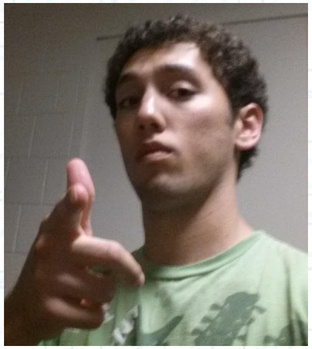
Arduino Workshop

“The best thing about a boolean is even if you are wrong, you are only off by a bit.”

Meet the team!



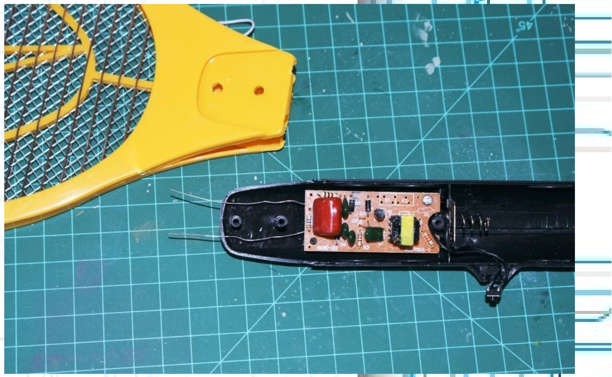
Dominic
Stanford
Electrical Engineering

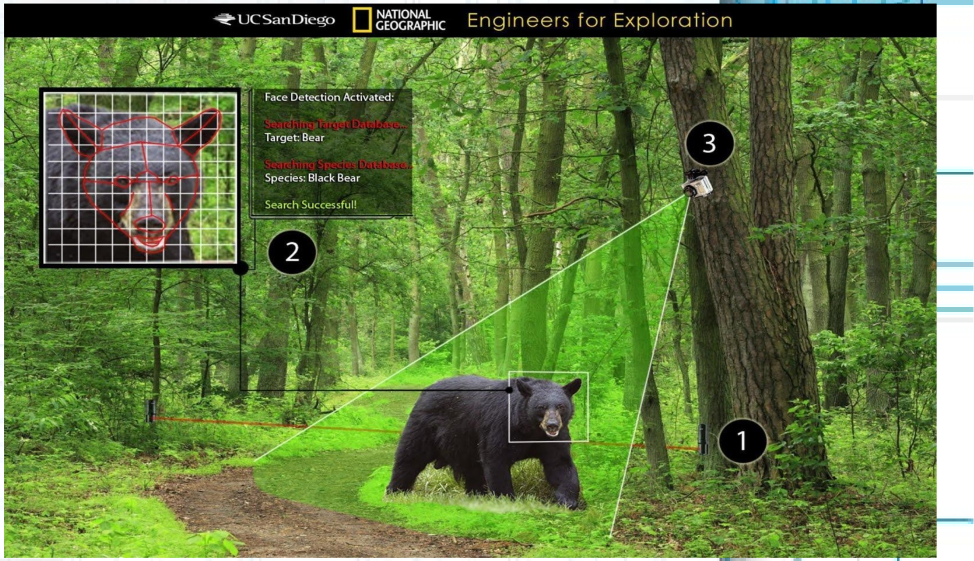
Morgan
Augustana College
Biochemistry and Mathematics

Jon
Clemson University
Electrical Engineering

Cool Projects

- Projects we have done:
  - Barometer
  - Gyroscope based mirror correction
  - E-textiles
  - Pitot tube
  - Fountain audio-visualizer
  - Arduino Cell Phone
  - Industrial Applications
  - Camera Trap



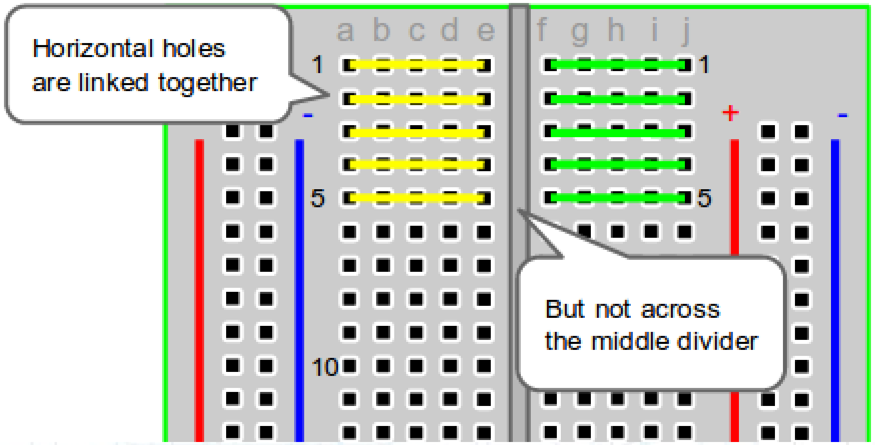

UCSanDiego
NATIONAL GEOGRAPHIC
Engineers for Exploration
Face Detection Activated:
Searching Target Database...
Target: Bear
Searching Species Database...
Species: Black Bear
Search Successful!
3
2
1

