

ARDUINO:

Intro to Microcontrollers - Day 2

The Community

<http://www.arduino.cc/>

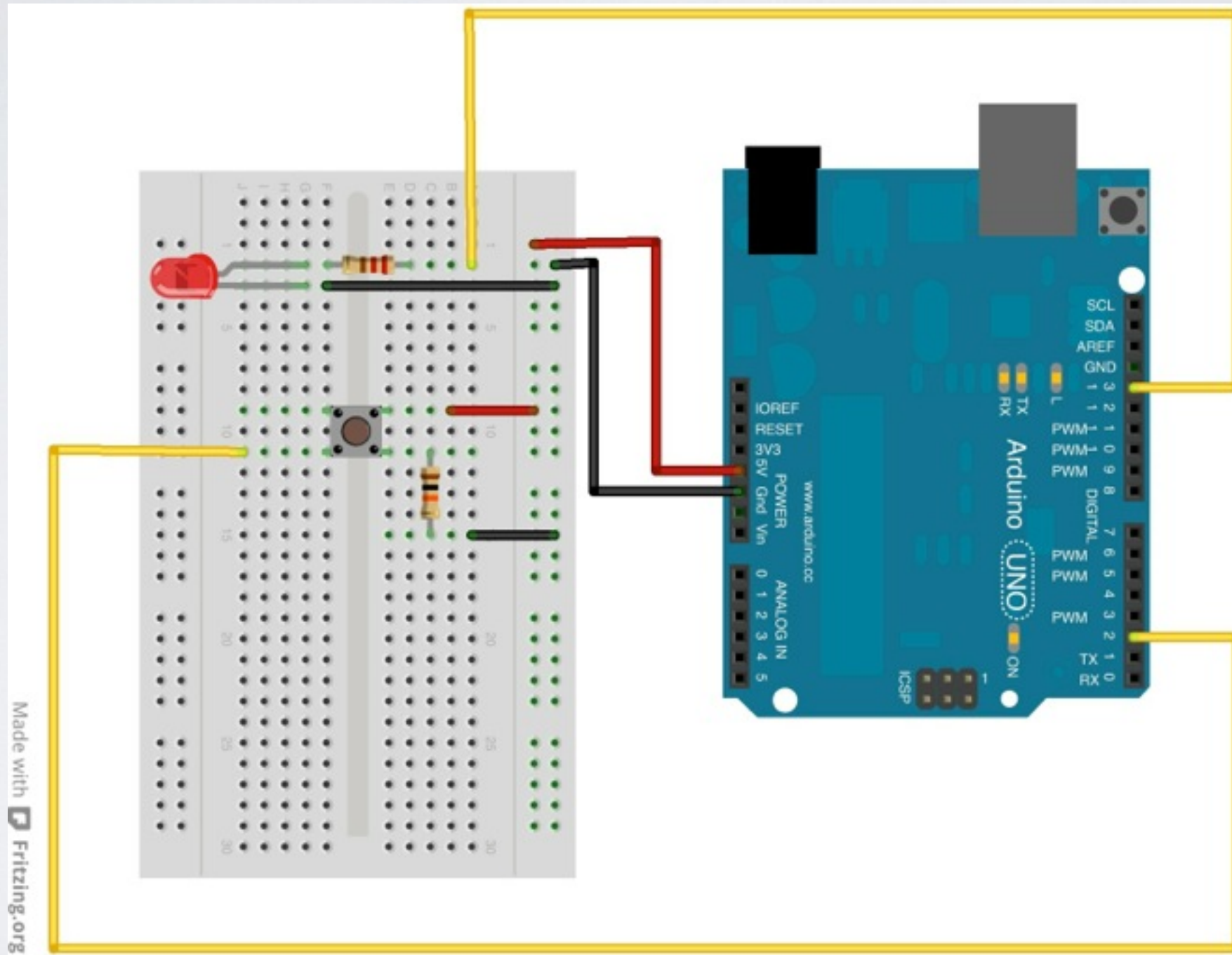
<http://www.adafruit.com/>

<https://www.sparkfun.com>

<http://fritzing.org/home/>

Way More....

Digital Input



DIGITAL INPUT (BUTTON)

Parts for this project

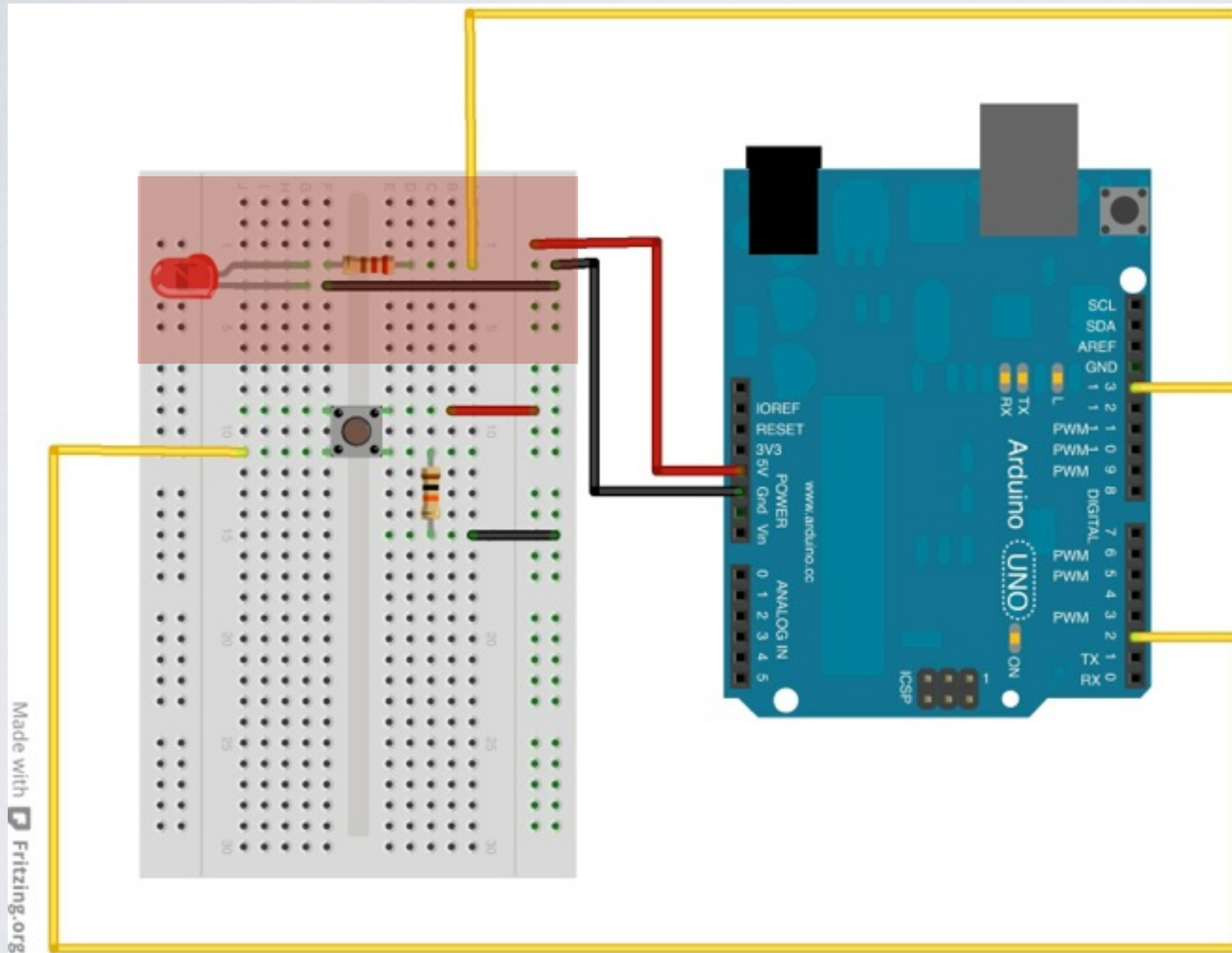
- Solderless Breadboard
- 7 x Flexible Wire Jumpers
- 1 x LEDs (any color)
- 2 x 220 Ohm Resistors
- 1 x Tactile Pushbutton
- Arduino Duo board
- USB Cable

