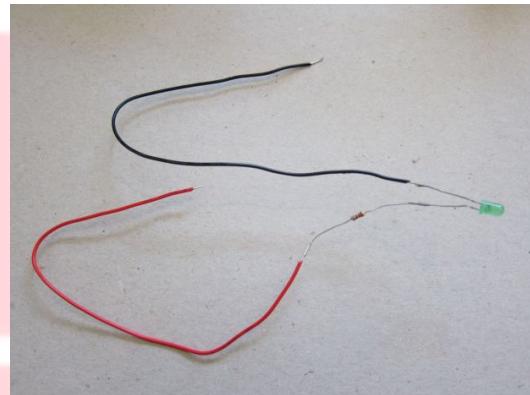
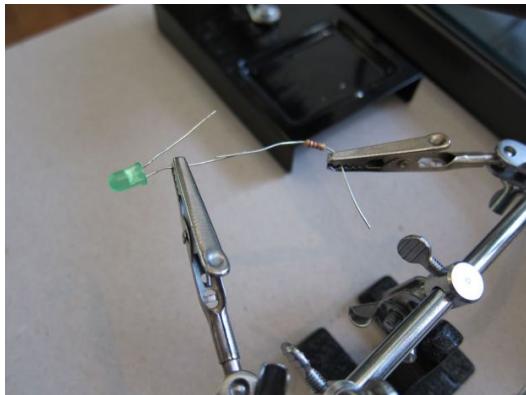
Apply power to the Arduino, and test the circuit.

If the PIR sensor detects motion, the Arduino will trigger the relay and the monkey will activate for 5 seconds, then go quiet for at least 10 seconds before re-arming.

<TODO> Write section about how to debug using Serial Monitor and setting code to debug mode. After we properly test in debug mode, change variable recompile and upload to board. Take off USB power, plug in to 9V power supply and test self-powered. Maybe bring large Dixie or solo cups to place over PIR sensor (classroom will be busy with lots of movement).

The following steps will be done based on the time remaining in class.

Step 11 – Add LED Power Indicator



- Solder a 220Ω resistor to the anode (positive) terminal of the LED. The anode is the longer of the 2 wires emanating from the LED.
- Solder a 6" length of red hookup wire to the resistor, and a 6" length of black wire to the LED's cathode.
- Insert the red wire into the 3V header on the Arduino, and the black wire to Gnd on the Arduino.

Step 12 – Add Power On Switch

<TODO> – Will Add this week

Wrap Up

<TODO> Write up a quick conclusion and describe fun ways to keep extending this project.