Industrial Application

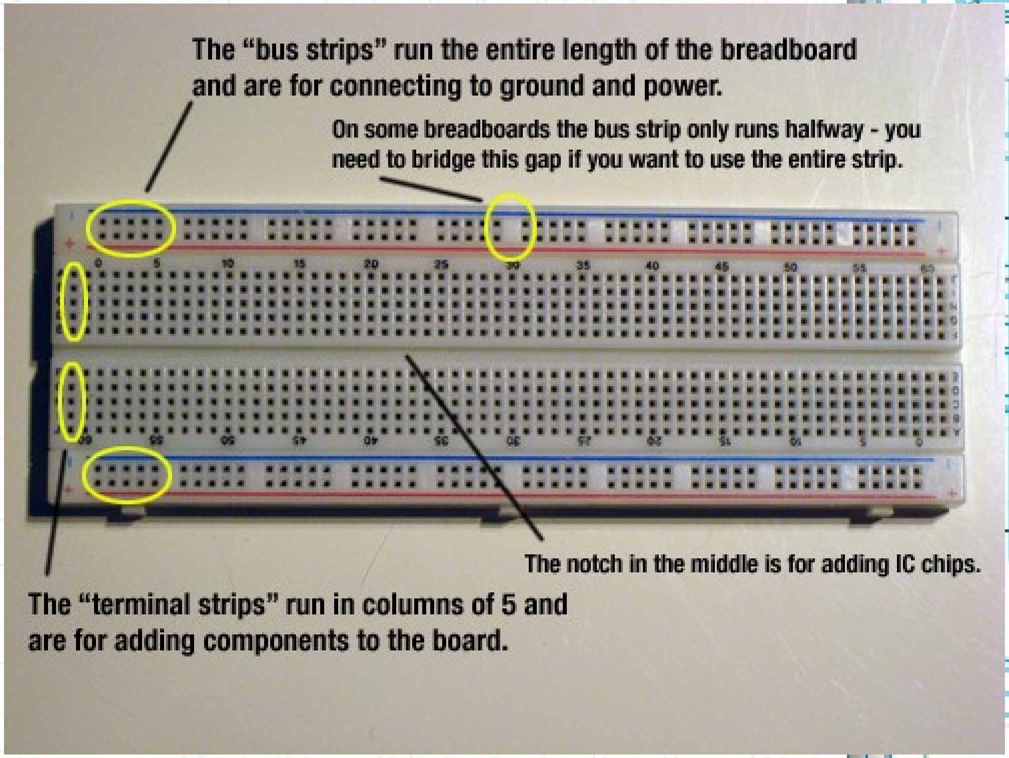
ECE 201

- Breadboard: basis for electronic prototypes
  - Easy to alter
  - No need for soldering
- Circuits: foundation for electronics
  - Kirchhoff's Laws
  - Can incorporate a variety of tools

Breadboard


Horizontal holes are linked together

But not across the middle divider


The “bus strips” run the entire length of the breadboard and are for connecting to ground and power.

On some breadboards the bus strip only runs halfway - you need to bridge this gap if you want to use the entire strip.

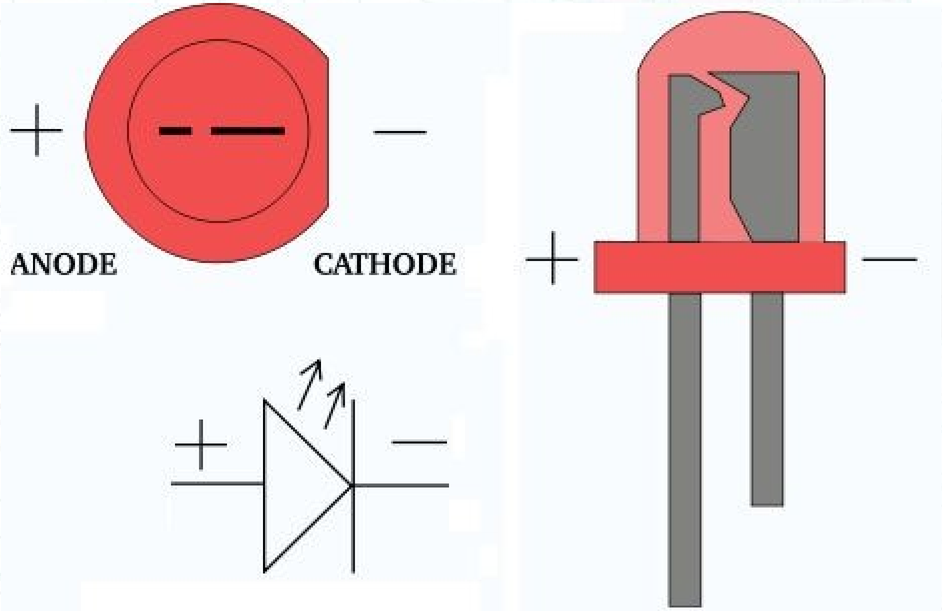
The notch in the middle is for adding IC chips.

The “terminal strips” run in columns of 5 and are for adding components to the board.

http://computers.tutsplus.com/tutorials/how-to-use-a-breadboard-and-build-a-led-circuit--mac-54746

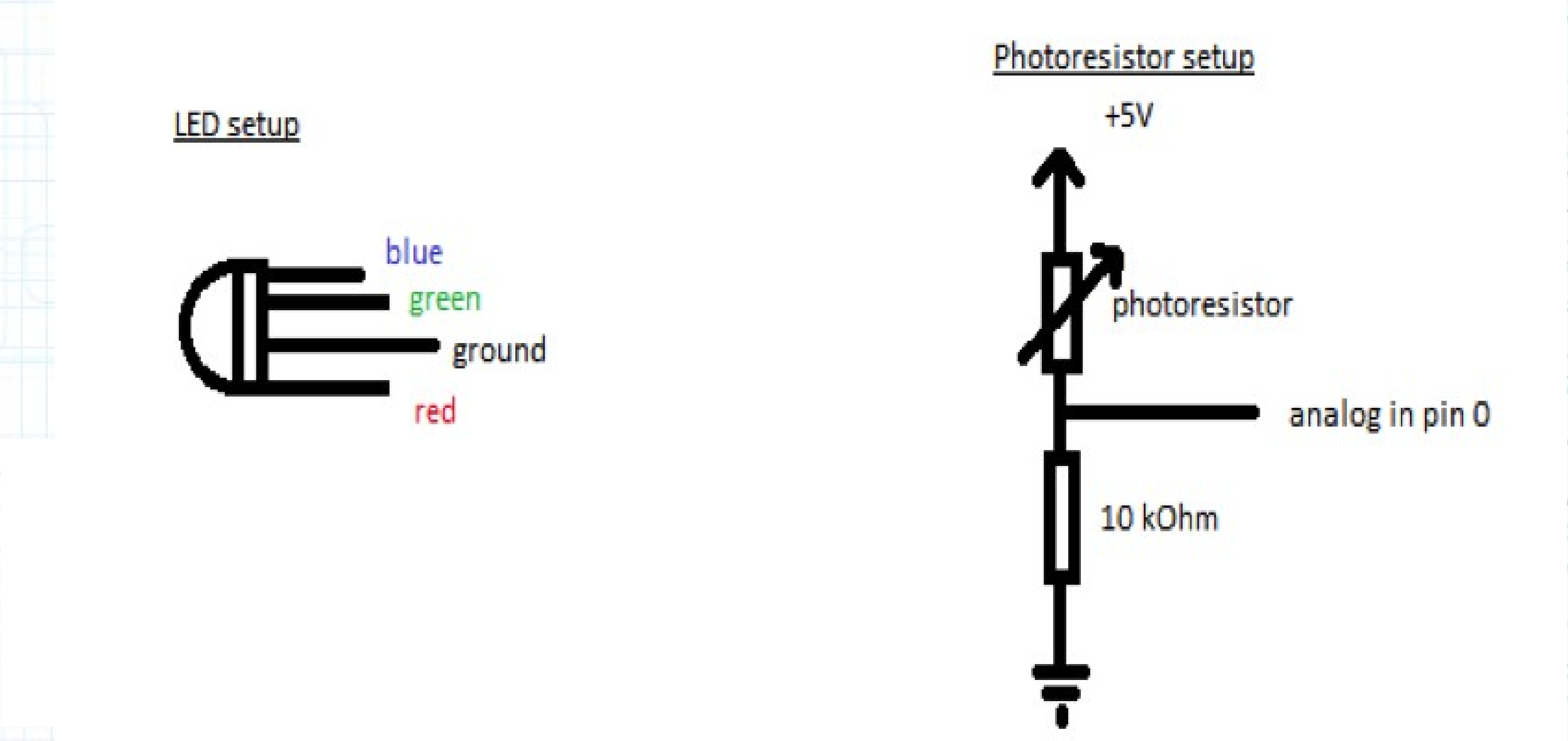
http://tymkrs.tumblr.com/post/6386624174/how-to-use-a-breadboard

