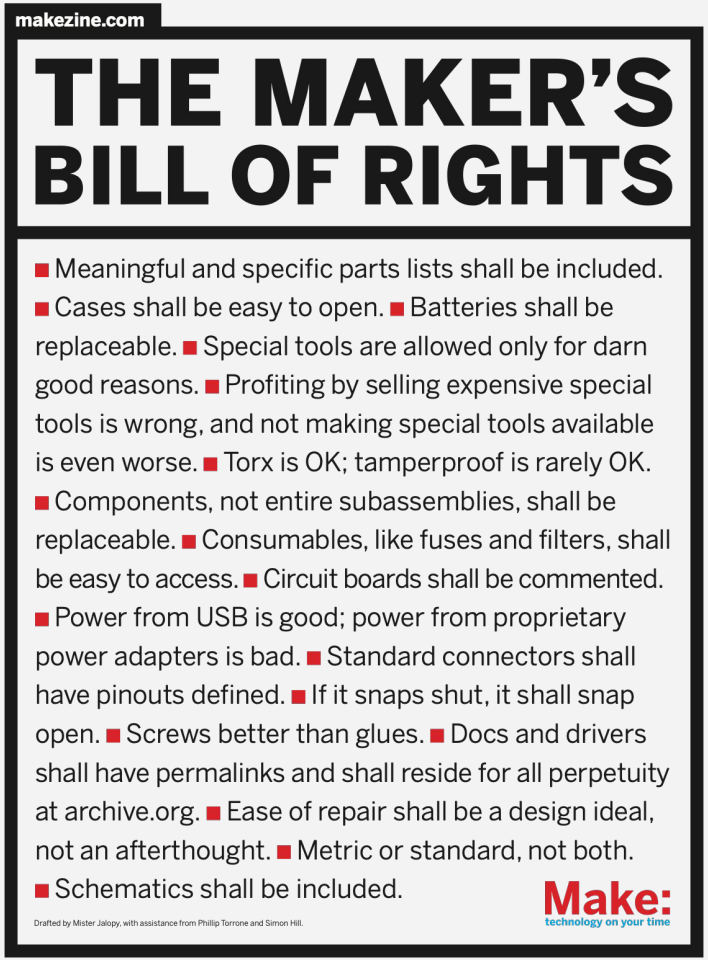

MT06 - ARDUINO Y
PROGRAMACIÓN
FAB
LAB
BCN

MT06* Introducción Arduino / Programación		
MASTER CLASS	7/12	8 a 930hs
LABVIRTUAL	14/12	8 a 930hs
REVIEW / WEBINAR	17/12	8 a 10hs

Clase 06/12:

- **Presentación MT06**
- **Iniciación a Arduino y electrónica**
- **Q&A - conversation**
- **Desafío**

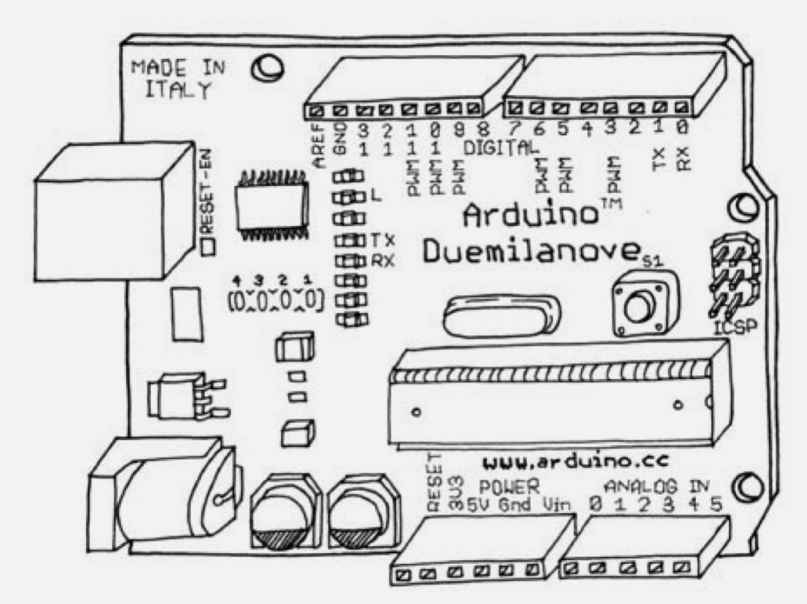
INTRODUCCIÓN



OPEN // SOURCE

Es un manifiesto para aquellos que quieren la libertad de jugar, rehacer, reparar, recombinar y actualizar las cosas que poseen. Publicado por Make: en 2005, articula una lista de 17 mandamientos que los fabricantes deben seguir para hacer que sus productos sean reparables y pirateados.

PHYSICAL//
COMPUTING



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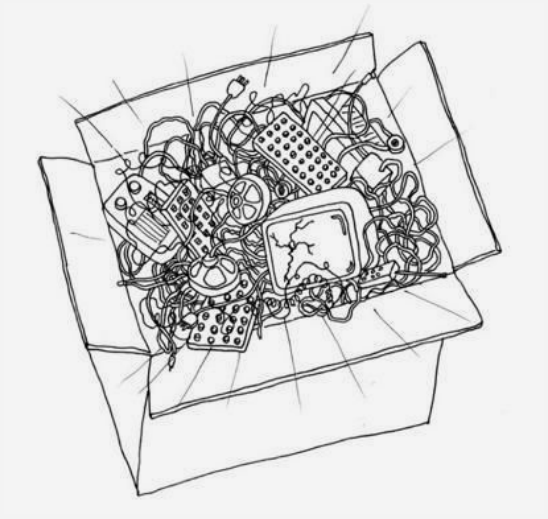
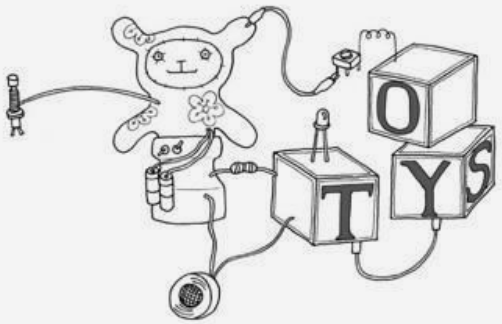
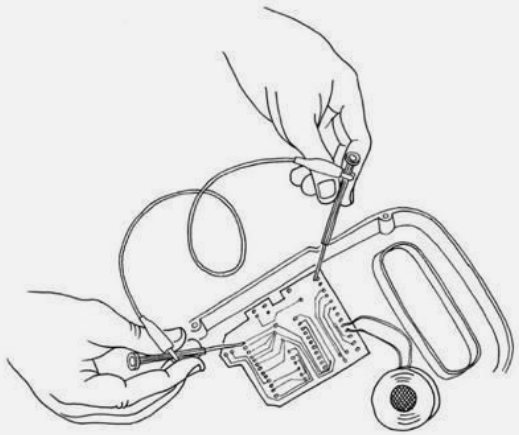
PHYSICAL//
COMPUTING

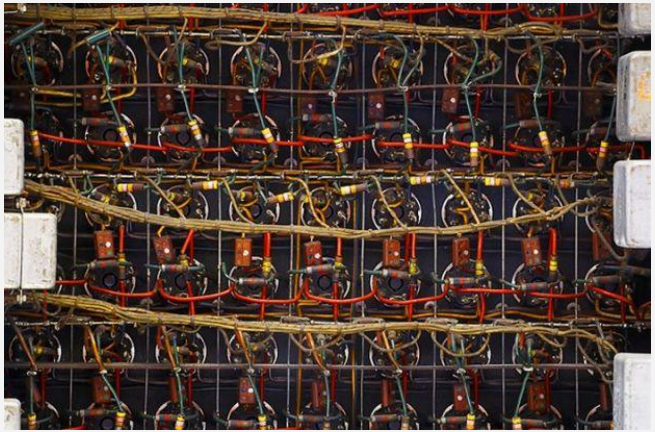






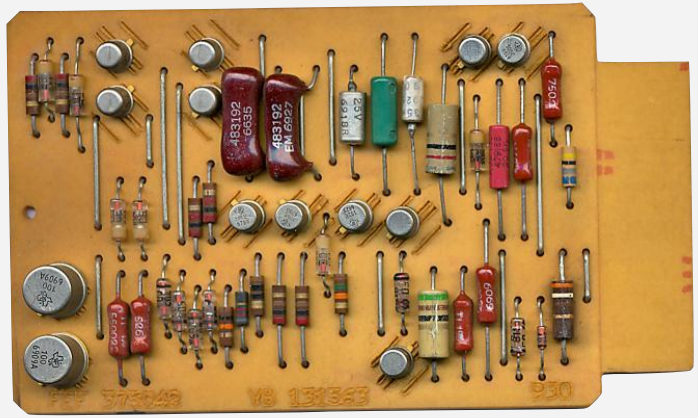
HISTORIA

COMPUTING // HISTORY



En los Laboratorios Bell, John Bardeen, Walter Houser Brattain y William Shockley inventan el transistor.

1946



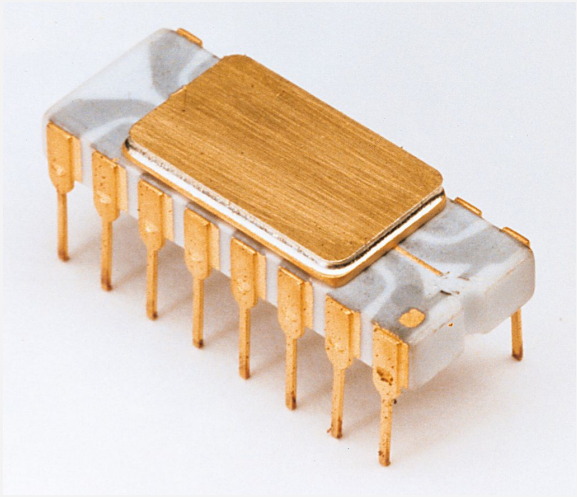
Jack S. Kilby construye el primer circuito integrado.

1959

COMPUTING // HISTORY

The Apollo Guidance Computer:

1968



In 1974 Intel released the first microcontroller, the Intel 4004:

1974

COMPUTING // HISTORY

Steve Jobs, Steve Wozniak, Mike Markkula fundan Apple.

1976

Microsoft presenta su sistema operativo MS-DOS, por encargo de IBM.

1982

COMPUTING // HISTORY

Motorola lanzó, el 3 de enero de 1996, el StarTAC, era el teléfono móvil más pequeño y ligero del planeta. Lo que redefinió la idea de cómo debería ser un celular.

1996

Presentación del primer iPhone, por la empresa Apple, un teléfono inteligente o *smartphone*.

2007

COMPUTING // HISTORY

La Raspberry Pi Zero recibe una actualización, con una tarjeta inalámbrica (Wi-Fi y Bluetooth). También es la primera versión con un puerto de cámara integrado.