DIGITAL INPUT (BUTTON)

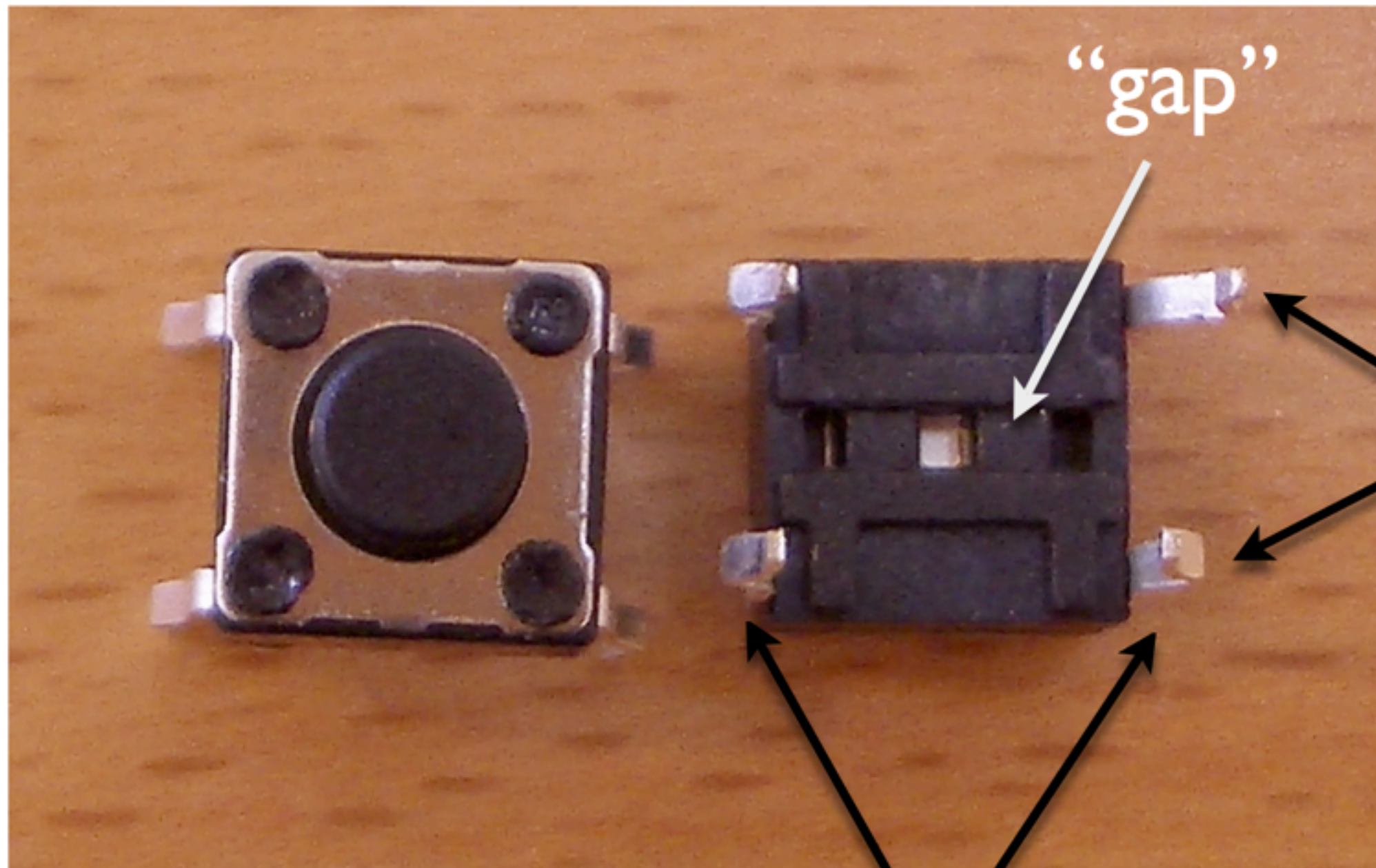
Connect an LED, cathode to ground pin and anode in upper row.

Place a resistor in series with the anode(long lead of LED)

Connect the resistor to Pin 13



DIGITAL INPUT (BUTTON)

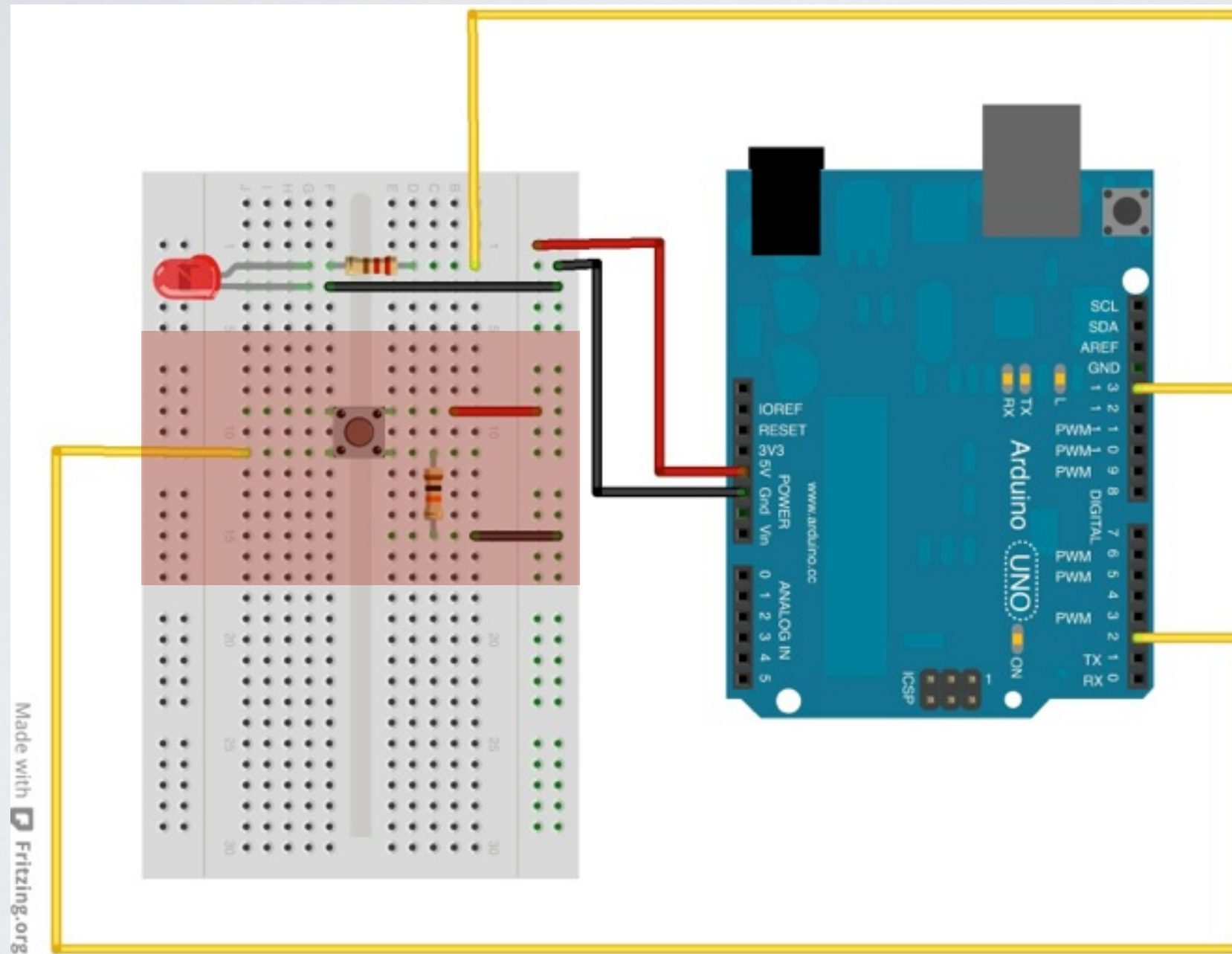


"gap"

connect
when
pushed

always connected together

DIGITAL INPUT (BUTTON)



Connect 5V and GND to the side strips

Add a pushbutton across the center vertical row.

Connect the top pin to 5V.

Connect lower side to ground in series with a resistor.