More LEDs

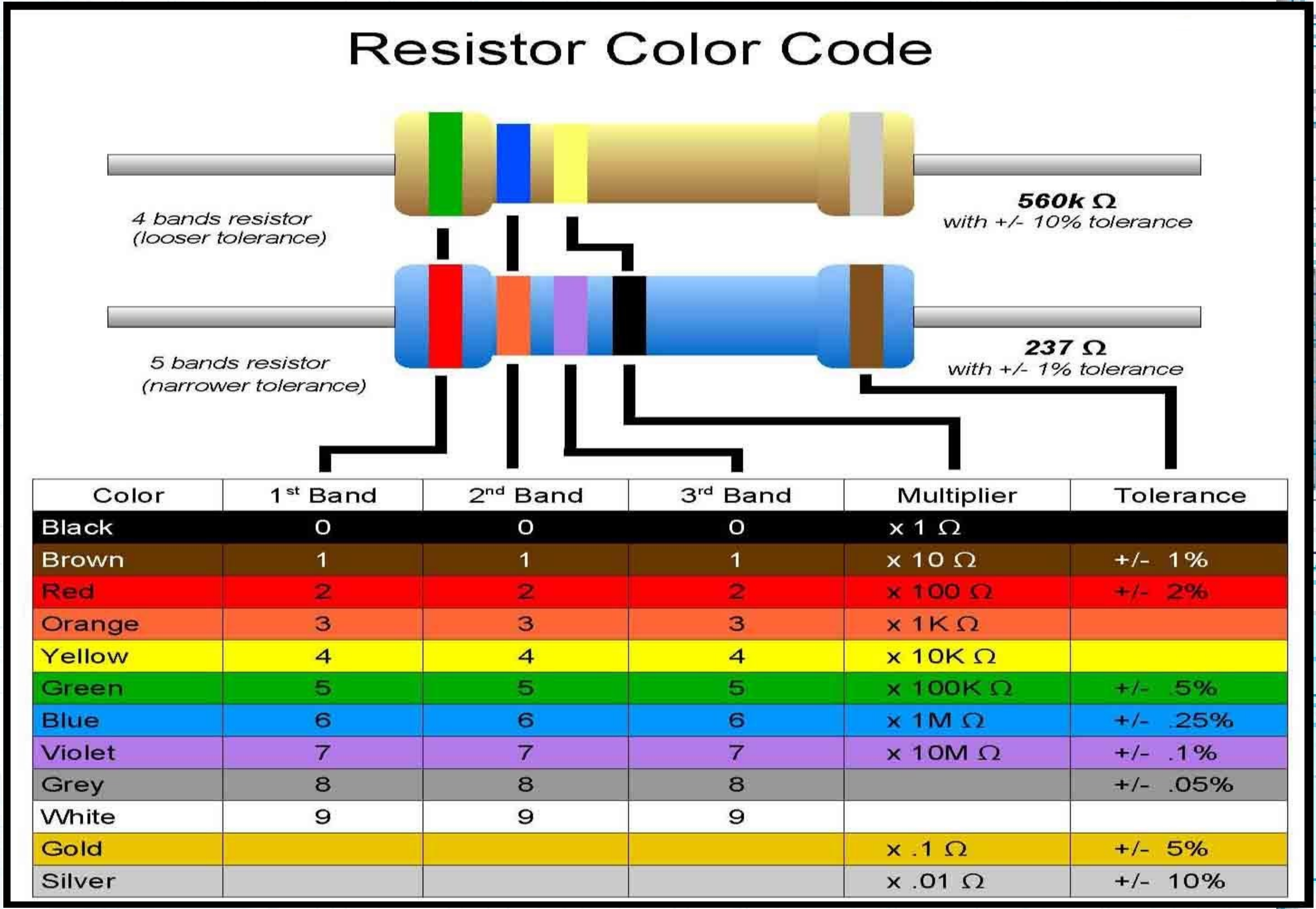


http://www.instructables.com/id/LED-Polarity-Tester/

LEDs and Voltage Dividers



Resistors!