2017

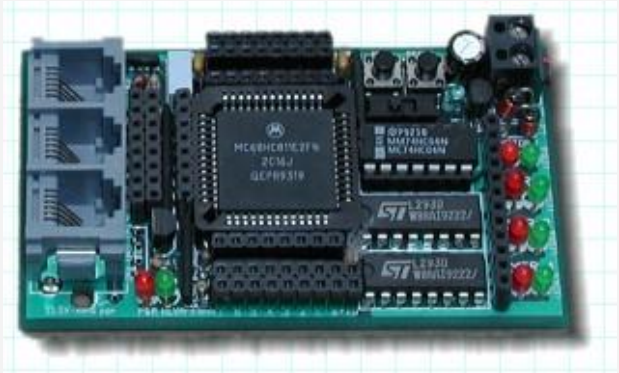
COMPUTING // HISTORY

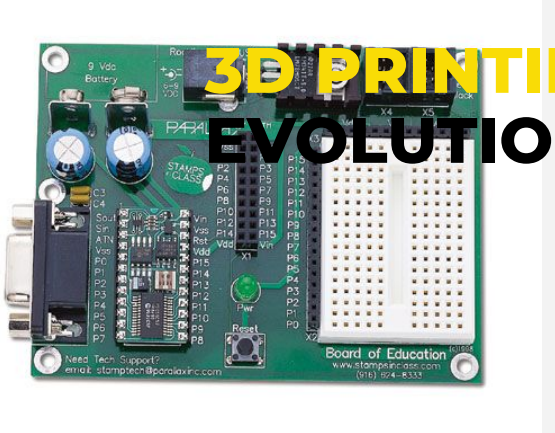
Apollo	Arduino	Raspberry	iPhone 6
2 MHz	16 MHz	700 MHz x 2	1400 MHz x 2
4kB RAM	2kB RAM	512MB RAM	1GB RAM
72kB ROM	32kB FLASH	8GB FLASH	16GB FLASH

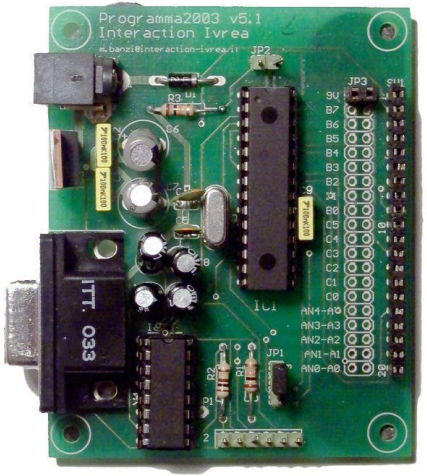
3D PRINTING//
EVOLUTION

"The 3D Printing Revolution" Richard D'Aveni

3D PRINTING//
EVOLUTION

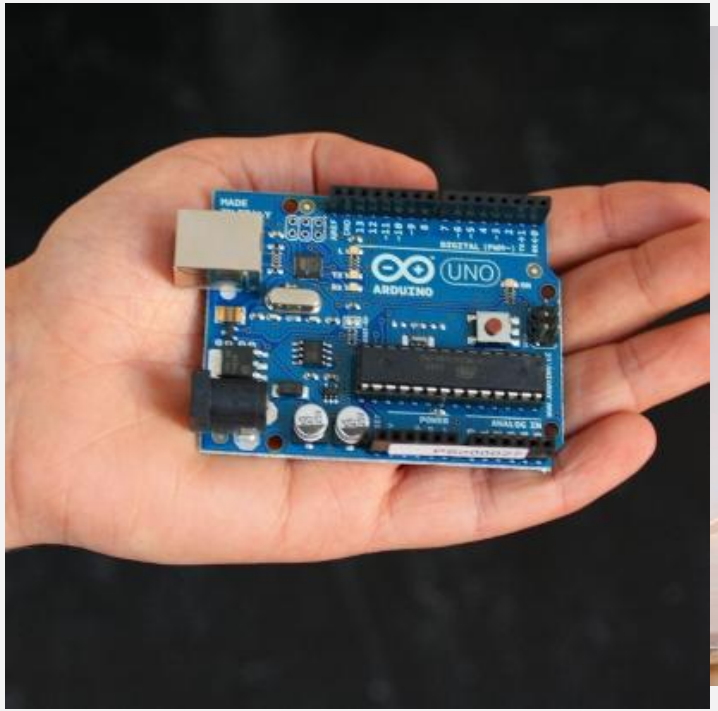






ARDUINO

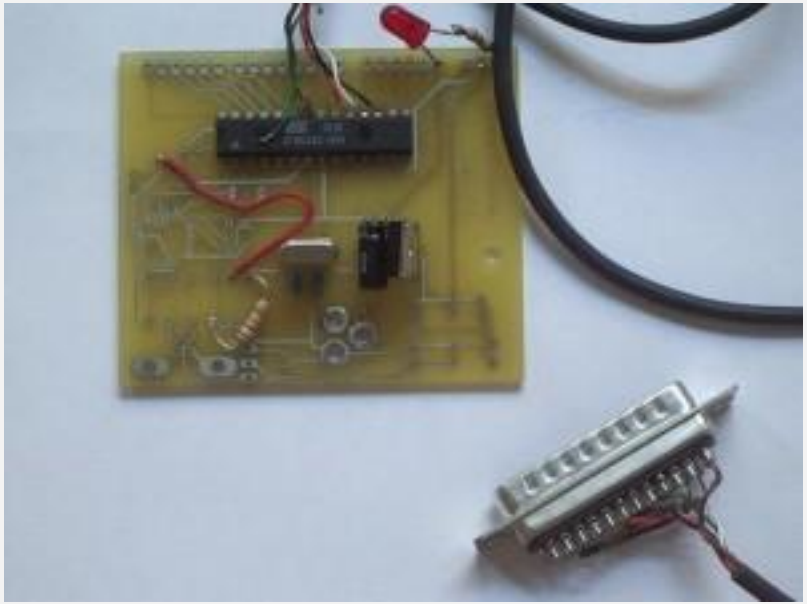
ARDUINO//
ORIGINS

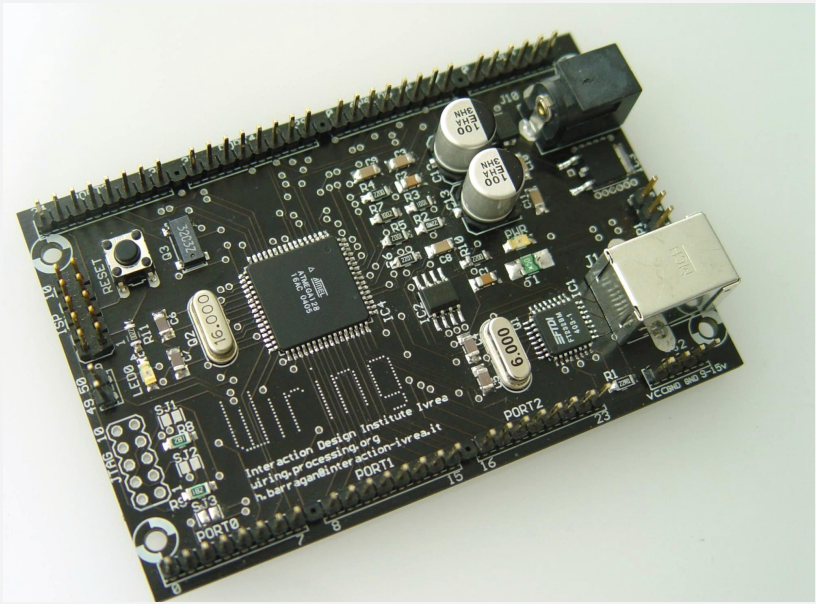


El proyecto «Arduino» se inició en el año 2005 como un proyecto enfocado a estudiantes en el Interaction Design Institute Ivrea (IDII), de Ivrea (Italia)

ARDUINO//
ORIGINS

ARDUINO //
EVOLUTION





"The 3D Printing Revolution" Richard D'Aveni

ARDUINO // EVOLUTION

Arduino Uno

Arduino Leonardo

Arduino Tre

Arduino Micro

Arduino Due

Arduino Yún

Arduino Robot

Arduino Esplora

http://arduino.cc/en/Main/Hardware

ARDUINO//
EVOLUTION

Arduino Mega ADK

Arduino Ethernet

LilyPad Arduino USB

LilyPad Arduino Simple

Arduino Nano

Arduino Pro Mini

Arduino Mega 2560

Arduino Mini

LilyPad Arduino SimpleSnap

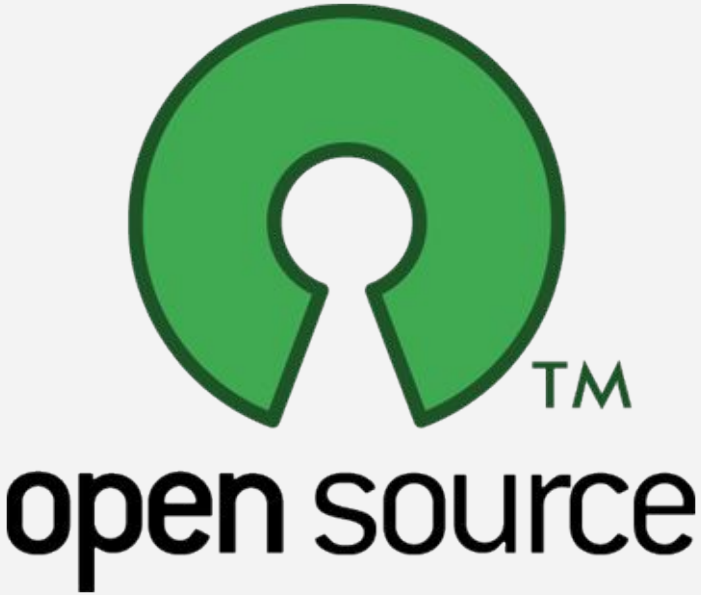
LilyPad Arduino

Arduino Pro

Arduino Fio

http://arduino.cc/en/Main/Hardware

ARDUINO// ECOSYSTEM



ARDUINO// ECOSYSTEM

http://www.bareconductive.com/wp-content/uploads/2015/03/BareConductive_MicrocontrollerGuide1.pdf

https://www.sparkfun.com/arduino_guide

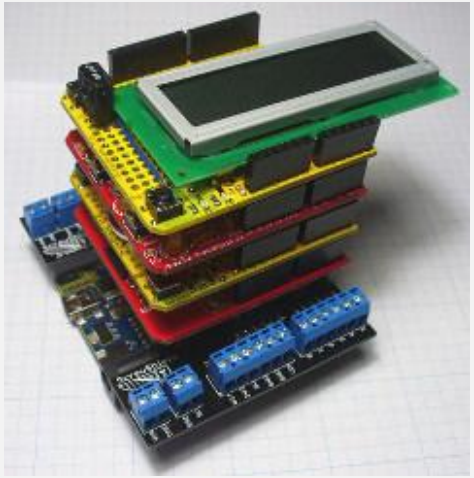
https://learn.adafruit.com/embedded-linux-board-comparison

http://www.makershed.com/Articles.asp?ID=302&Click=127972

DETAILS / TECH SPECS

	ARDUINO LEONARDO	TOUCH BOARD	LILYPAD ARDUINO	ADAFRUIT TRINKET	MAKEY MAKEY	DENTAKU OTOTO	RASPBERRY PI (MODEL B+)	INTEL EDISON (ARDUINO B/O KIT)	BEAGLEBONE BLACK	UDOO QUAD	SPARK CORE	FREESCALE FREEDOM
ONBOARD PROCESSOR	ATmega32U4 at 16 MHz	ATmega32U4 at 16 MHz	Atmega328 at 8 MHz	Attiny85 at 8 MHz	ATmega32U4 at 16 MHz	ATmega32U4 at 16 MHz	BCM2835 at 700 MHz	Dual Core Intel Atom at 500 MHz	ARM Cortex-A8 AM335x at 1 GHz	ARM Cortex-A9 Quad core at 1GHz	STM32F103 at 72 MHz	MKL46Z256VLLZ4 at 48 MHz
CO-PROCESSOR								Intel Quark microcontroller at 100 MHz	2x 32-bit RISC processor at 200 MHz	Atmel SAM3X8E at 84 MHz		
RAM	2.5 KB	2.5 KB	2 KB	512 B	2.5 KB	2.5 KB	512 MB	1 GB	512 MB	1 GB	20 KB	32 KB
Number of **touch sensors**	0	12	0	0	6	12	0	0	0	0	0	15
Capacitive sensing (one-handed triggering)												
Proximity sensing (trigger without touch)												
Onboard **MP3** / **WAV** / **OGG** / **FLAC** / **MIDI** playback												
Onboard polyphonic **MIDI** synthesis												
Micro **SD** card slot												
On / **Off** switch												
Lithium Polymer (**LiPo**) cell charging via **USB**												
Can run from a Lithium Polymer (**LiPo**) cell												
Can act as a **USB serial device**												
Can act as a **USB keyboard** or **mouse**												
Can act as a **USB MIDI interface**												
Arduino **shield** compatible												
Onboard headphone / **line** output												
Onboard **video** out												
Can be programmed using the **Arduino IDE**												
Number of **USB** host sockets	0	0	0	0	0	0	4	0	1	2	0	1
Onboard **LAN**												
Onboard **WIFI**												
Onboard **SATA**												
Works out of the box												
Approvals	CE, FCC	CE, FCC			CE	CE, FCC	CE, FCC		CE, FCC	CE, FCC		CE
Country of manufacture	ITALY	UK	USA	USA	CHINA	UK	UK	CHINA	USA	ITALY	CHINA	CHINA

ARDUINO//
SHIELDS



http://shieldlist.org/

Arduino Shield List

Pin usage details for 317 shields from 125 makers, and counting!