Connect the opposite lower pin of the switch to pin 2

DIGITAL INPUT (BUTTON)

```
// constants won't change. They're used here to set pin numbers:
const int buttonPin = 2;    // the number of the pushbutton pin
const int ledPin = 13;      // the number of the LED pin

// variables will change:
int buttonState = 0;        // variable for reading the pushbutton status

void setup() {
  // initialize the LED pin as an output:
  pinMode(ledPin, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinMode(buttonPin, INPUT);
}

void loop(){
  // read the state of the pushbutton value:
  buttonState = digitalRead(buttonPin);

  // check if the pushbutton is pressed.
  // if it is, the buttonState is HIGH:
  if (buttonState == HIGH) {
    // turn LED on:
    digitalWrite(ledPin, HIGH);
  }
  else {
    // turn LED off:
    digitalWrite(ledPin, LOW);
  }
}
```


DIGITAL INPUT (BUTTON)

digitalRead()

Syntax:

digitalRead(pin)

Parameters

**pin: the number of the digital pin you want to read
(int)**

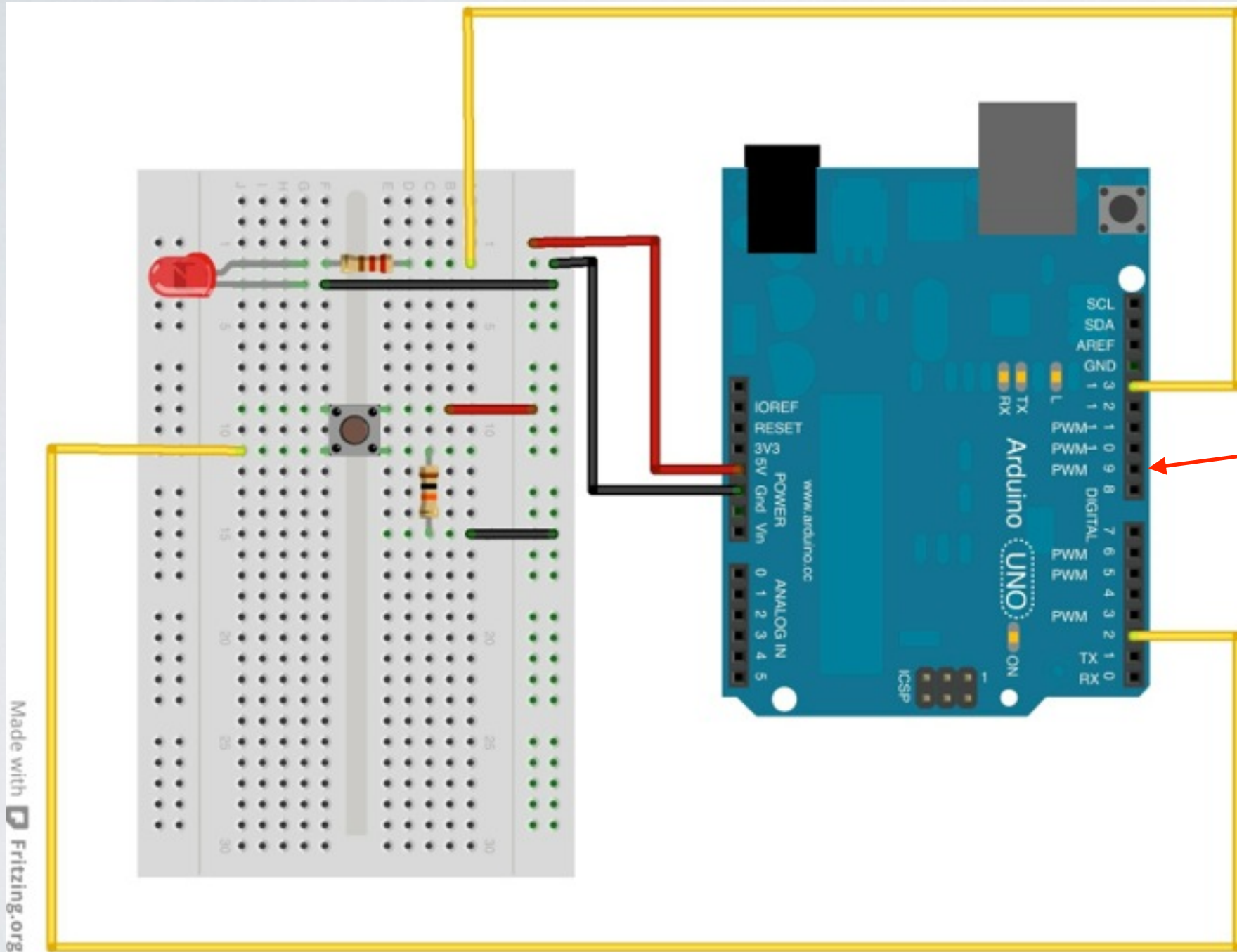
Returns

HIGH or LOW

VARIATION I

Keep Same
Circuit

*Except, Move
the LED pin from
13 to pin 9



FADE OR BLINK

Upload Fade_Or_Blink from the code folder.

```
/*
 * FadeOrBlink
 *
 */

int ledPin = 9;           // choose the pin for the LED
int inputPin = 2;         // choose the input pin (for a pushbutton)
int val = 0;              // variable for reading the pin status
int fadeval = 0;

void setup() {
  pinMode(ledPin, OUTPUT); // declare LED as output
  pinMode(inputPin, INPUT); // declare pushbutton as input
}

void loop(){
  val = digitalRead(inputPin); // read input value
  if (val == HIGH) {           // pushed button means do blinking
    digitalWrite(ledPin, LOW); // turn LED OFF
    delay(50);
    digitalWrite(ledPin, HIGH); // turn LED ON
    delay(50);
  }
  else { // else button isn't pressed so do fading
    for(fadeval = 0 ; fadeval <= 255; fadeval+=5) { // fade in (from min to max)
      analogWrite(ledPin, fadeval); // sets the value (range from 0-255)
      delay(10);
    }
    for(fadeval = 255; fadeval >=0; fadeval-=5) { // fade out (from max to min)
      analogWrite(ledPin, fadeval);
      delay(10);
    }
  }
}
```


FADE OR BLINK

analogWrite();

Syntax:

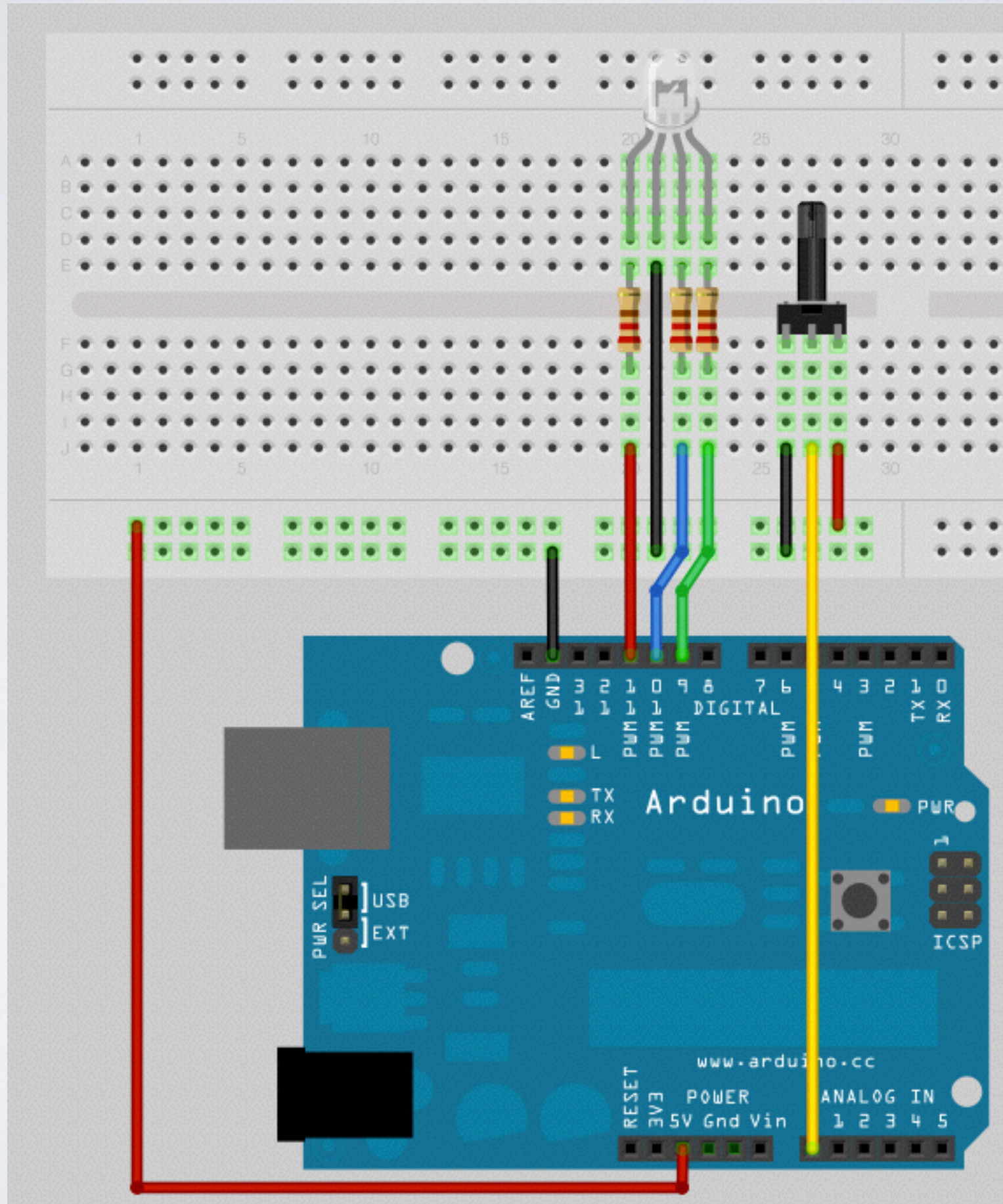
analogWrite(pin, value)

Parameters:

pin: the pin to write to.

value: the duty cycle: between 0 (always off) and 255 (always on).

ANALOG-IN ANALOG-OUT

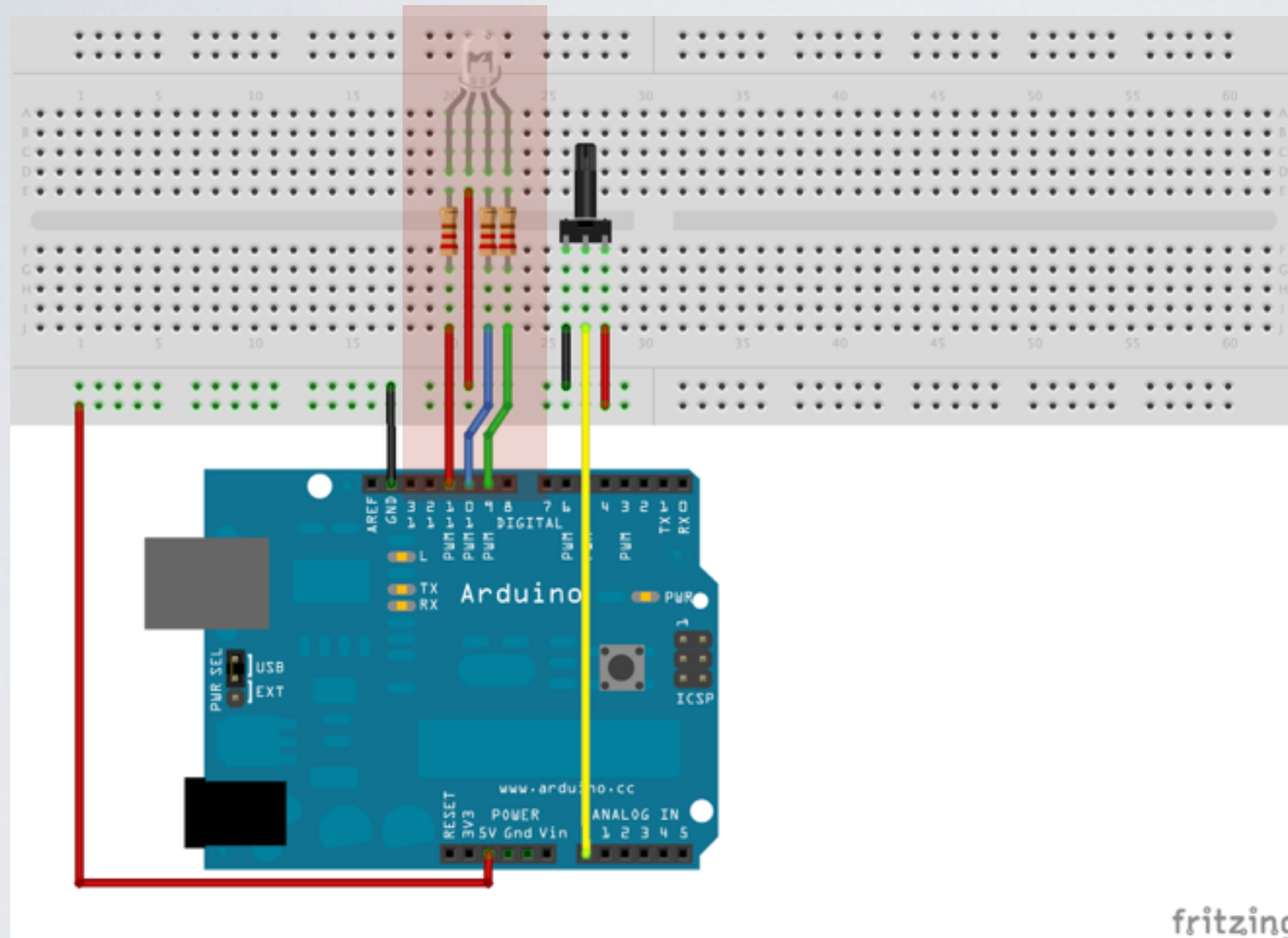


ANALOG-IN ANALOG-OUT

Parts for this project

- Solderless Breadboard
- 8 x Flexible Wire Jumpers
- 1 x RGB LED *****Use the one I provide(not the one in the Kit!)****
- 3 x 220 Ohm Resistors
- 1 x Blue Potentiometer with white knob
- Arduino Duo board
- USB Cable