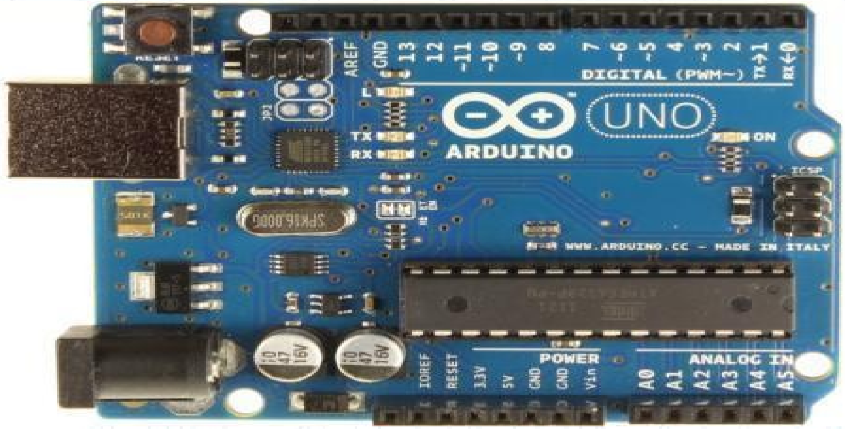
Resistor Color Code

Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

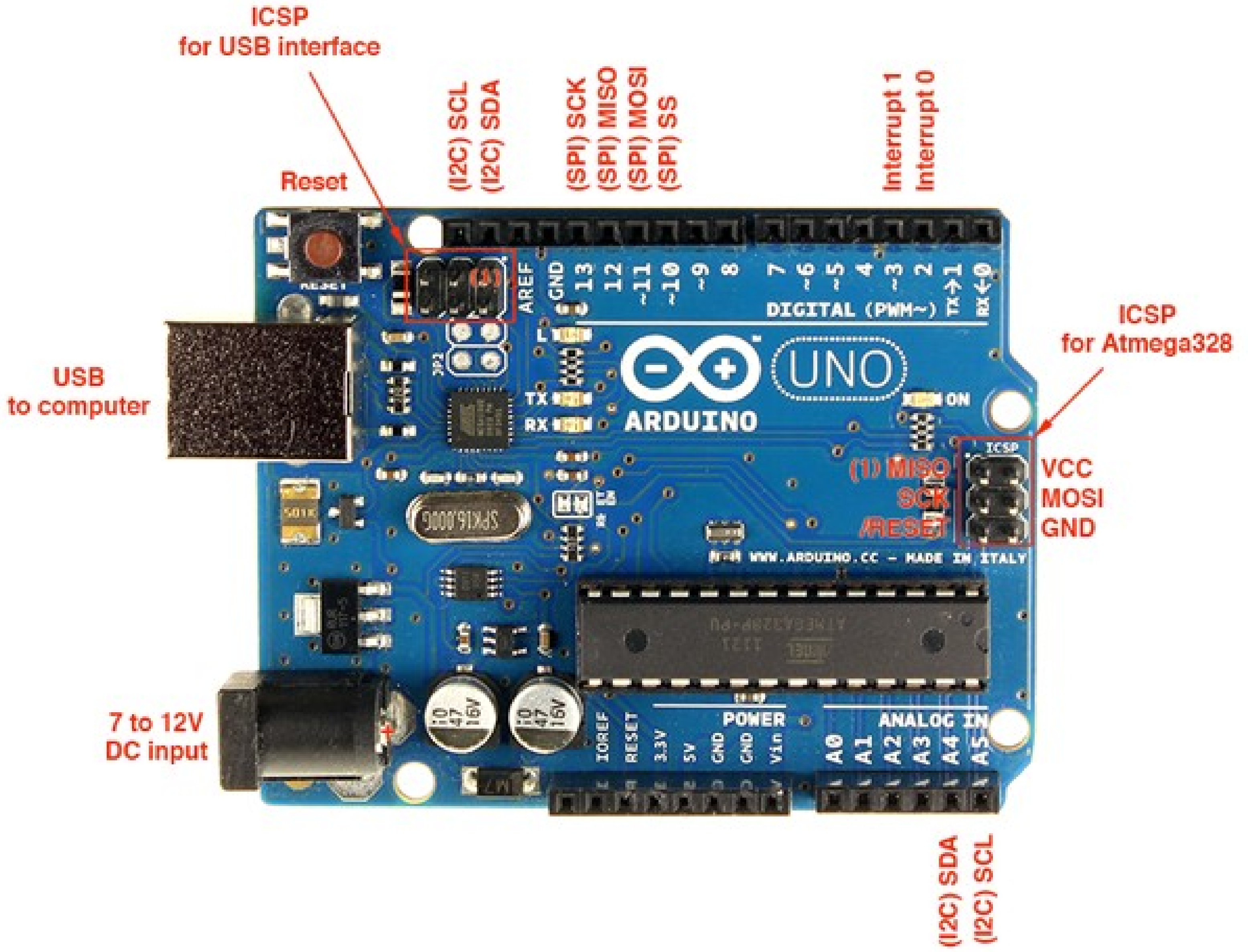
http://www.google.com/imgres?imgurl=&imgrefurl=http%3A%2F%2Fdiy-stem.org%2Fknatom%2Fresistors%2F&h=0&w=0&tbnid=VbUoXDea
7PenhM&zoom=1&tbnh=187&tbnw=270&docid=zo0TrBBZQS2NVM&tbm=isch&client=ubuntu&ei=KpXEU76BLu3hsASLzYHoBw&ved=0CAUQsCUoAQ

Arduino

- Microcontroller
- Open source physical computing platform
- Inexpensive, cross-platform
- Rapid prototyping