Search: GO

> Home

- 4D Systems (4)
- Adafruit Industries (9)
- AeroQuad (2)
- Andre Concalves (2)
- antrax Datentechnik (1)
- Applied Platonics (1)
- ArduCapSense (1)
- Arduino (3)
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- Ben Combee (1)
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- Bliptronics (2)
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- Collin Schulz (1)
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- Control Connection (1)
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- Critical Velocity (5)
- Critter and Guitari (1)
- Excamera Labs (1)
- Faz Jaxton (1)
- FlamingoEDA (1)
- Freetronics (12)
- Futura Elettronica (2)
- Galileo 7 (4)
- GeekOnFire (1)
- GfxHax (1)
- GinSing (1)
- Gravitech (1)
- Homeroasters (1)
- HW Kitchen (1)
- ITead Studio (6)
- Jee Labs (1)
- Jimmie Rodgers (1)
- John Liu (3)
- Knutsel (1)
- Lars Schumann (3)
- Libelium (6)
- LinkSprite (5)
- Liquidware (12)
- Logos Electromechanical (1)
- Low Voltage Labs (1)
- Luke Weston (1)
- macetech (3)
- Maker Shed (1)
- Mark Sproul (1)
- Ocean Controls (1)
- Open Electronics (1)
- PDK Solutions (1)
- Photoduino (1)
- Pololu (1)
- Practical Maker (5)
- Protuino (2)
- Ray's Hobby (1)
- Renbotics (2)
- RepRap Research Foundation (1)
- Ro-Bot-X Designs (1)
- Robot Power (1)
- RobotPirate (1)
- Rocket Scream (1)
- Rogue Robotics (1)
- Rugged Circuits (6)
- Samurai Circuits (3)
- Scattered Mind (1)
- Schmelle2 (6)
- Seeed Studio (14)
- Shieldstudio (2)
- SK Pang Electronics (3)
- Small Room Labs (1)
- Smart Energy Groups (1)
- Snootlab (6)
- Solarbotics (2)
- SonikTech (1)

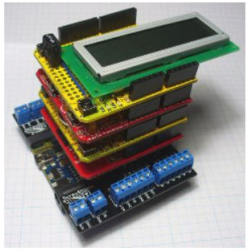


Photo: John Boxall

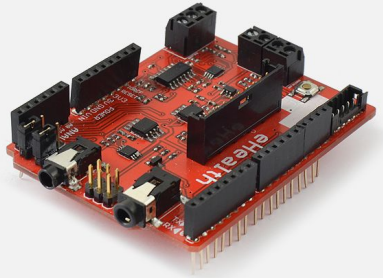
Tweets by @shieldlist

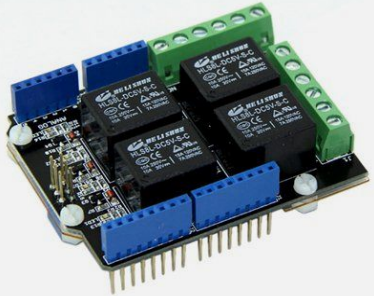
Arduino Shield List Retweeted

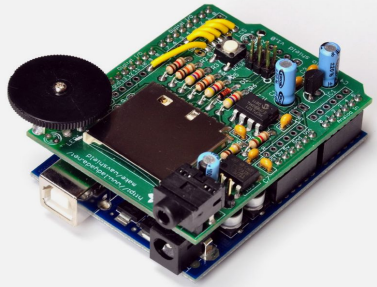
Freetronics
@freetronics

DIY keyed headers for Arduino:
freetronics.com.au/blogs/news/ski...

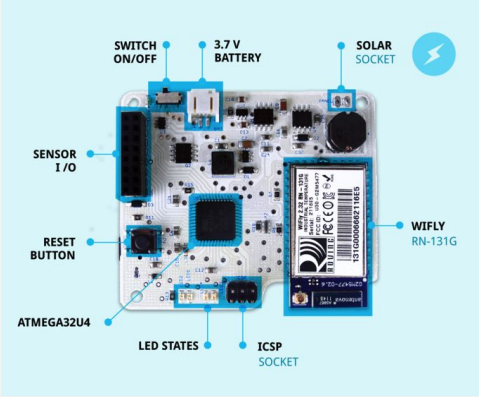
ARDUINO//
SHIELDS

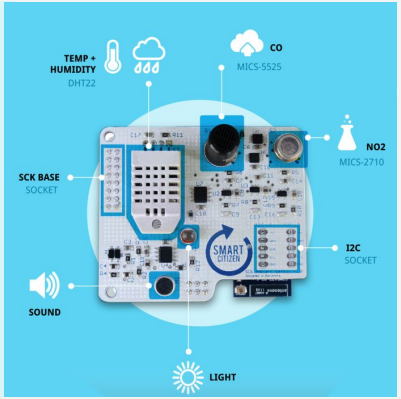


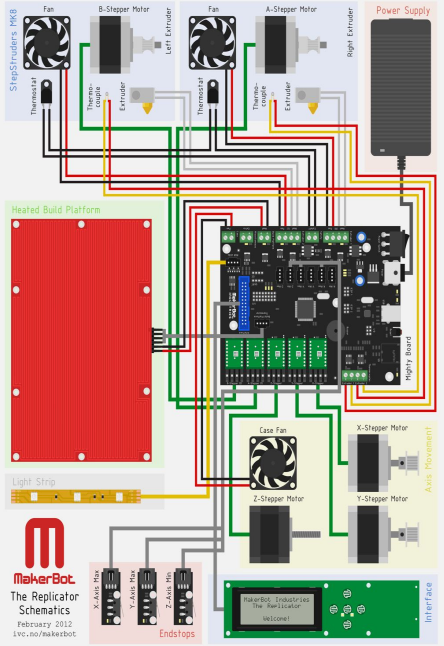




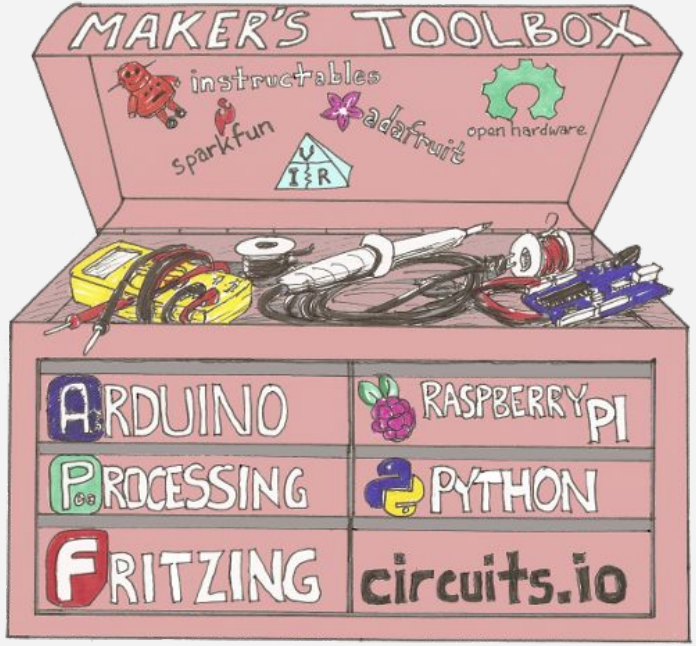
ARDUINO//
SHIELDS







ARDUINO//
ECOSYSTEM

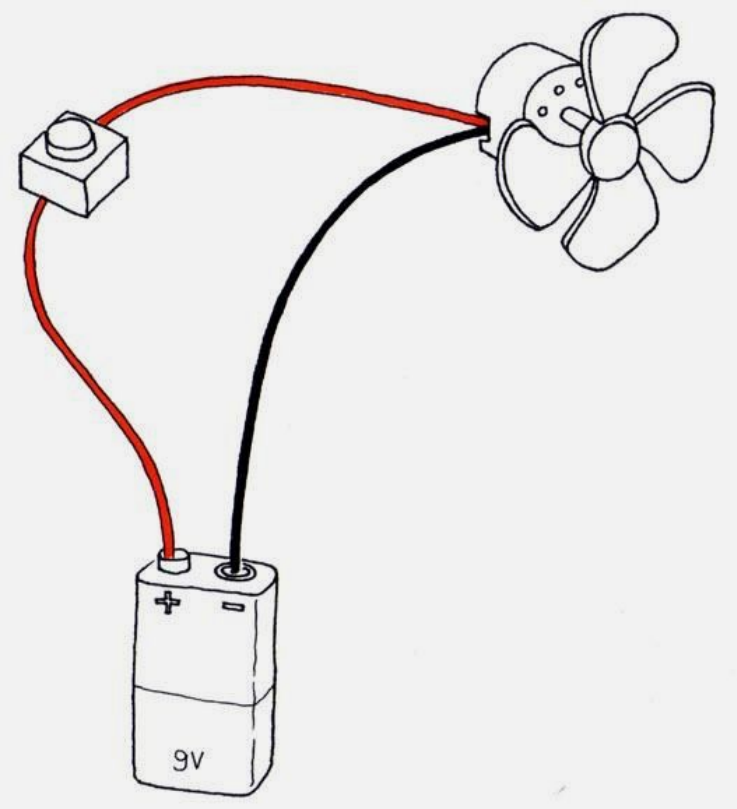


arduino.cc

fritzing.org

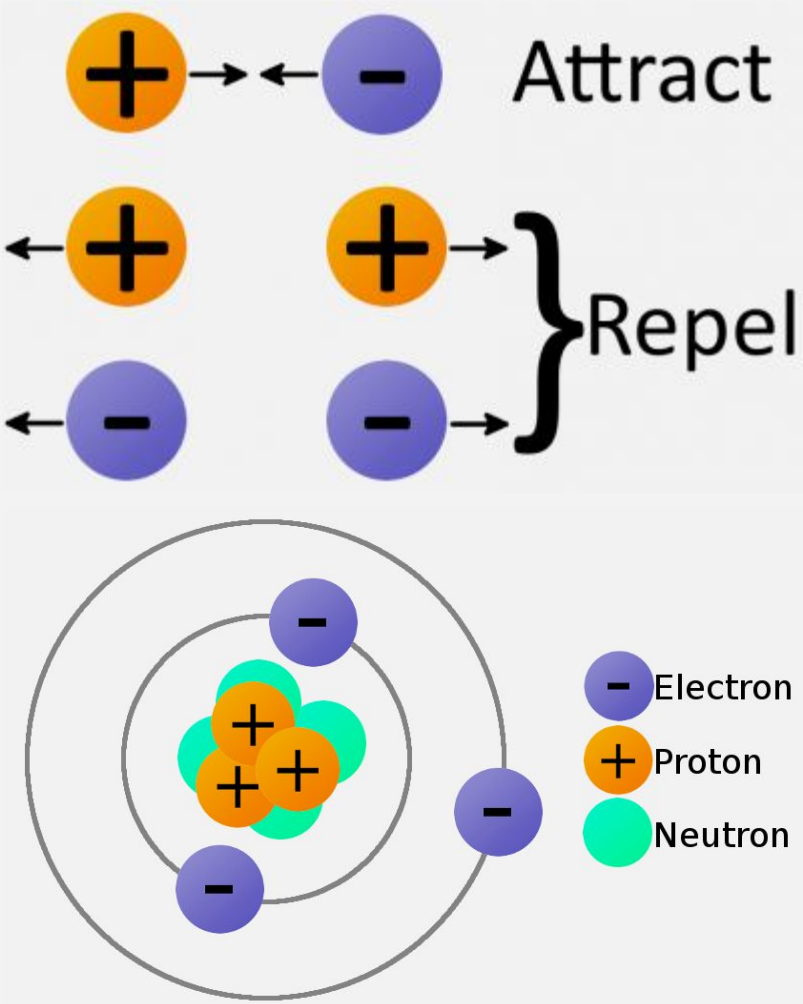
processing.org

ELECTRICIDAD



ELECTRICIDAD// 101

En esta sección, comprenderemos los conceptos básicos de la electricidad y cómo puede ayudarnos a representar la información. Comenzaremos con el circuito más simple e inferiremos de él cómo se puede almacenar, administrar y enviar la información a otros componentes.