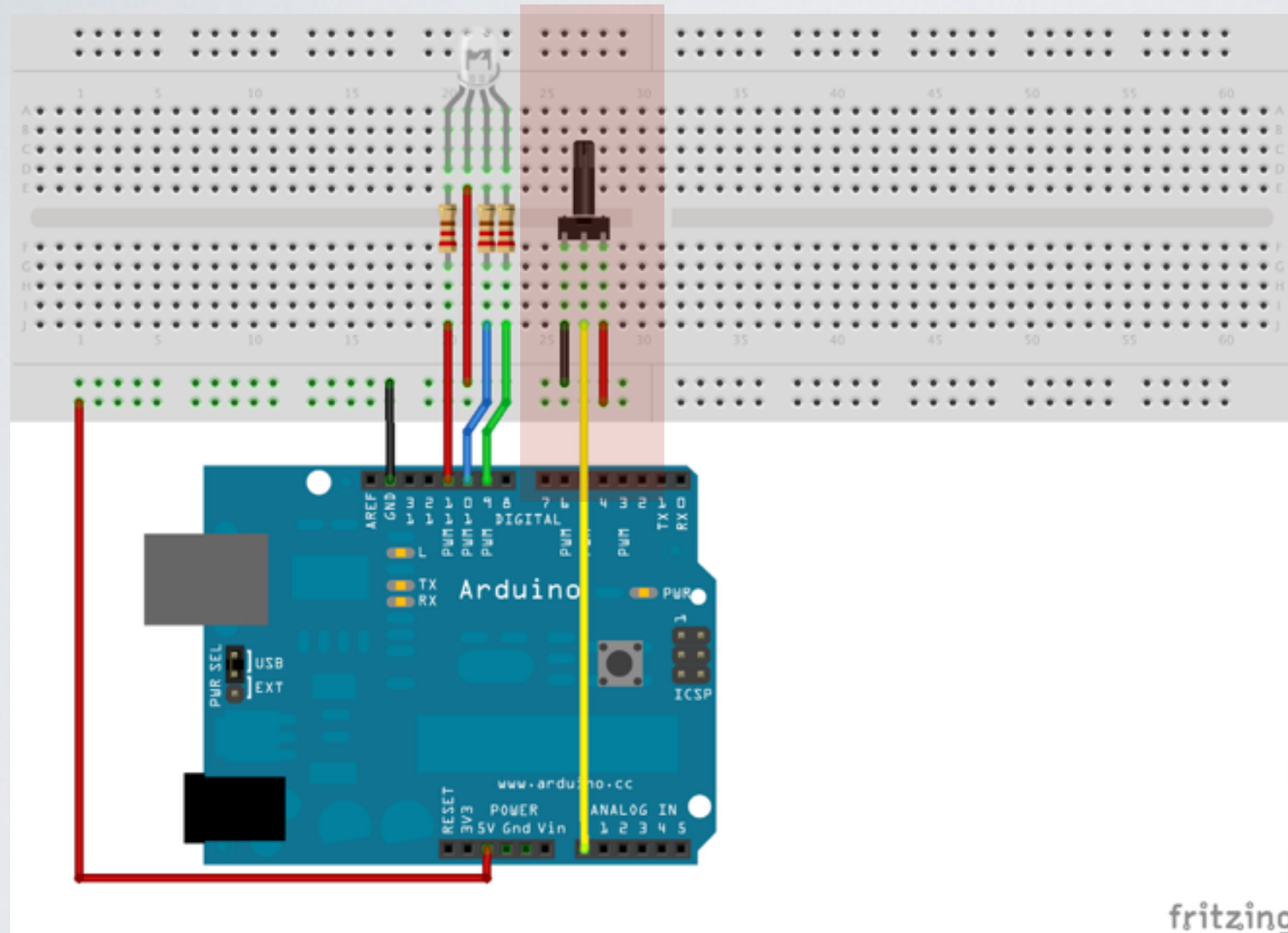
ANALOG-IN ANALOG-OUT



**Connect 5V and
GND
to the side strips**

**Connect the short
leads of the LED to
pins 9, 10, 11 in series
with a
resistor.**

ANALOG-IN ANALOG-OUT



**Connect the
Potentiometer across
3 row**

**One side goes to
ground.**

**The other goes to
+5V**

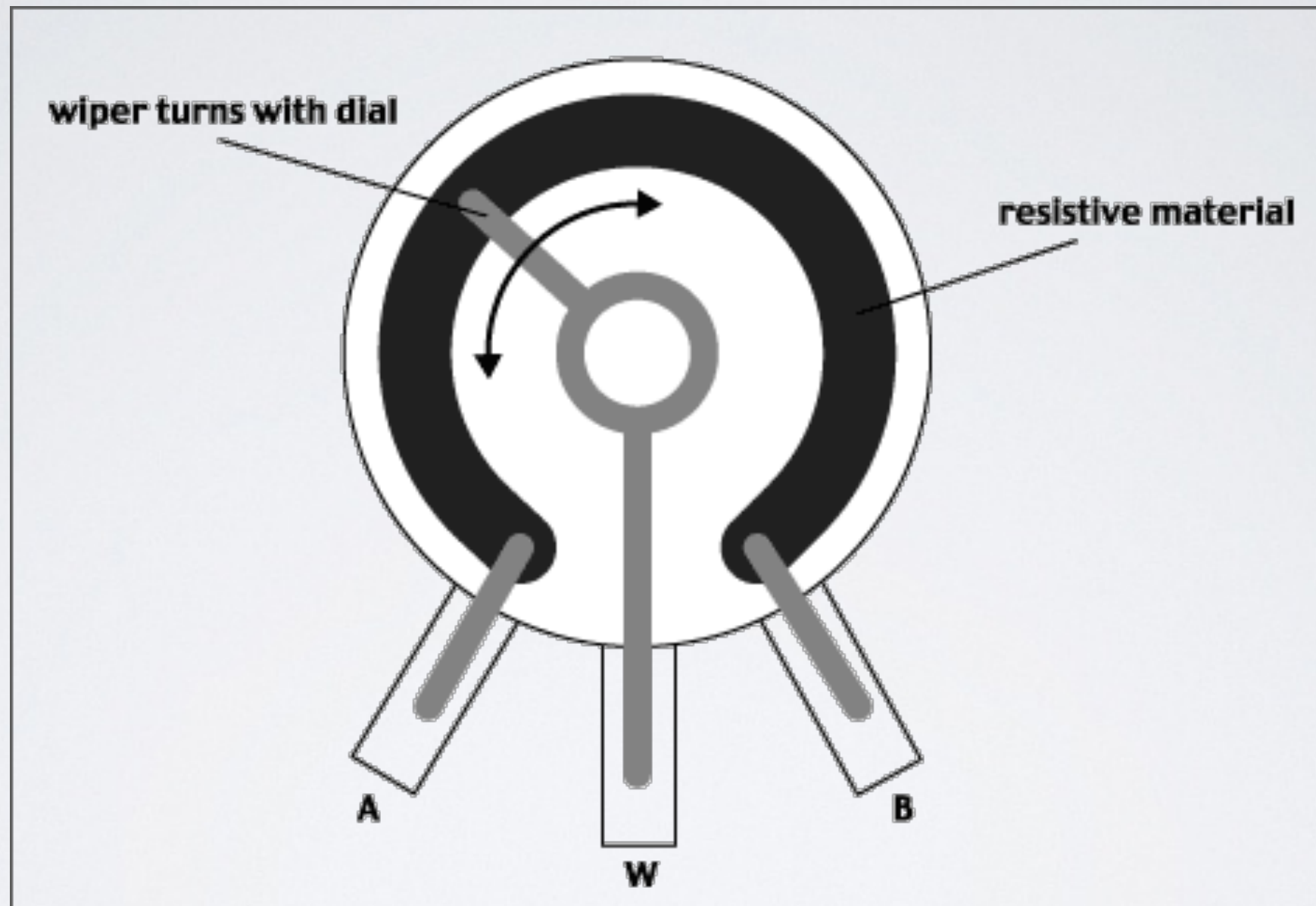
**The Center Pin
Connects to analog in
0
(Marked A0)**