Arduino Components

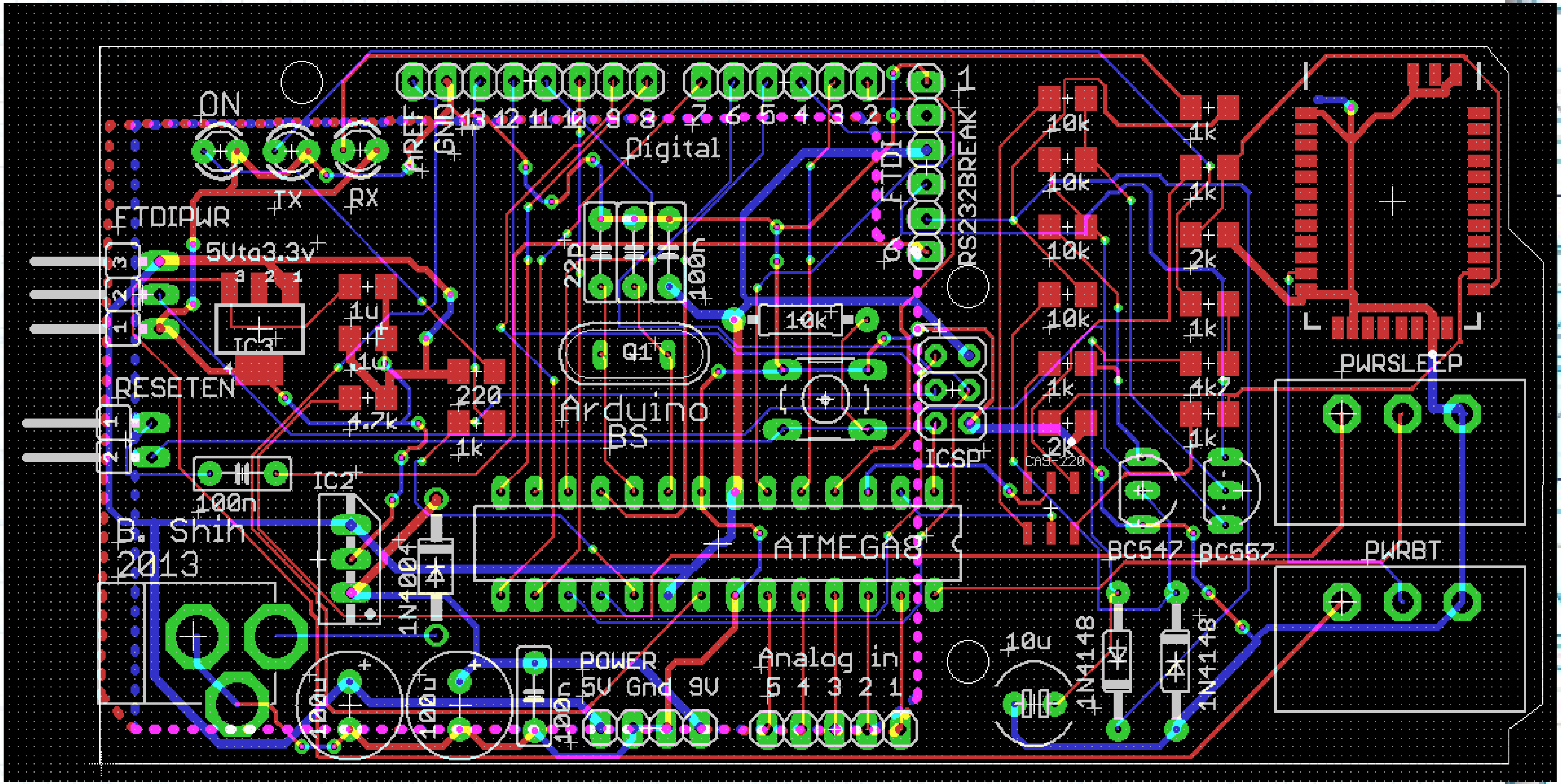


Digital------------------Analog

- 1 → HIGH (> 3.3V)
- 0 → Low (< 3.3V)
- Read and write voltages to pins

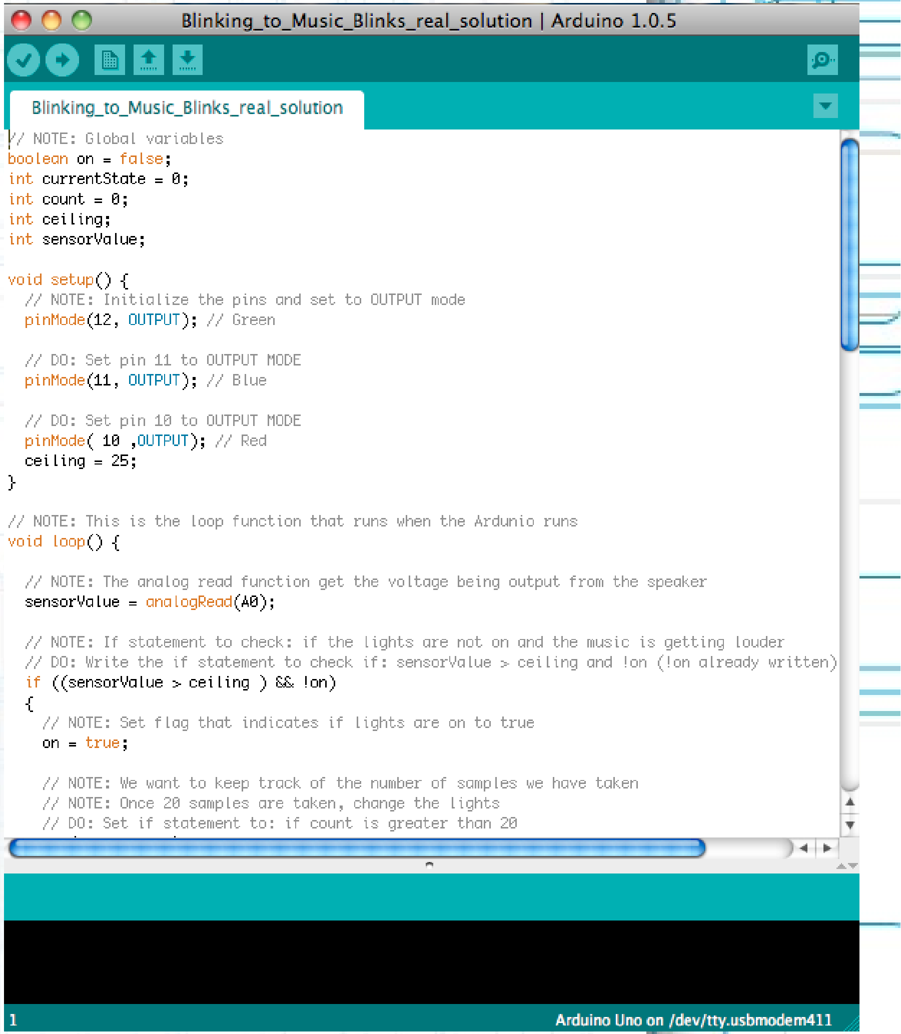
- Read a voltage and get a value between decimal value
- Output a PWM signal

Arduino PCB


ON
TX
RX
FTDIPWR
5Vto3.3v
IC3
RESETEN
1u
1u
4.7k
220
1k
100n
IC2
B. Shih
2013
AREF
GND
13 12 11 10 9 8
7 6 5 4 3 2 1
Digital
22p
100n
Q1
Arduino
BS
10k
FTDI
RS232BREAK
ICSP
ATMEGA8
1N4004
100u
100u
100n
POWER
5V Gnd 9V
Analog in
5 4 3 2 1
10k
10k
10k
10k
1k
2k
1k
1k
1k
2k
1k
4k7
1k
CASE-220
BC547
BC557
10u
1N4148
1N4148
PWRSLEEP
PWRBT

Code

- Arduino IDE
- Processor:
  - Programmed with a C derivative.
- What actually happens:
  - Code gets compiled to machine code
  - Syntax Errors get caught here
  - Machine Code gets loaded onto the microcontroller
  - Microcontroller executes code
- Why is this so amazing?