ELECTRICIDAD//
CARGA

Todo se trata de carga eléctrica. Los objetos pueden contener una carga eléctrica (positiva o negativa) o no (lo que significa que son neutrales).

En las partículas subatómicas, los protones tienen carga positiva, los electrones tienen carga negativa y los neutrones son neutrales.

Estas partículas las encontramos en los átomos y definen el mundo tal y como lo vemos, siendo la estructura subyacente de lo que entendemos como elementos (Hidrógeno, Helio, Uranio ...). Todos sabemos que las partículas se cargan así:

ELECTRICIDAD//
VOLTAJE

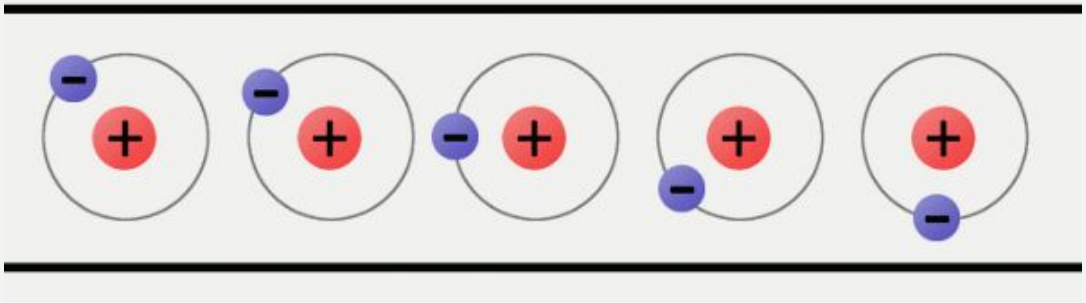
AC

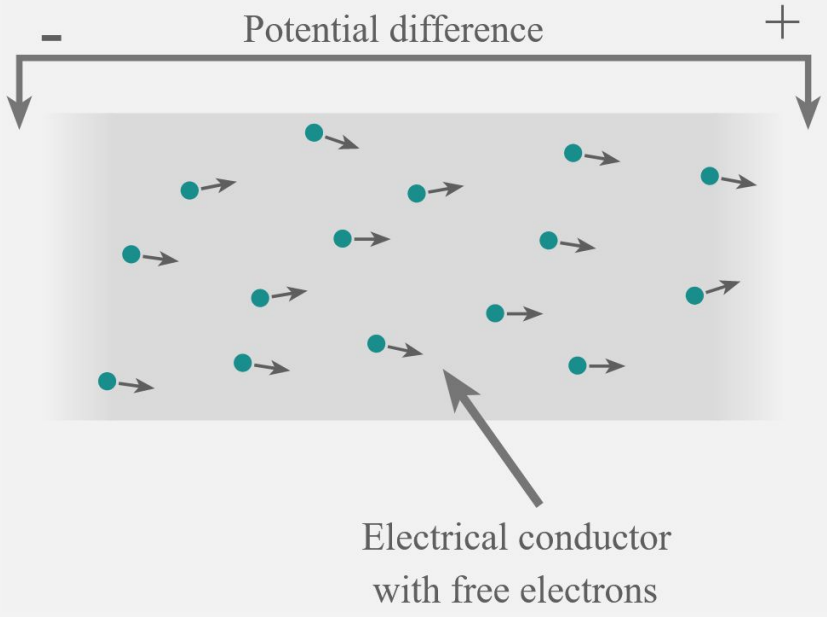
DC

Cuando forzamos a los electrones a agruparse en un área determinada, dejando otra área sin electrones, creamos una diferencia de voltaje. Este voltaje es la relación entre la energía que aplicamos y la carga eléctrica:

E = V x carga

Cuando dos objetos tienen una diferencia de voltaje, podemos decir que sus electrones intentarán saltar entre sí creando un flujo de corriente, para equilibrar la situación y estabilizarse. El voltaje se expresa en voltios (V). Este voltaje puede ser constante en el tiempo o alterno:

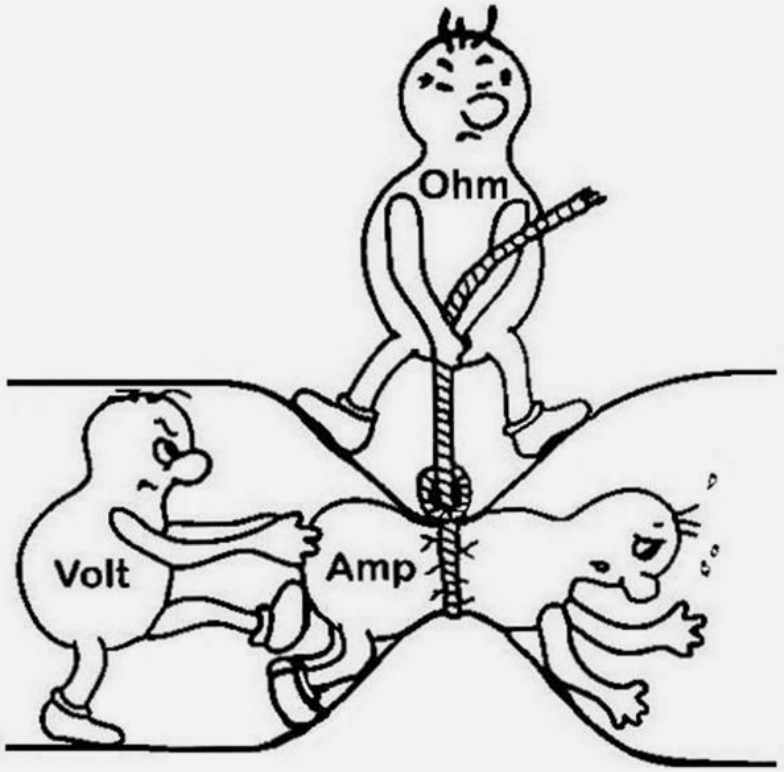




ELECTRICIDAD//
CORRIENTE

When two objects are subject to a difference voltage, electrons will try to come back to their position. When doing so, we say there is an *electric current* or just *current*.

This movement of electrons inside a material is measured in Amperes (A) or just Amps. If we have alternating voltage, we will have also alternating current (AC), and the same with constant voltage, in which case we will have DC.

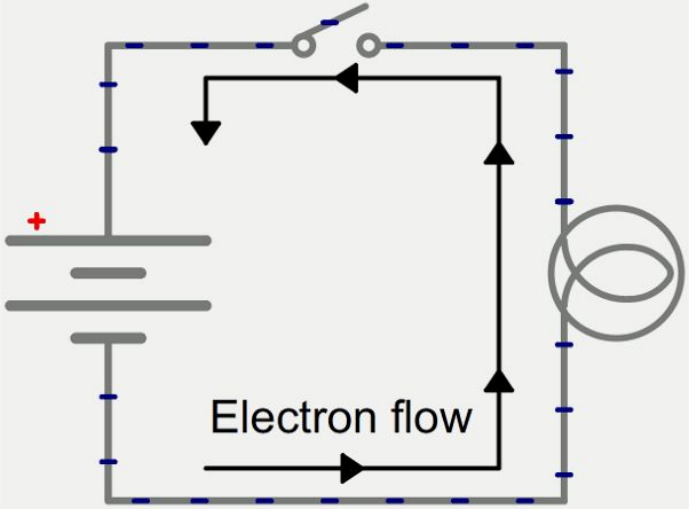


ELECTRICIDAD//
LEY DE OHM

Georg Ohm descubrió que el voltaje (V), la resistencia (R) y la corriente (I) van con la siguiente fórmula:

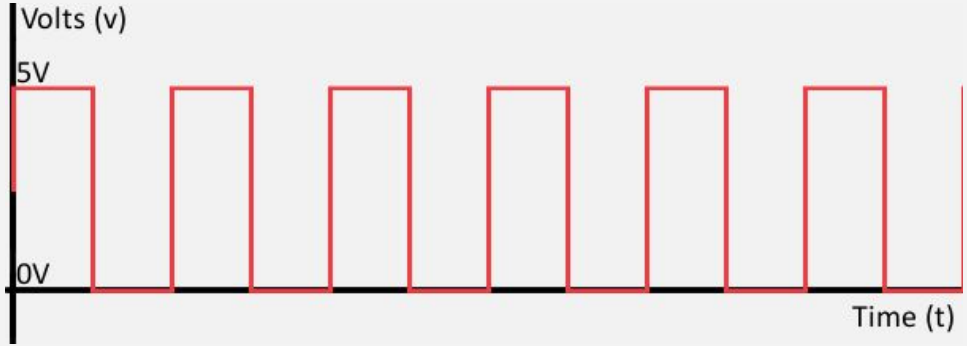
V = I x R

Lo que significa que cuando la resistencia es alta, casi no hay corriente (y cuando la corriente es 0, significa que tenemos un circuito abierto). Cuando la resistencia es casi 0, la corriente puede ser muy grande, lo que lleva a lo que llamamos un corto.



ELECTRICIDAD//
CONTROL

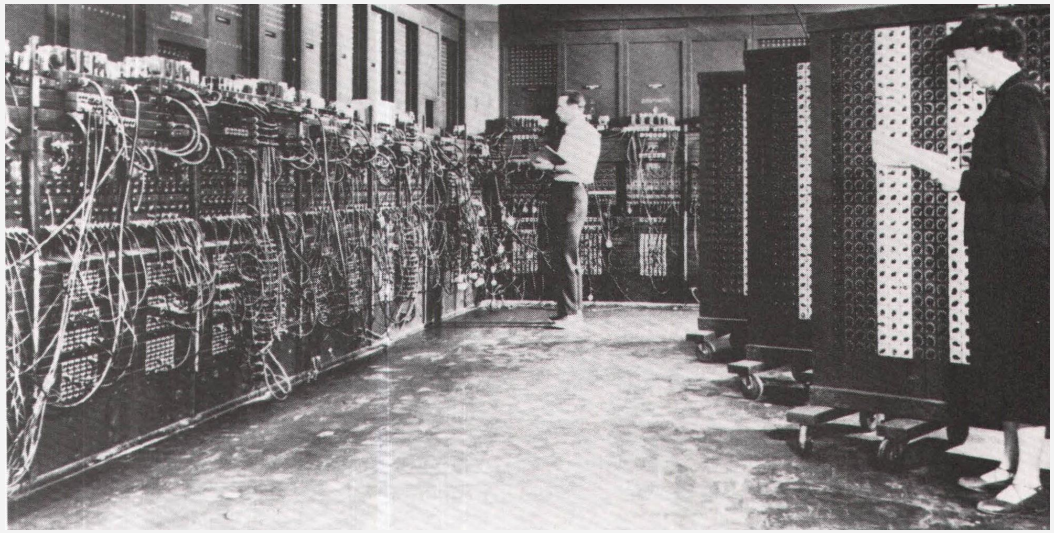
Lo bueno de esto es que podemos controlar este flujo (o la falta de él), ¡y luego podemos hacer cosas geniales!