ANALOG-IN ANALOG-OUT

Upload RBG_Pot_Fader.ino

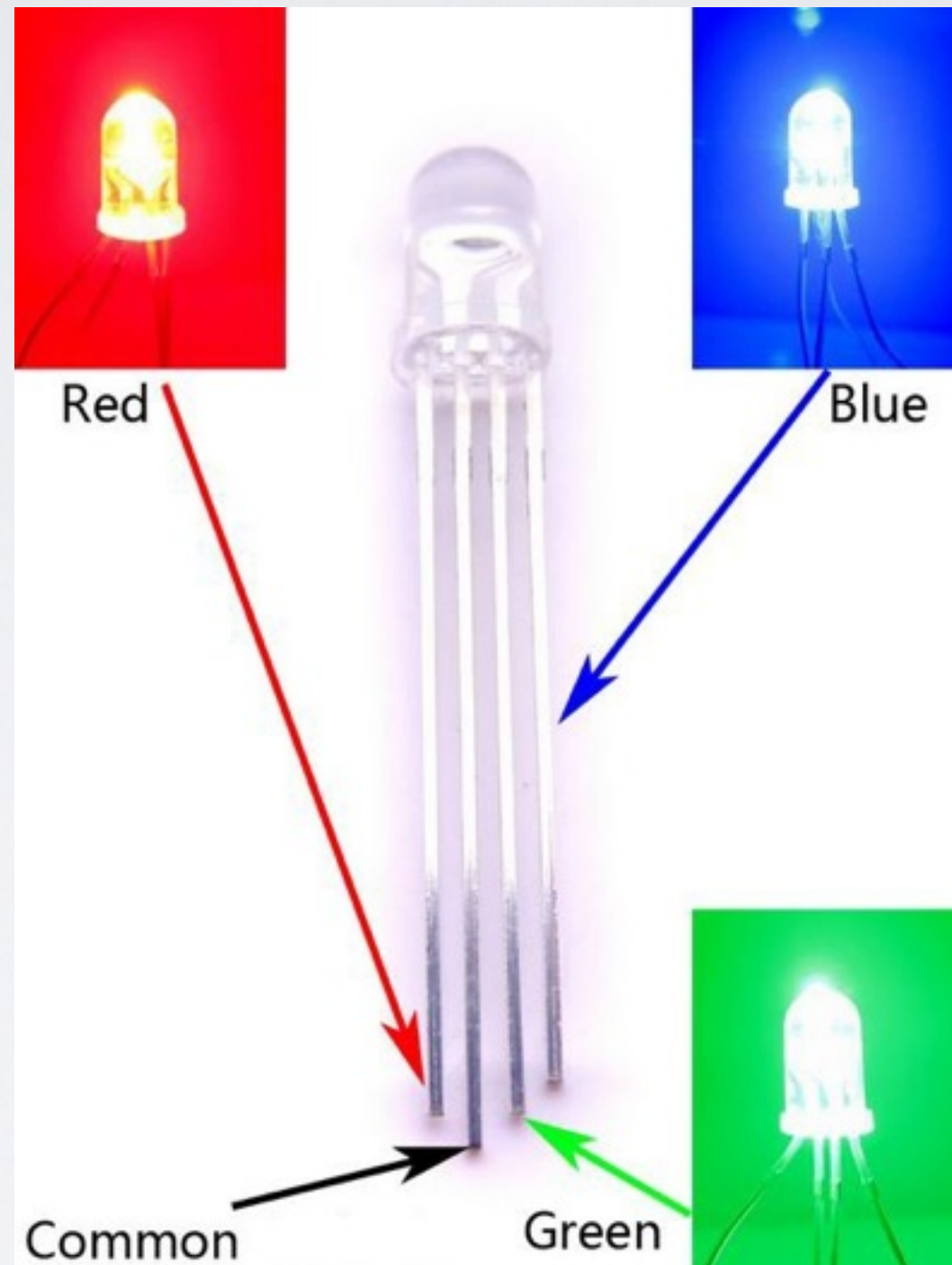
ANALOG-IN ANALOG-OUT

Potentiometer



ANALOG-IN ANALOG-OUT

RBG LED

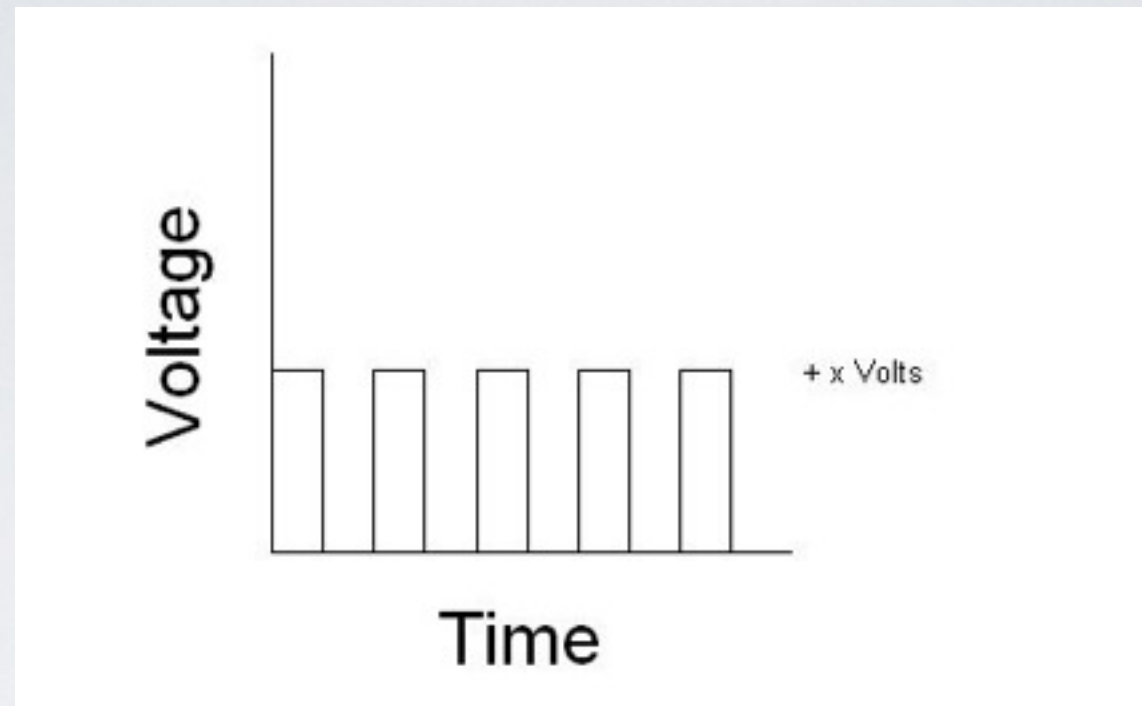


PULSE WIDTH MODULATION

- PWM stands for Pulse Width Modulation.

- Rather than limiting or controlling the voltage or current going through your LED, the voltage is fixed. When the full voltage is sent through the LED, it will emit the maximum of light it can (basically the same as connecting directly to a fully charged battery)

PULSE WIDTH MODULATION



As you can see, we have now changed our constant voltage input for a square wave. In this graphic, our voltage is on half the time and off half the time.

The technical term here would be that we have a 50% duty cycle (50% of the time on.) With such an input on our LED, the amount of light given off appears diminished by 50%.

The reason I say it appears, is because it gives off its maximum amount of light, but only 50% of the time, so our eyes perceive only half the amount of light (more on this on the next slide).

PULSE WIDTH MODULATION

How Come I Perceive Less Light And No Blinking Or Strobbling??

Your eyes are a little like tiny cameras that take about 24 pictures per second. Your brain takes those images and assembles them into what we perceive as the continuous movie of our lives.

If the PWM frequency was less than 24 times per second (or only slightly more), we would perceive it as a strobe, but if the light from a PWM controlled LED is switched fast enough – way more than 24 times per second – our eyes will perceive it as continuous...

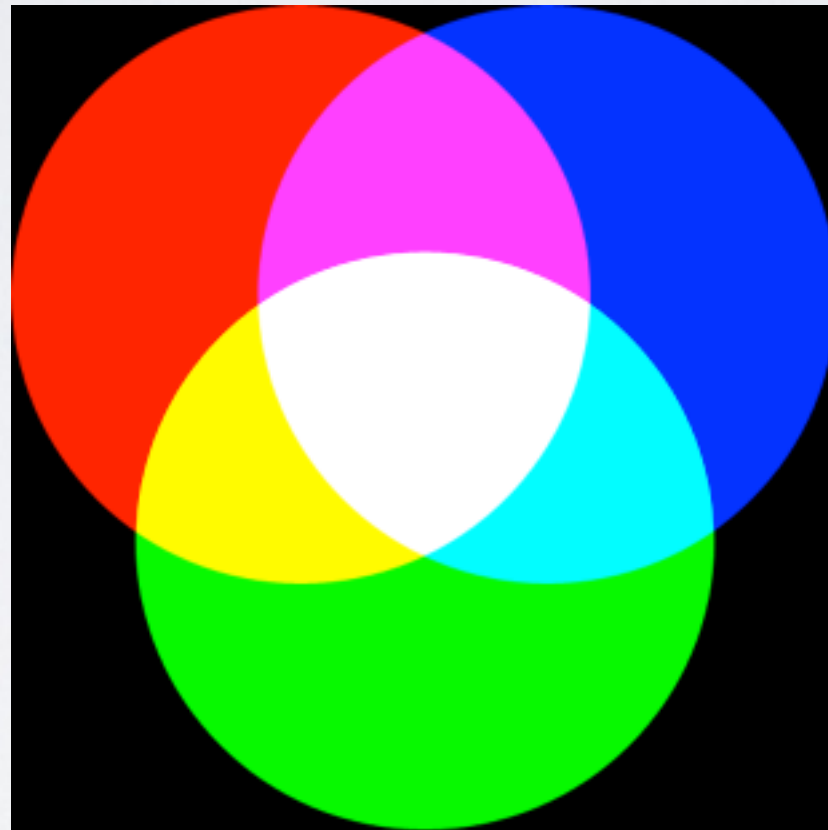
PULSE WIDTH MODULATION

The lower frequency PWM will be more perceivable to the eyes as a fast strobe effect – remember what it looks like to dance in a club when the only lighting around are strobes? Well, imagine that strobe is even faster, to the point that motion is almost continuous...

