

Arduino Lesson: Pot + LEDs + Resistors + if

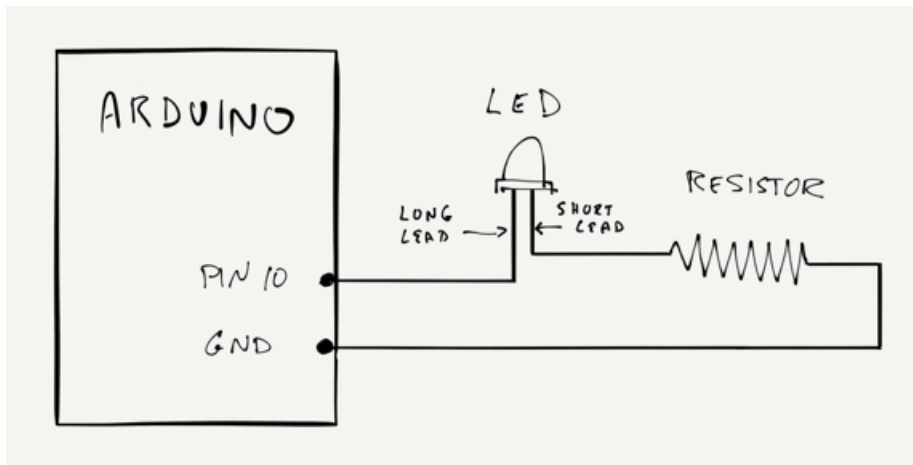
You will need: An Arduino, USB cable, breadboard (one of the regular sized ones this time, with two red & blue strips down the sides), jumper wires, one potentiometer ("pot"), three LEDs and three 330 ohm (or thereabouts) resistors.

DO NOT CONNECT THE USB CABLE UNTIL SUPERVISOR CHECKOUT! We want no power on the board until we've checked it. This is a much more complex breadboard than before and if you short power and ground you may fry the Arduino and that makes us very unhappy! ;-)

Using a pair of (black and white) jumper wires, connect the Arduino +5V and Ground to the long red and blue strip of pins on one side of the breadboard. (While I always use black for ground and white for power, these boards use blue for ground and red for power).

In the past we connected LEDs directly between a digital pin and ground. This is OK for short-term use, but has one problem: most LEDs will burn out quickly when powered directly by a digital pin. We need to add a resistor to all LEDs from now on; this reduces the current through them, and slightly reduces their brightness, but also increases their lifetime (to almost forever!).

We are going to create this circuit:



When we do "digitalWrite(10,LOW)", nothing happens. No power flows out of pin 10 and the LED does not light up. When we do "digitalWrite(10,HIGH)", power flows out of pin 10, through the LED, through the resistor, and back to ground. And the LED lights up.

Why the resistor? Without it, too much power would flow, the LED would burn too brightly, and might eventually burn out. With a 330 to 1000 ohm resistor, we get far less power, the LED still glows pretty bright, and will last basically forever.

We are actually going to create three such circuits with three LEDs and three resistors, on pins 10, 11, and 12.

Insert the two leads of the LED into two separate rows of the breadboard. As a convention to help you remember, put the long end in the row closer to the top of the breadboard.

Bend a resistor into a "U" shape. I use a small needle-nose pliers to get a neat bend -- grab the resistor right against its body and then bend on the outside edge of the pliers, about 2 mm away from the body of the resistor. Do this for both sides. This is not an important step: electrons don't care how nicely the wire bends! But: (a) it will look cooler, and (b) if you bend resistors squarely, right out of the main body, you get a sharp bend that can break off easily. Resistor leads are thin and if you bend them back and forth even a few times they will break. By going out a few millimeters and rounding the bend just a bit, we get a smooth bend that is less likely to break.