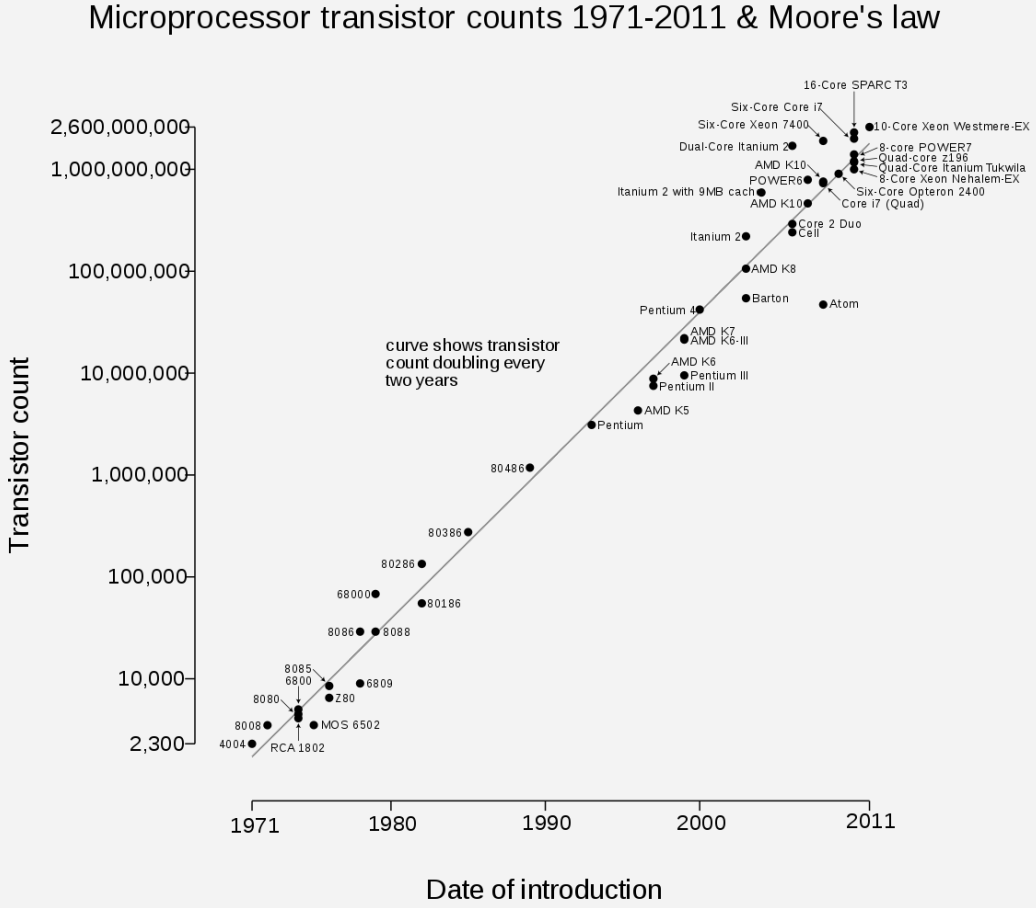
Hemos estandarizamos lo que consideramos como 1 (alto voltaje) y 0 o bajo voltaje. A esto lo llamamos niveles lógicos:

COMPUTING

COMPUTING // CONTROL

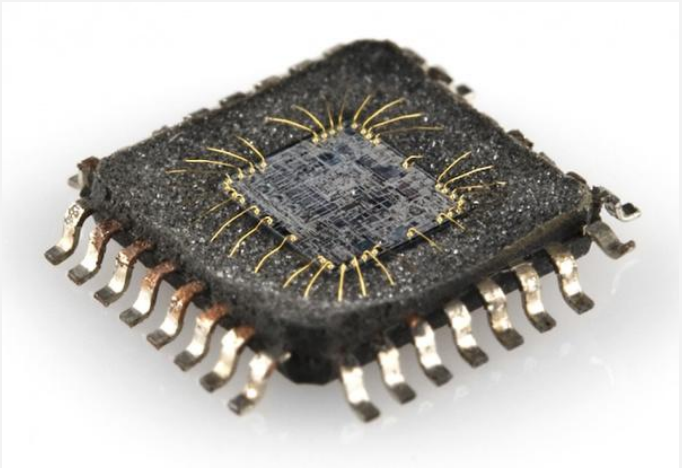


Las primeras máquinas informáticas eran programables en el sentido de que podían seguir la secuencia de pasos que se habían configurado para ejecutar, pero el "programa", o los pasos que debía ejecutar la máquina, se configuraban generalmente cambiando la forma en que se conectaban los cables. en un panel de conexiones o panel de conexiones.



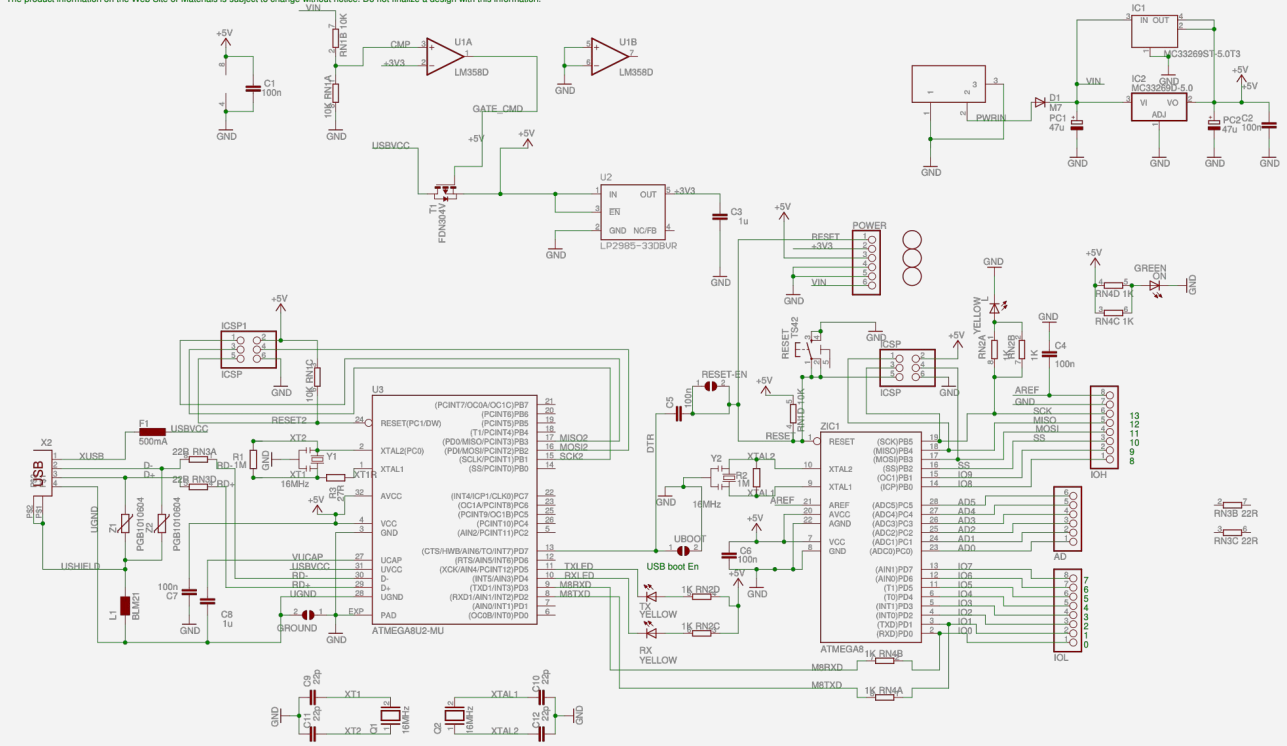
COMPUTING // CONTROL

La **ley de Moore** expresa que aproximadamente cada 2 años se duplica el número de transistores en un microprocesador.