RGB COLOR MIXING

Color mixing

Now that you have red, green and blue light, you can start having fun with color mixing. Color mixing is the neat ability that our eyes have to combine different light colors and create a new color



A additive (light) color mixing diagram

According to this diagram, if we have both red and blue light mixed together we should get a violet light.

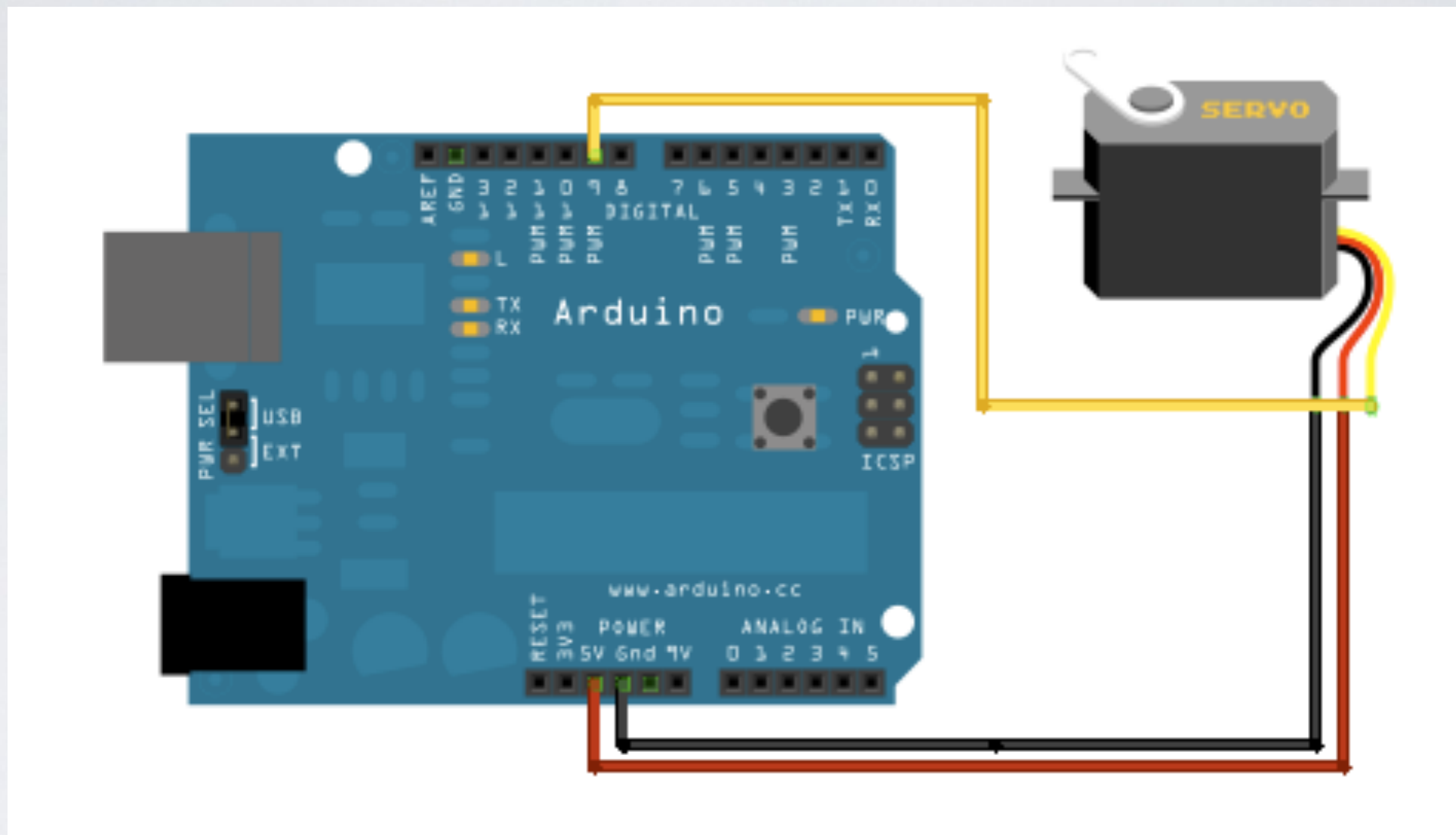
RGB COLOR MIXING

RainbowRGB

SimpleRGB

RandomRGB Fader

SERVO



SERVO

SERVO_SWEEP.INO

```
#include <Servo.h>
```

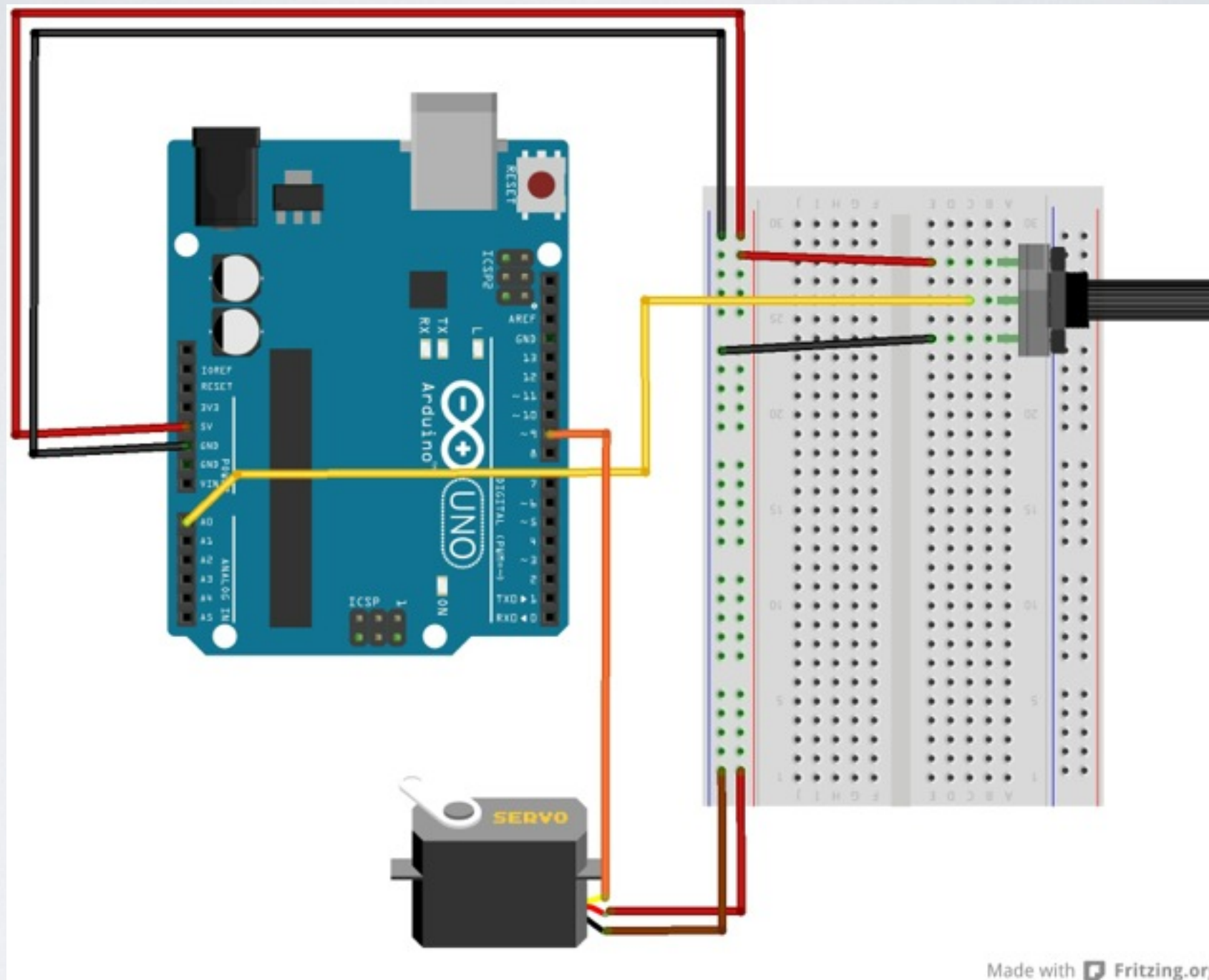
```
Servo myservo; // create servo object to control a servo  
               // a maximum of eight servo objects can be created
```

```
int pos = 0;   // variable to store the servo position
```

```
void setup()  
{  
  myservo.attach(9); // attaches the servo on pin 9 to the servo object  
}
```

```
void loop()  
{  
  for(pos = 0; pos < 180; pos += 1) // goes from 0 degrees to 180 degrees  
  {                                // in steps of 1 degree  
    myservo.write(pos);           // tell servo to go to position in variable 'pos'  
    delay(15);                    // waits 15ms for the servo to reach the position  
  }  
  for(pos = 180; pos >= 1; pos -= 1) // goes from 180 degrees to 0 degrees  
  {  
    myservo.write(pos);           // tell servo to go to position in variable 'pos'  
    delay(15);                    // waits 15ms for the servo to reach the position  
  }  
}
```