Blinking_to_Music_Blinks_real_solution | Arduino 1.0.5
Blinking_to_Music_Blinks_real_solution

```
// NOTE: Global variables
boolean on = false;
int currentState = 0;
int count = 0;
int ceiling;
int sensorValue;

void setup() {
  // NOTE: Initialize the pins and set to OUTPUT mode
  pinMode(12, OUTPUT); // Green

  // DO: Set pin 11 to OUTPUT MODE
  pinMode(11, OUTPUT); // Blue

  // DO: Set pin 10 to OUTPUT MODE
  pinMode( 10 ,OUTPUT); // Red
  ceiling = 25;
}

// NOTE: This is the loop function that runs when the Ardunio runs
void loop() {

  // NOTE: The analog read function get the voltage being output from the speaker
  sensorValue = analogRead(A0);

  // NOTE: If statement to check: if the lights are not on and the music is getting louder
  // DO: Write the if statement to check if: sensorValue > ceiling and !on (!on already written)
  if ((sensorValue > ceiling ) && !on)
  {
    // NOTE: Set flag that indicates if lights are on to true
    on = true;

    // NOTE: We want to keep track of the number of samples we have taken
    // NOTE: Once 20 samples are taken, change the lights
    // DO: Set if statement to: if count is greater than 20
```

Language Basics

- Header:
  - #include [statements]

- // Comments these words are not compiled!

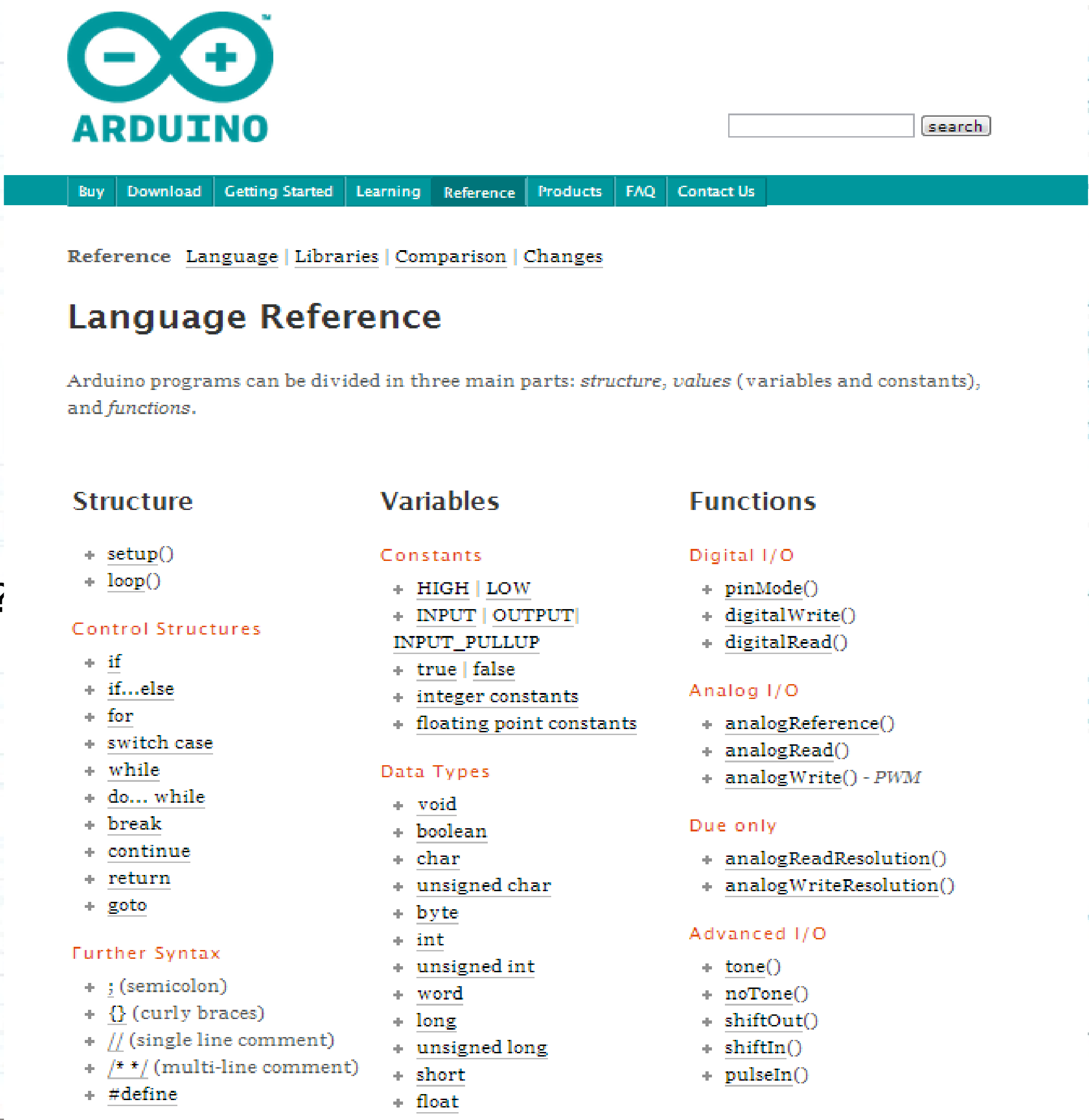
- void **setup**(void) {}   <-- must
- void **loop**() {}   <-- must

- [type] functionName([type] var, [type] var2)

- '{' and '}' indicate a "body" of code
  - if, else, else if
  - for
  - switch

Online API

- What is a library?
- Why use a library?
- What code is in the library?
- Can I make my own library functions?
- Where can I go for help coding?
- http://arduino.cc/en/Reference/If



Reference Language | Libraries | Comparison | Changes

Language Reference

Arduino programs can be divided in three main parts: *structure*, *values* (variables and constants), and *functions*.