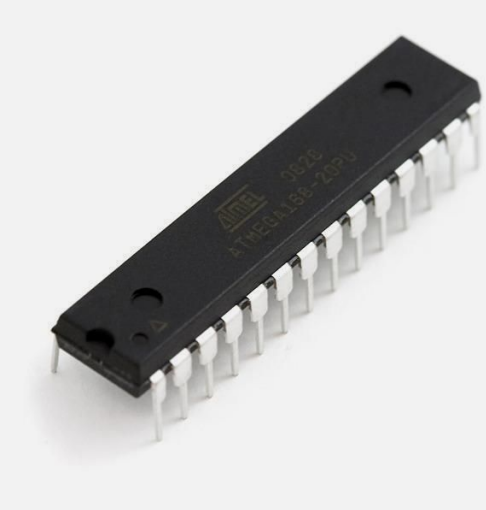


PHYSICAL COMPUTING

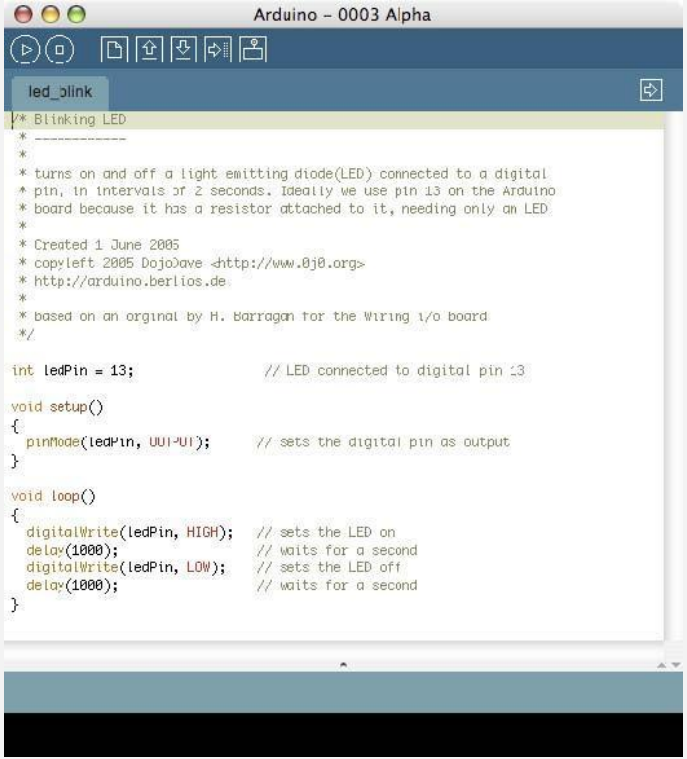
3D PRINTING//
EVOLUTION

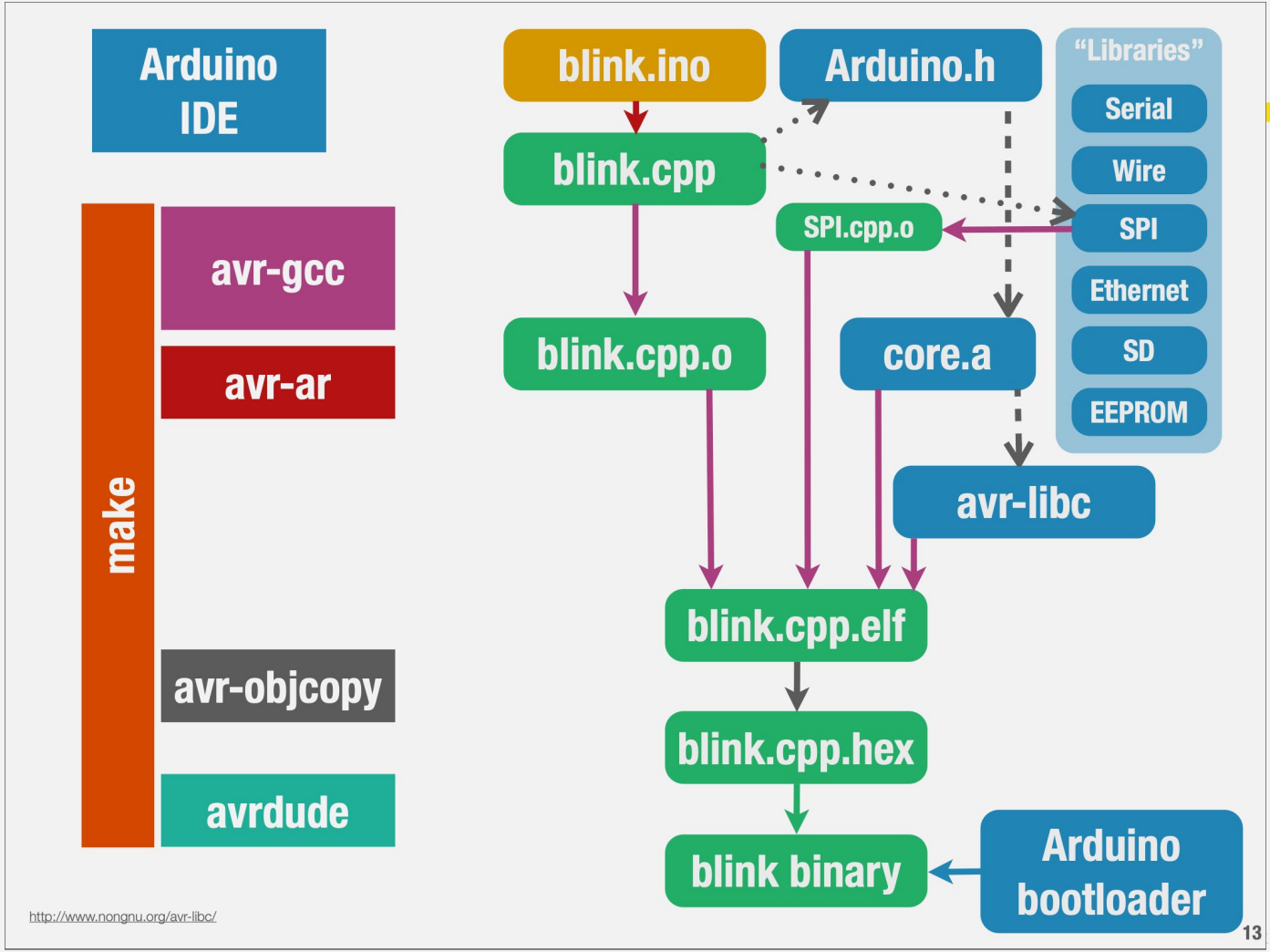


PHYSICAL // COMPUTING

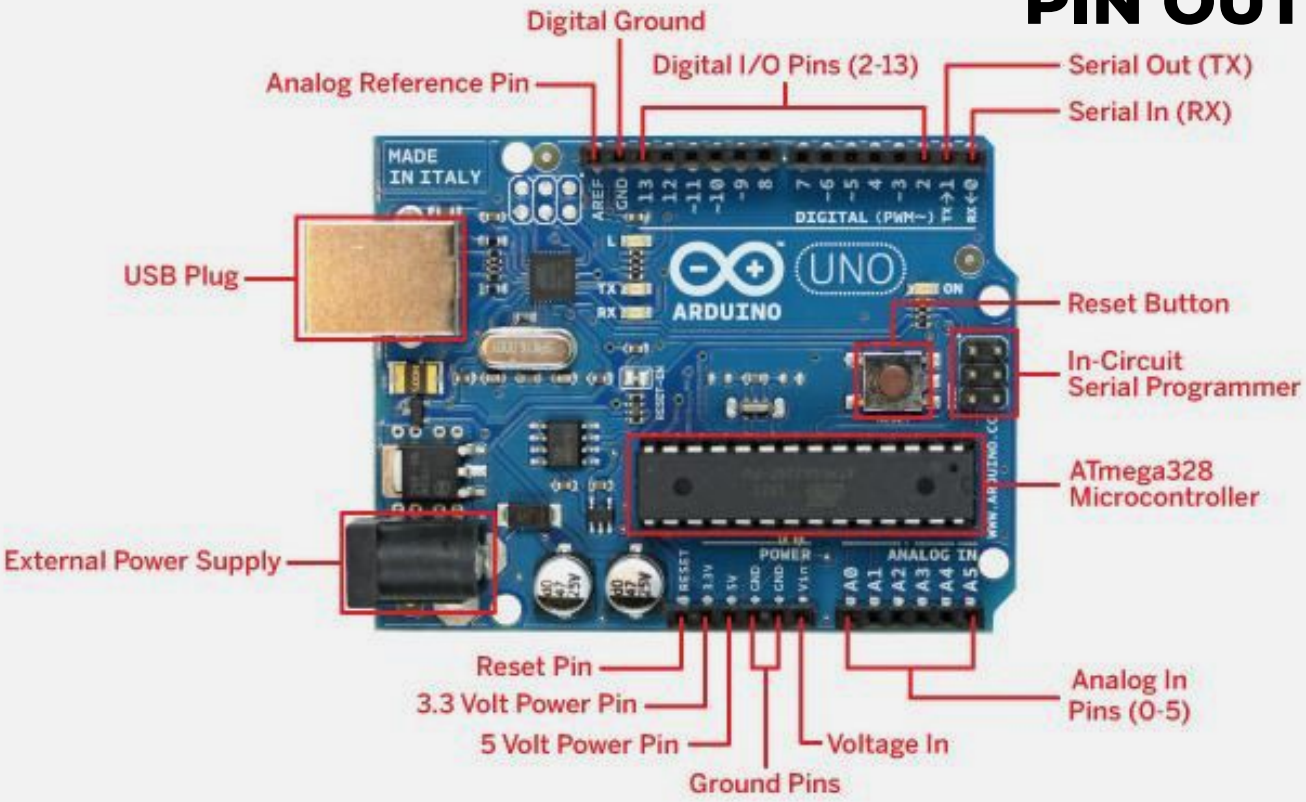


+

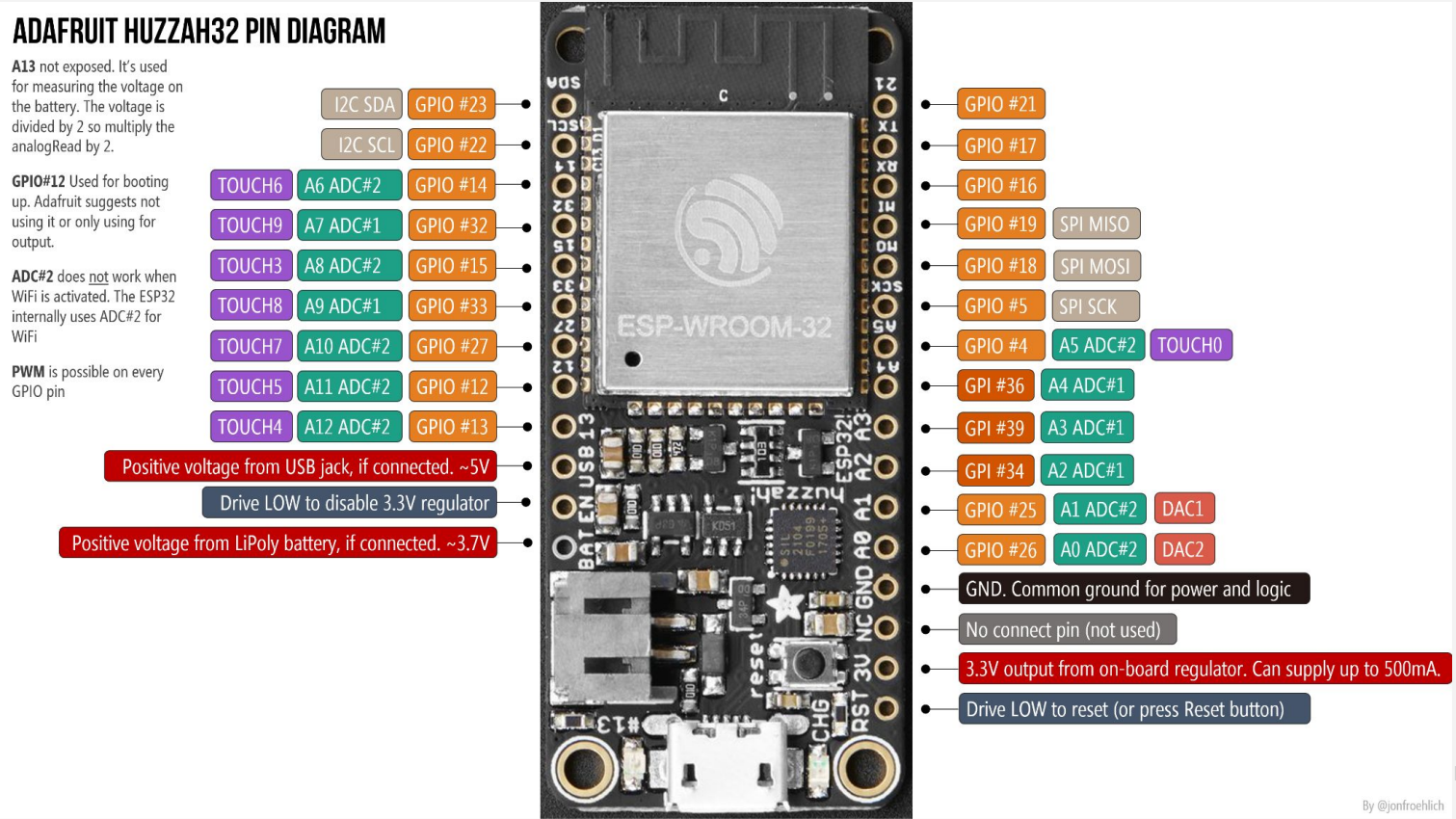



Arduino IDE
make
avr-gcc
avr-ar
avr-objcopy
avrdude
blink.ino
Arduino.h
"Libraries"
Serial
Wire
SPI
Ethernet
SD
EEPROM
blink.cpp
SPI.cpp.o
blink.cpp.o
core.a
avr-libc
blink.cpp.elf
blink.cpp.hex
blink binary
Arduino bootloader
http://www.nongnu.org/avr-libc/

ARDUINO //
PIN OUT



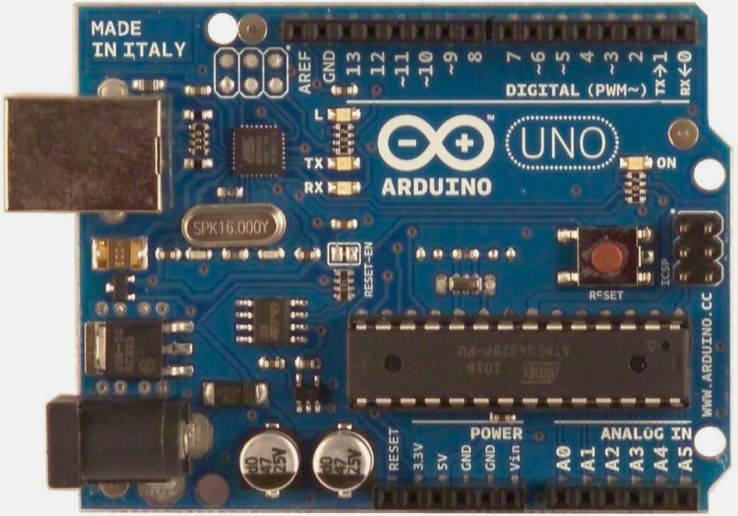
ESP32 FEATHER //
PIN OUT



ARDUINO //
PIN OUT

Digital IN / OUT x13
- Analog OUT (PWM) x6
- Analog IN x6

	INPUTS	OUTPUTS
DIGITAL (on / off)	digitalRead HIGH / LOW 255 / 0	digitalWrite HIGH / LOW 255 / 0
ANALOG (less / more)	analogRead 0 - 1023	analogWrite PWM 0 - 255



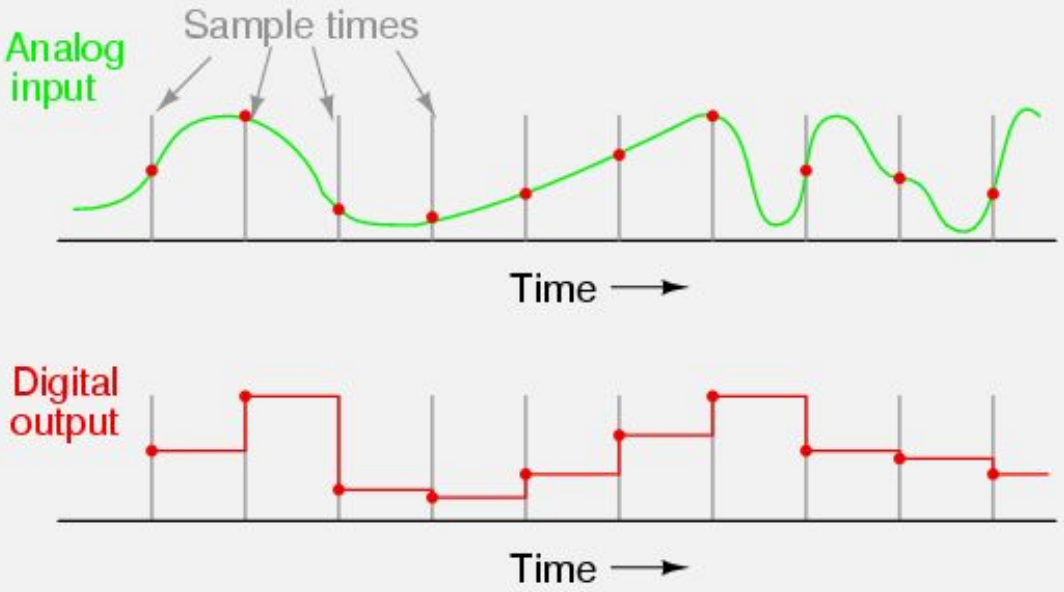
digitalRead
digitalRead(pin);
LOW/HIGH 0/255