SERVO WITH KNOB



SERVO

SERVO_KNOB.INO

// Controlling a servo position using a potentiometer (variable resistor)
// by Michal Rinott <<http://people.interaction-ivrea.it/m.rinott>>

```
#include <Servo.h>
```

```
Servo myservo; // create servo object to control a servo
```

```
int potpin = 0; // analog pin used to connect the potentiometer  
int val; // variable to read the value from the analog pin
```

```
void setup()  
{  
  myservo.attach(9); // attaches the servo on pin 9 to the servo object  
}
```

```
void loop()  
{  
  val = analogRead(potpin); // reads the value of the potentiometer (value between 0 and 1023)  
  val = map(val, 0, 1023, 0, 179); // scale it to use it with the servo (value between 0 and 180)  
  myservo.write(val); // sets the servo position according to the scaled value  
  delay(15); // waits for the servo to get there  
}
```


SERIAL COMMUNICATIONS

```
/*  
 * Hello World!  
 *  
 * This is the Hello World! for Arduino.  
 * It shows how to send data to the computer  
 */  
  
void setup()                // run once, when the sketch starts  
{  
  Serial.begin(9600);       // set up Serial library at 9600 bps  
  
  Serial.println("Hello world!"); // prints hello with ending line break  
}  
  
void loop()                 // run over and over again  
{  
  // do nothing!  
}
```

SERIAL COMMUNICATIONS

```
int a = 5;
int b = 10;
int c = 20;

void setup()           // run once, when the sketch starts
{
  Serial.begin(9600);   // set up Serial library at 9600 bps

  Serial.println("Here is some math: ");

  Serial.print("a = ");
  Serial.println(a);
  Serial.print("b = ");
  Serial.println(b);
  Serial.print("c = ");
  Serial.println(c);

  Serial.print("a + b = ");    // add
  Serial.println(a + b);

  Serial.print("a * c = ");    // multiply
  Serial.println(a * c);

  Serial.print("c / b = ");    // divide
  Serial.println(c / b);

  Serial.print("b - c = ");    // subtract
  Serial.println(b - c);
}

void loop()             // we need this to be here even though its empty
{
}
```

SERIAL COMMUNICATIONS

*Place an LED between Pin 13 and GND

```
/*
 * Serial Read Basic
 * -----
 * Blink the pin 13 LED if an 'H' is received over the serial port
 *
 */

int ledPin = 13; // select the pin for the LED
int val = 0;     // variable to store the data from the serial port

void setup() {
  pinMode(ledPin,OUTPUT); // declare the LED's pin as output
  Serial.begin(19200);    // connect to the serial port
}

void loop () {
  // Serial.available() is a way to see if there's serial data
  // without pausing your code
  if( Serial.available() ) {
    val = Serial.read(); // read the serial port
    if( val == 'H' ) {   // if it's an 'H', blink the light
      digitalWrite(ledPin, HIGH);
      delay(1000);
      digitalWrite(ledPin, LOW);
    }
  }
}
}
```


CONTROL STRUCTURES

IF Statement

if, which is used in conjunction with a comparison operator, tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

```
if (someVariable > 50)
{
    // do something here
}
```


CONTROL STRUCTURES

IF / ELSE

if/else allows greater control over the flow of code than the basic if statement, by allowing multiple tests to be grouped together. For example, an analog input could be tested and one action taken if the input was less than 500, and another action taken if the input was 500 or greater. The code would look like this:

```
if (pinFiveInput < 500)
{
    // action A
}
else
{
    // action B
}
```


CONTROL STRUCTURES

IF / ELSE

if/elseif Each test will proceed to the next one until a true test is encountered. When a true test is found, its associated block of code is run, and the program then skips to the line following the entire if/else construction. If no test proves to be true, the default else block is executed, if one is present, and sets the default behavior.

```
if (pinFiveInput < 500)
{
    // do Thing A
}
else if (pinFiveInput >= 1000)
{
    // do Thing B
}
else
{
    // do Thing C
}
```

CONTROL STRUCTURES

IF Statement Comparison Operators:

$x == y$ (x is equal to y)

$x != y$ (x is not equal to y)

$x < y$ (x is less than y)

$x > y$ (x is greater than y)

$x <= y$ (x is less than or equal to y)

$x >= y$ (x is greater than or equal to y)

CONTROL STRUCTURES

Switch Case

else Like if statements, switch...case controls the flow of programs by allowing programmers to specify different code that should be executed in various conditions. In particular, a switch statement compares the value of a variable to the values specified in case statements. When a case statement is found whose value matches that of the variable, the code in that case statement is run.

The break keyword exits the switch statement, and is typically used at the end of each case. Without a break statement, the switch statement will continue executing the following expressions ("falling-through") until a break, or the end of the switch statement is reached.

```
switch (var) {  
    case 1:  
        //do something when var equals 1  
        break;  
    case 2:  
        //do something when var equals 2  
        break;  
    default:  
        // if nothing else matches, do the default  
        // default is optional  
}  
}
```


CONTROL STRUCTURES

while loops

while loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the while loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

```
while(expression) {  
    // statement(s)  
}
```

EXAMPLE

```
var = 0;  
while(var < 200){  
    // do something repetitive 200 times  
    var++;  
}
```

CONTROL STRUCTURES

do - while

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested at the end of the loop, so the **do** loop will *always* run at least once.

```
do
{
    // statement block
} while (test condition);
```

EXAMPLE

Example

```
do
{
    delay(50);           // wait for sensors to
    stabilize
    x = readSensors();   // check the sensors
} while (x < 100);
```

CONTROL STRUCTURES

break

break is used to exit from a do, for, or while loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

Example

```
for (x = 0; x < 255; x ++)  
{  
    digitalWrite(PWMPin, x);  
    sens = analogRead(sensorPin);  
    if (sens > threshold){          // bail out on sensor  
detect  
        x = 0;  
        break;  
    }  
    delay(50);  
}
```


CONTROL STRUCTURES

break

break is used to exit from a do, for, or while loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

Example

```
for (x = 0; x < 255; x ++)  
{  
    digitalWrite(PWMPin, x);  
    sens = analogRead(sensorPin);  
    if (sens > threshold){          // bail out on sensor  
detect  
        x = 0;  
        break;  
    }  
    delay(50);  
}
```

CONTROL STRUCTURES

continue

The continue statement skips the rest of the current iteration of a loop (do, for, or while). It continues by checking the conditional expression of the loop, and proceeding with any subsequent iterations.

```
for (x = 0; x < 255; x ++)  
{  
    if (x > 40 && x < 120) {           // create jump in  
values  
        continue;  
    }  
  
    digitalWrite(PWMpin, x);  
    delay(50);  
}
```

CONTROL STRUCTURES

return

Terminate a function and return a value from a function to the calling function, if desired

Example

```
int checkSensor() {  
    if (analogRead(0) > 400) {  
        return 1;  
    }  
    else{  
        return 0;  
    }  
}
```