Structure

- setup()
- loop()

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return
- goto

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define

Variables

Constants

- HIGH | LOW
- INPUT | OUTPUT | INPUT_PULLUP
- true | false
- integer constants
- floating point constants

Data Types

- void
- boolean
- char
- unsigned char
- byte
- int
- unsigned int
- word
- long
- unsigned long
- short
- float

Functions

Digital I/O

- pinMode()
- digitalWrite()
- digitalRead()

Analog I/O

- analogReference()
- analogRead()
- analogWrite() - *PWM*

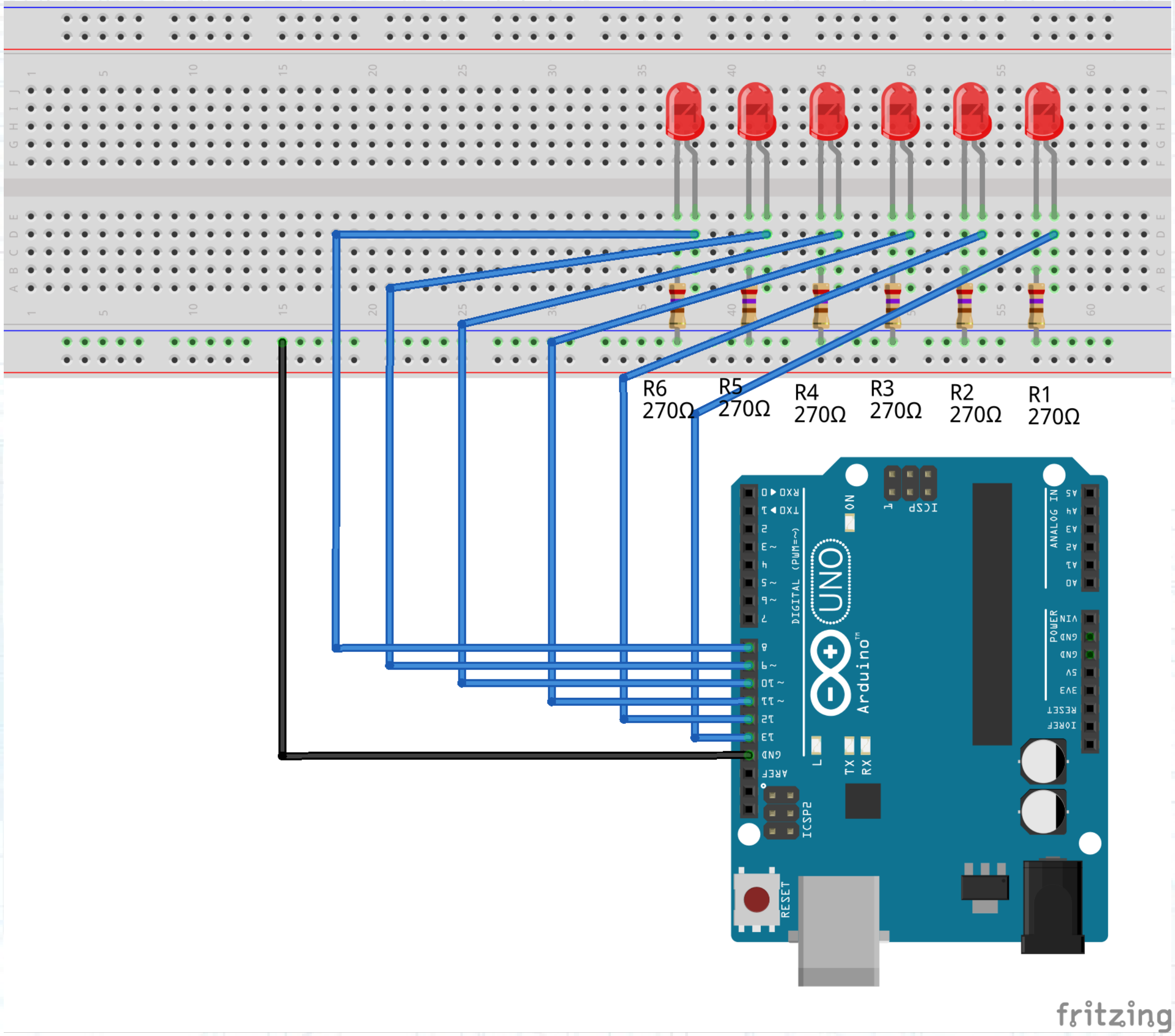
Due only

- analogReadResolution()
- analogWriteResolution()

Advanced I/O

- tone()
- noTone()
- shiftOut()
- shiftIn()
- pulseIn()