SIGNALS // INPUT

digitalWrite
digitalRead(pin, value);
LOW/HIGH 0/255

SIGNALS // INPUT

ARDUINO //
SIGNALS

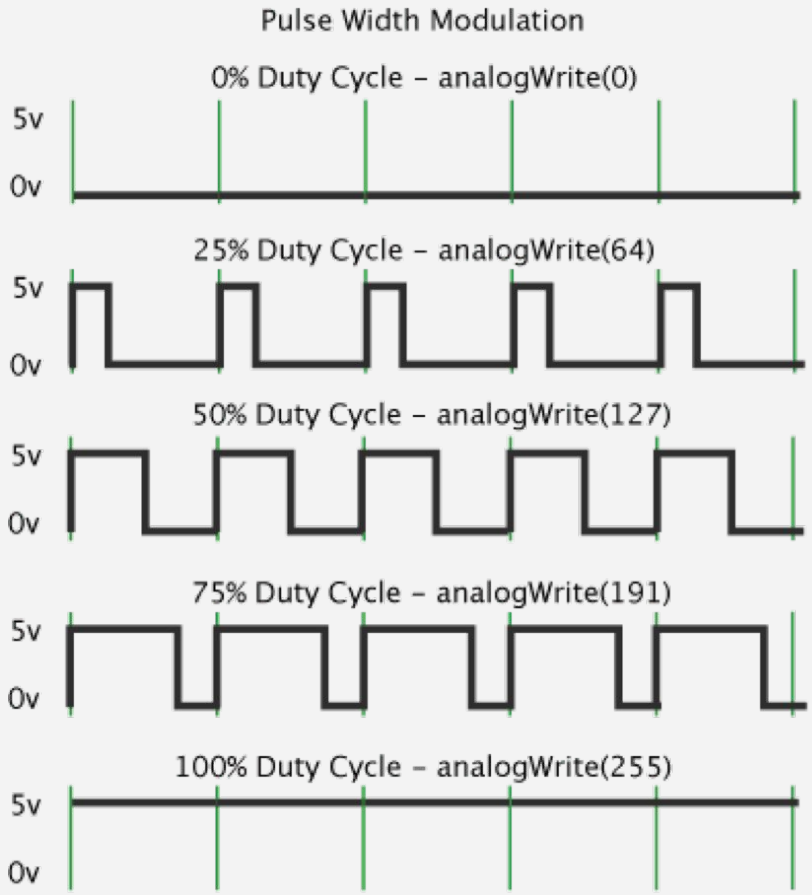


ADC (Analog to Digital Converter)
10 bits

analogRead

analogRead(pin);

0-1023



ARDUINO // SIGNALS

PWM (Pulse-width modulation)

analogWrite

analogWrite(pin, value);

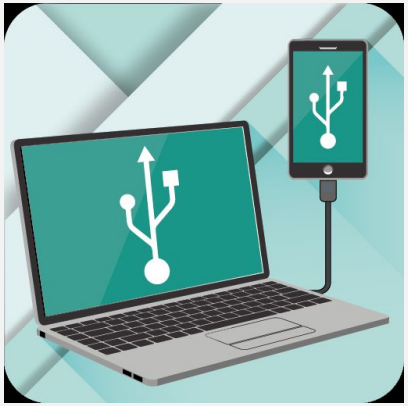
0-255

Ejemplo 1: Blink

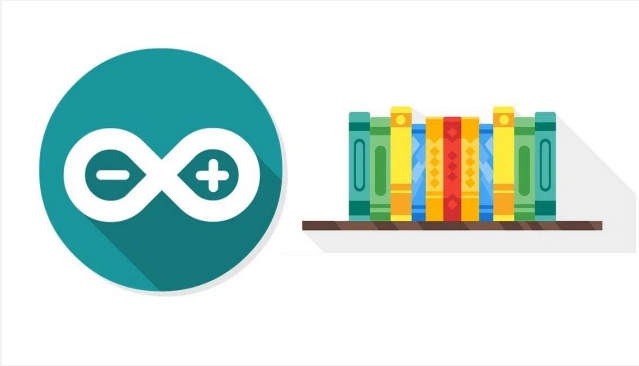
ENTORNO DE TRABAJO/
SOFTWARE

Arduino IDE

USB Drivers

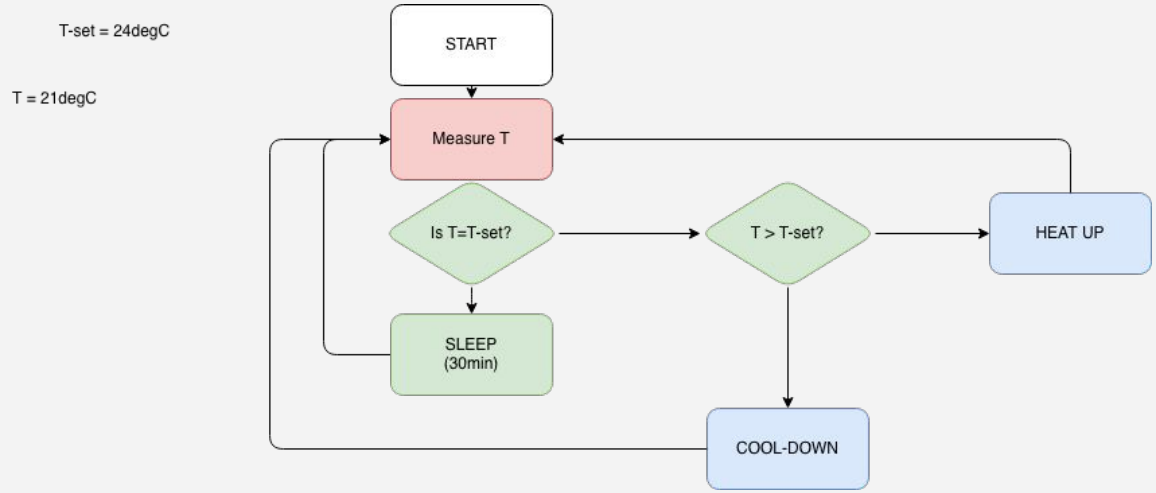


Arduino Libraries

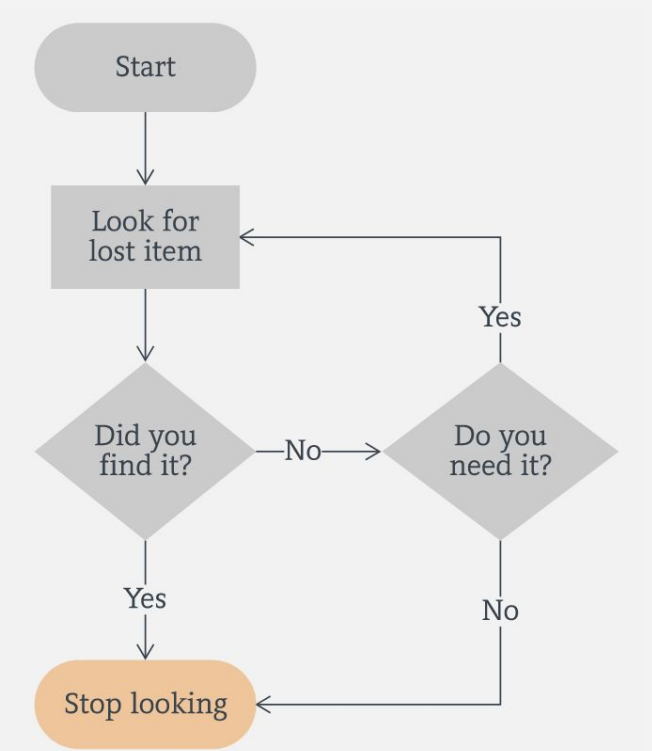


Flow Charts

COMPUTING//
LOGICS

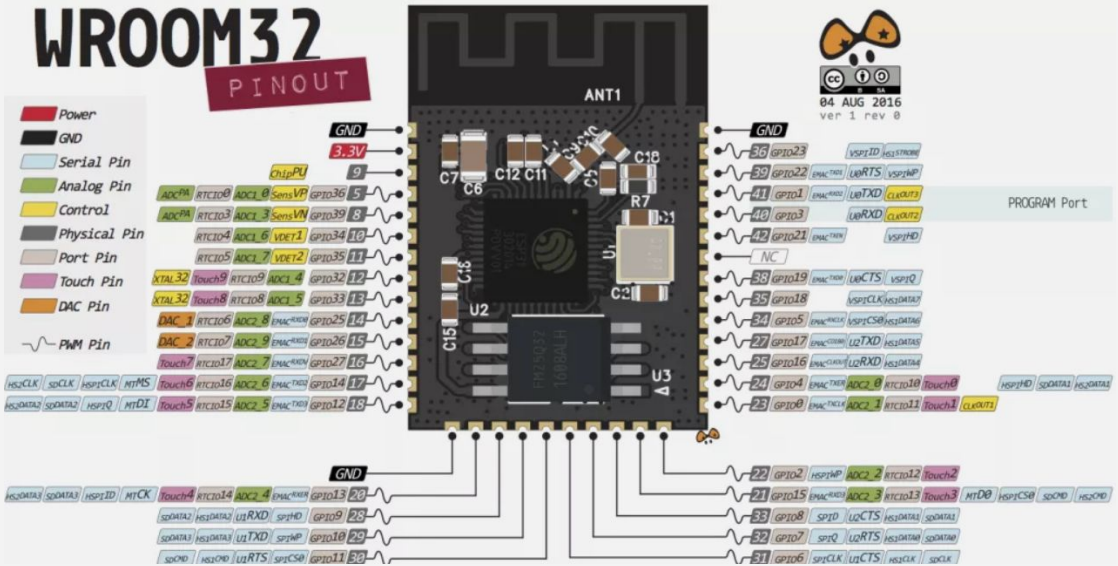


Un algoritmo es una secuencia finita de instrucciones bien definidas que se pueden implementar por computadora, generalmente para resolver una clase de problemas o realizar un cálculo. Los algoritmos son siempre inequívocos [...]



I/O Programming

HARDWARE// PROGRAMMING



El microcontrolador interactuará con el mundo exterior con sus PIN. Los pines pueden servir para recibir información, es decir, entradas, o activar, es decir, salidas:

Podemos usar estos pines para procesar entradas y generar salidas:

HARDWARE// PROGRAMMING

Programando logicas de control

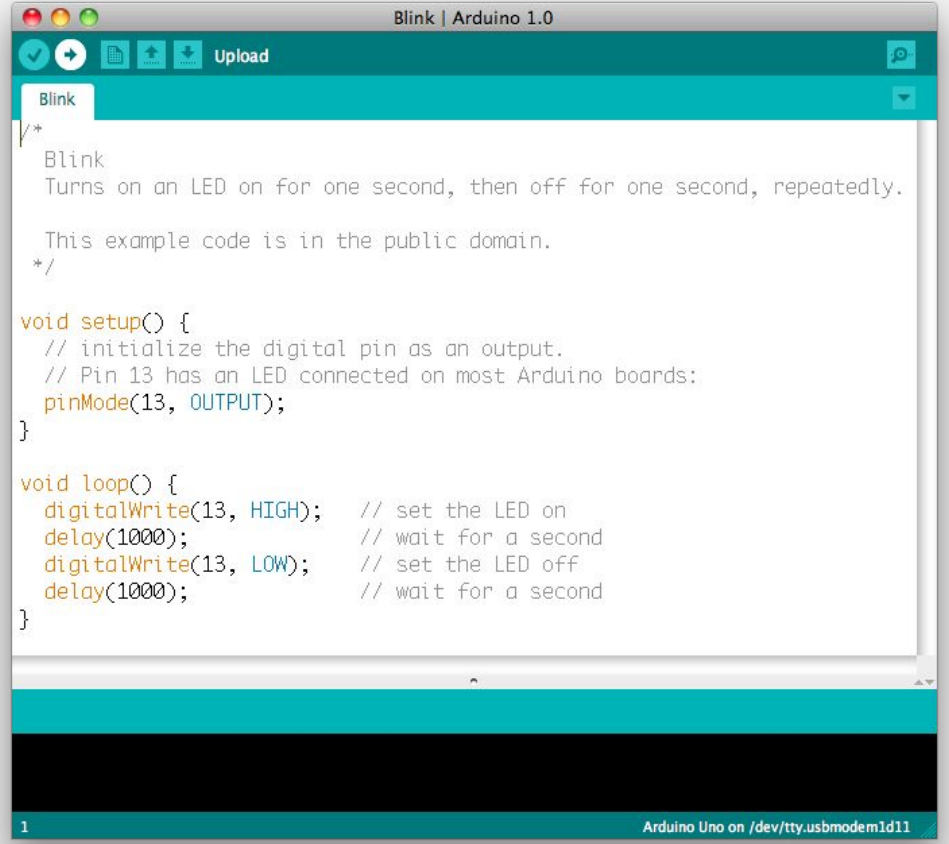
Podemos usar declaraciones de flujo de control para administrar cómo nuestro programa reacciona a diferentes entradas y actúa en las salidas.

```
while (condition) {

    // Do stuff
}
```

```
if (condition) {

    // Do stuff
} else {

    // Do other stuff
}
```

```
for (# iterations) {
    //Do stuff
}
```