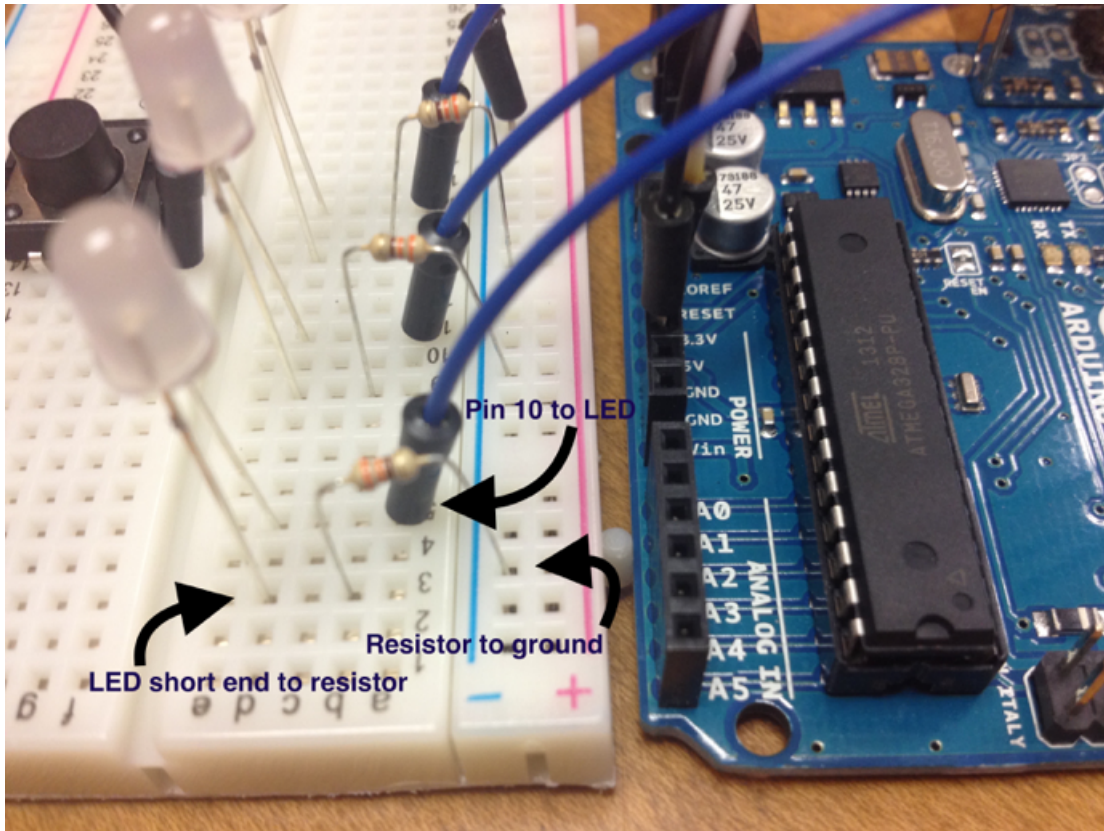
Insert one end of the resistor into the same row as the LED short end.

Insert the other end of the resistor into any hole in the ground strip on the edge of board.

And finally wire a (colored, not black or white) jumper from the Arduino pin 10 to the same row as the LED long end.

Now repeat the above steps two more times with two more LEDs, using Arduino pins 11 and 12 instead of 10.

It should look like this:



Now add the pot, following the exact same pattern as in previous lessons. (Position the pot on the other end or other side of the board so there is room. Or you can even use a separate breadboard for it.) Connect it as before, the pot center pin goes, via a colored jumper wire, to the Arduino "A0" pin, and the outer two pins go to power and ground (using white and black wires). You can run the power and ground jumpers from the pot to the + and - strips on the edge of your breadboard instead of connecting them all the way back to the Arduino.

(That is the point of the + and - strips: you will need power and ground often; the two strips down the side use a single pair of wires to connect to the Arduino, and then all the individual connections to power and ground on the breadboard only need run to the edge of the board! It's very convenient, eh?)

Now get a supervisor checkout on your connections. If you connect an LED backwards you may fry the LED. If you connect power or ground backwards or short them, you fry the Arduino!

Now connect the USB cable.

Load the "AnalogReadSerial" program provided in the Arduino examples: File --> Examples --> Basic --> AnalogReadSerial.

Modify the program: Inside the "setup" part, add:

```
pinMode(10,OUTPUT); pinMode(11,OUTPUT); pinMode(12,OUTPUT);
```

and after the last line inside the "loop", where it says "delay(1);" change the delay to 100 and add the following code:

```
digitalWrite(10,LOW); digitalWrite(11,LOW); digitalWrite(12,LOW);  
  
if (sensorValue < 250) return;  
  
digitalWrite(10,HIGH);  
  
if (sensorValue < 500) return;  
  
digitalWrite(11,HIGH);  
  
if (sensorValue < 750) return;  
  
digitalWrite(12,HIGH);  
  
}
```

Now, upload the program, start the Serial Monitor and turn the potentiometer back and forth and observe what happens!

You should get no lights on when the pot is all the way to 0, then one light on as it gets to 250, two lights past 500, and all three lights past 750. If you do, that's a PASS!

Write an essay on what you have learned about breadboarding.

Demonstrate with a demo kit how the code added above works to control the three lights. Supervisor pass required.