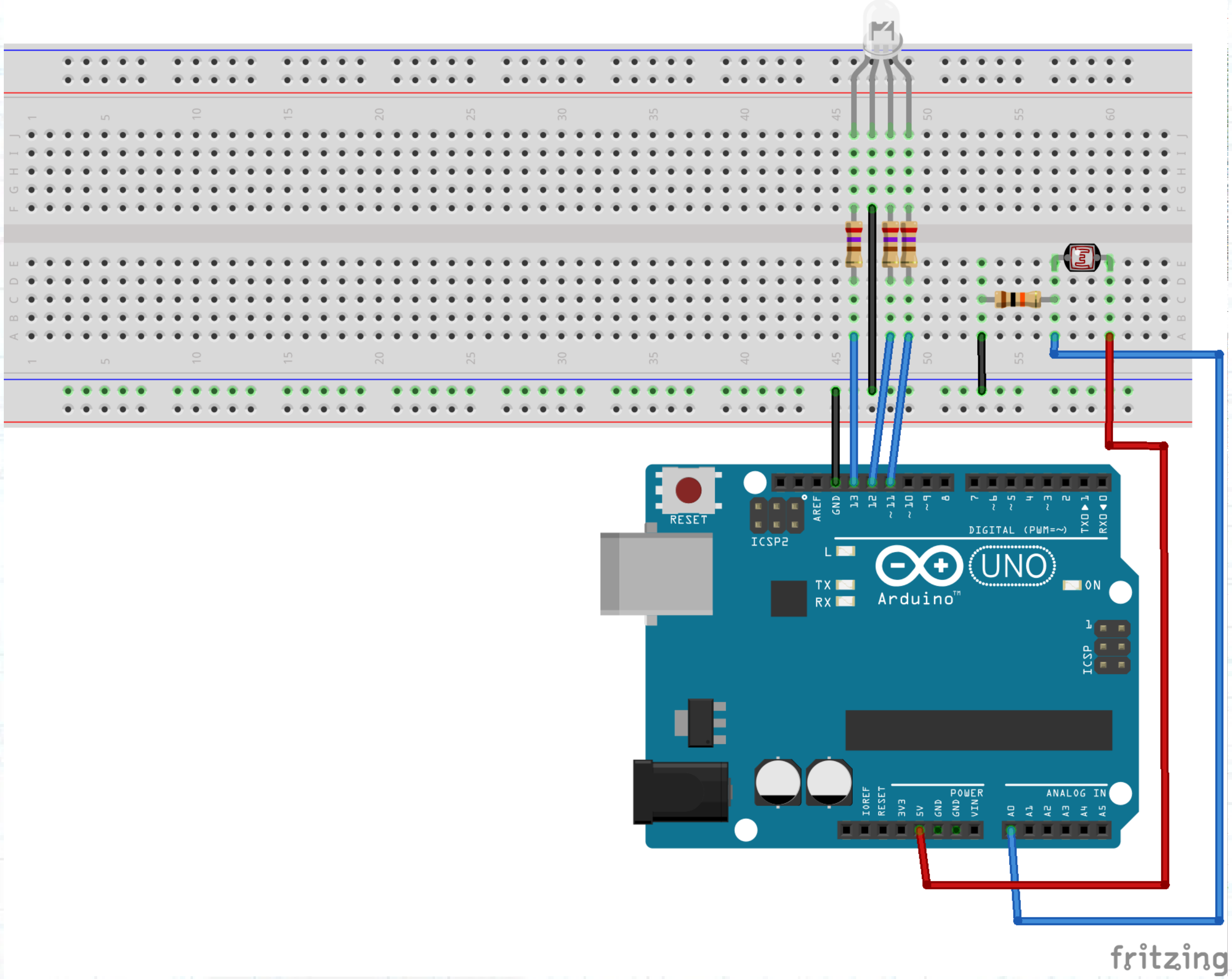
Die Circuit


R6
270Ω
R5
270Ω
R4
270Ω
R3
270Ω
R2
270Ω
R1
270Ω
UNO
Arduino
DIGITAL (PWM=~)
ANALOG IN
POWER
ICSP
ICSP2
RESET
AREF
GND
TX
RX
L
ON
fritzing

Die Parts

- 6 - LEDs
- 6 - 270 Ohm Resistor

Distance Detection Circuit



Distance Detection Parts

- 3 - 270 Ohm resistor
- 1 – 10K Ohm resistor
- 1 – Photo-resistor

Party Lights Parts

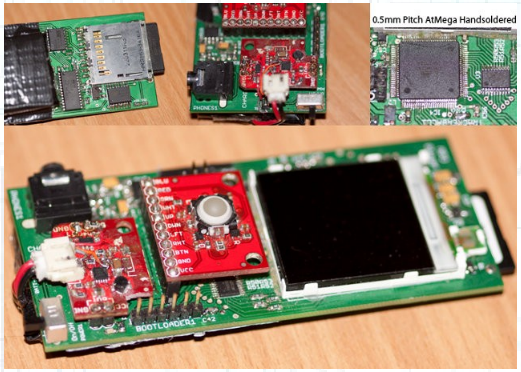
- 1 – Speaker
- 1 – Audio Jack
- 3 – LEDs
- 3 – 270 Ohm resistors

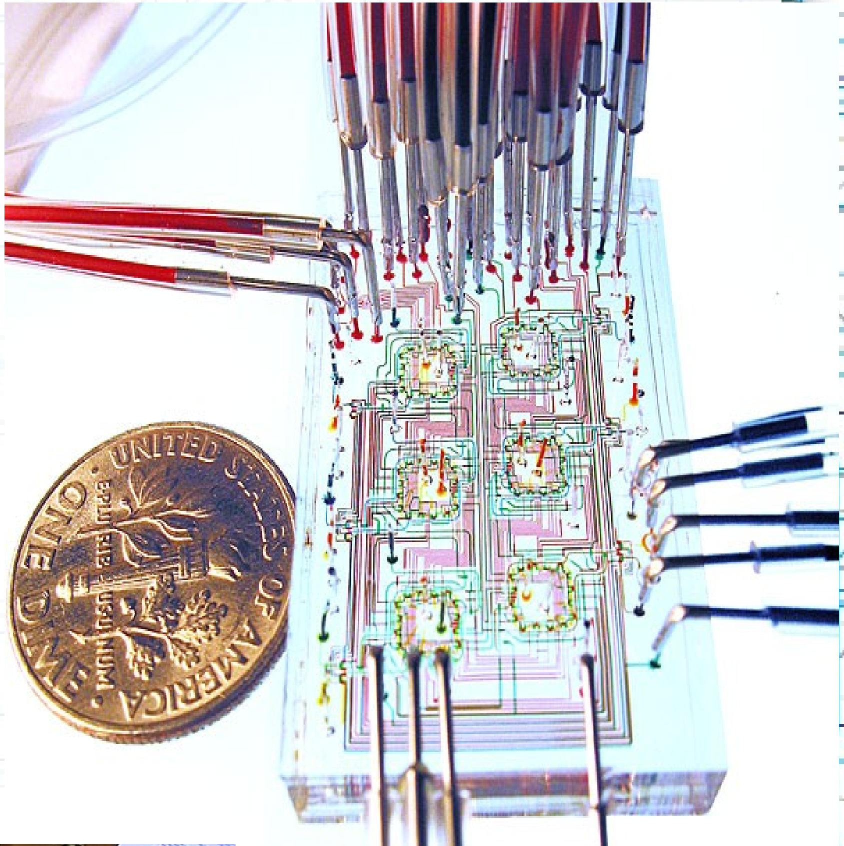
Chat Parts

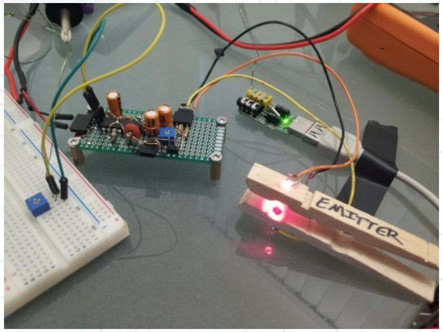
- 2 – Arduinos
- 3 – Wires

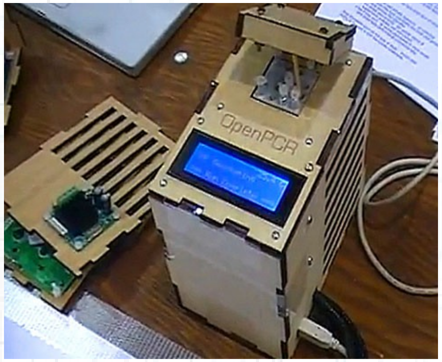
Real life application for Arduinos

- MP3 player
- Phone
- Robots
- Microfluidic devices
- Open PCR
- ECG and pulse oximeter









- http://www.nudatech.com/blog/20-arduino-projects-of-2012/
- http://medicarduino.net/?cat=4