Arduino programming

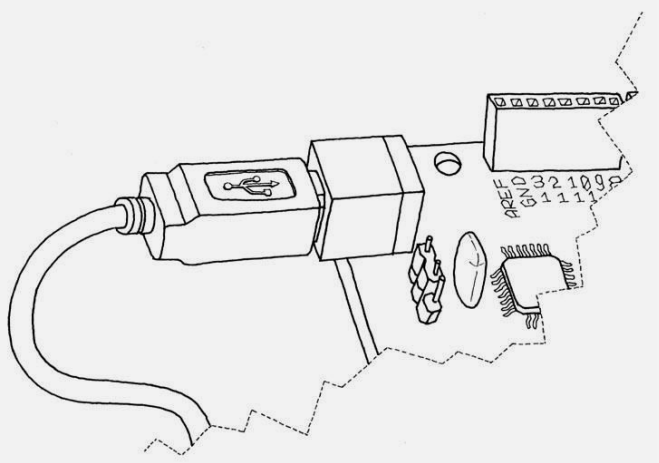


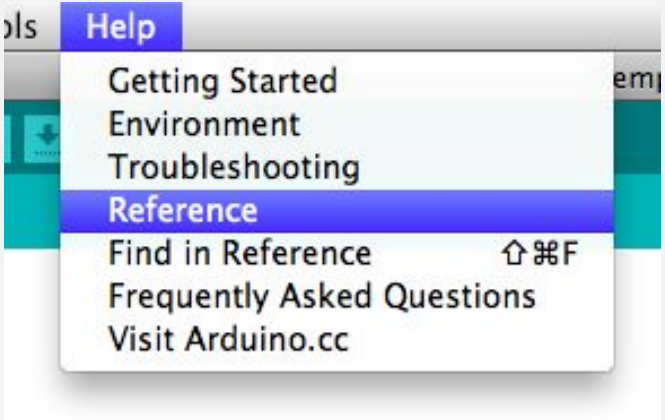
ARDUINO// PROGRAMMING

Instalación
Deberá instalar el IDE de Arduino.
Después de eso, necesitamos definir la placa que vamos a utilizar.

El primer ejemplo de programación se suele utilizar un LED ON/OFF y se le llama

“hello, world!”





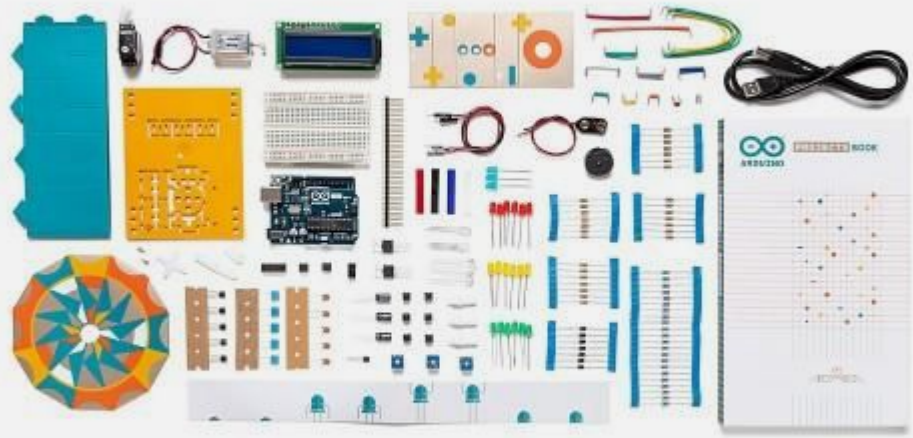
ARDUINO// PROGRAMMING

Uno de los puntos fuerte de utilizar el ecosistema de arduino es la cantida de información disponible.

Siempre que tengamos dudas o no sepamos utilizar algo podemos recurrir a AYUDA- REFERENCIA

Donde se explica que hace cada función

http://arduino.cc/en/Reference/HomePage



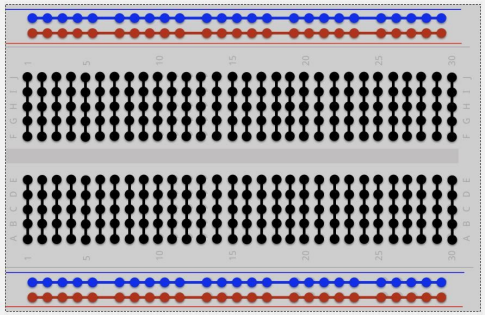
ARDUINO//
KITS

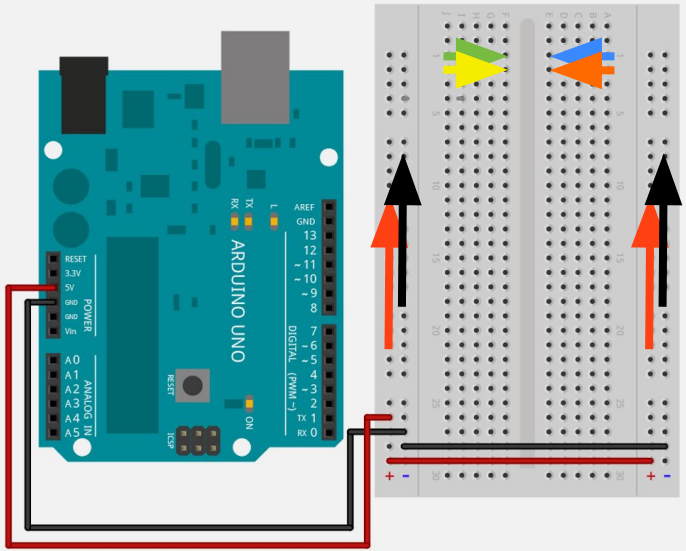
http://www.seeedstudio.com/wiki/Arduino_Sidekick_Basic_Kit

http://www.cooking-hacks.com/arduino-starter-kit

https://www.arduino.cc/

BREADBOARD

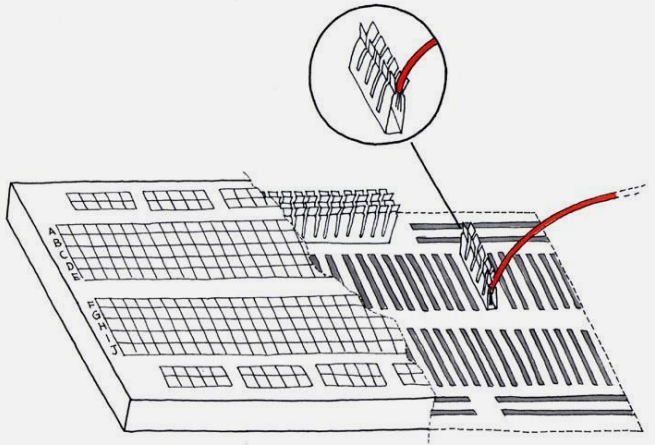




TABLERO//
PROTOTIPADO

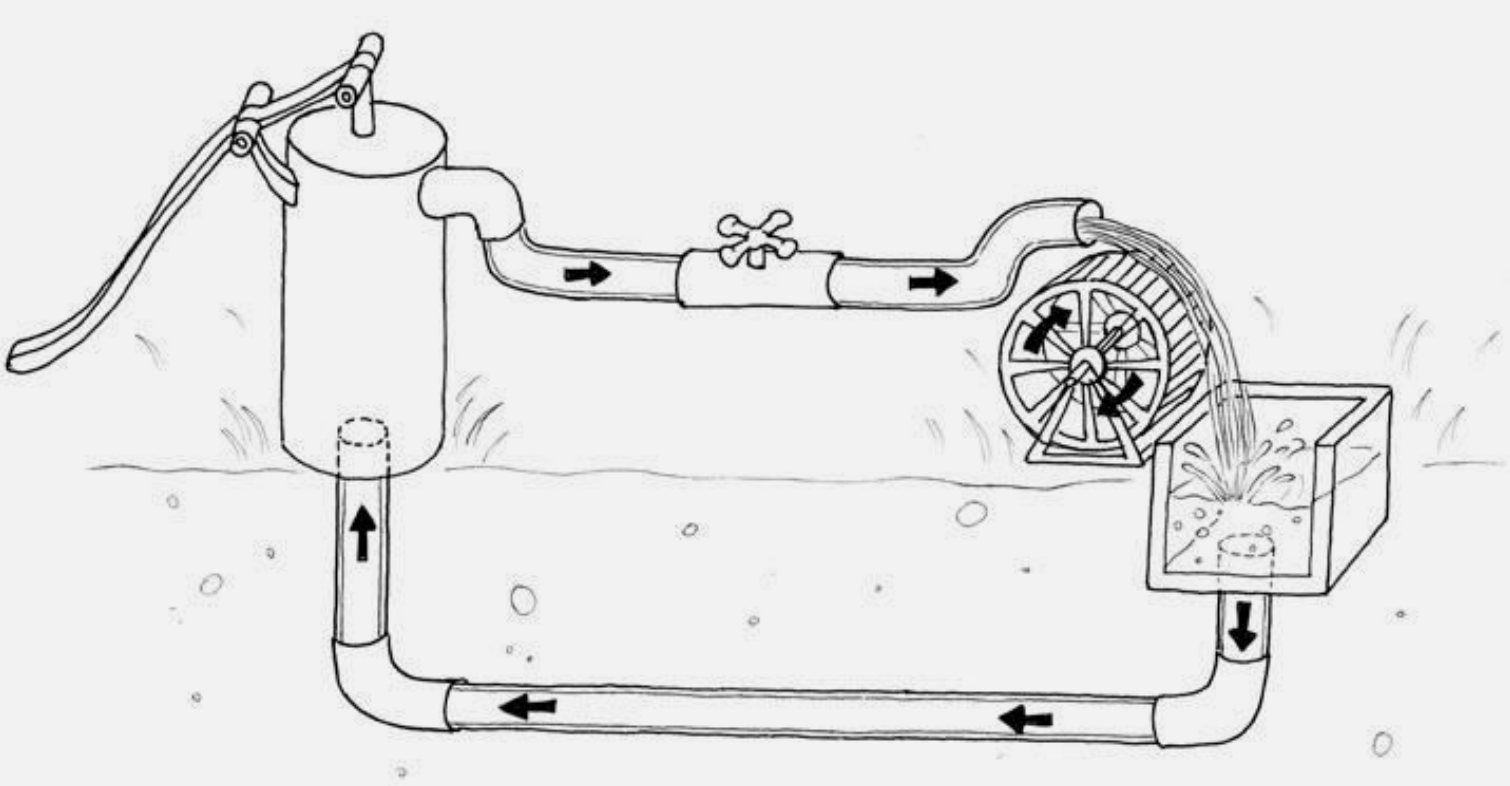
The Breadboard (aka Protoboard)
Una placa de pruebas es una herramienta de creación de prototipos que utilizamos para hacer que los circuitos sean rápidos y se repitan fácilmente:

http://www.protostack.com/blog/2011/09/8-breadboard-hacks/



RESISTENCIAS

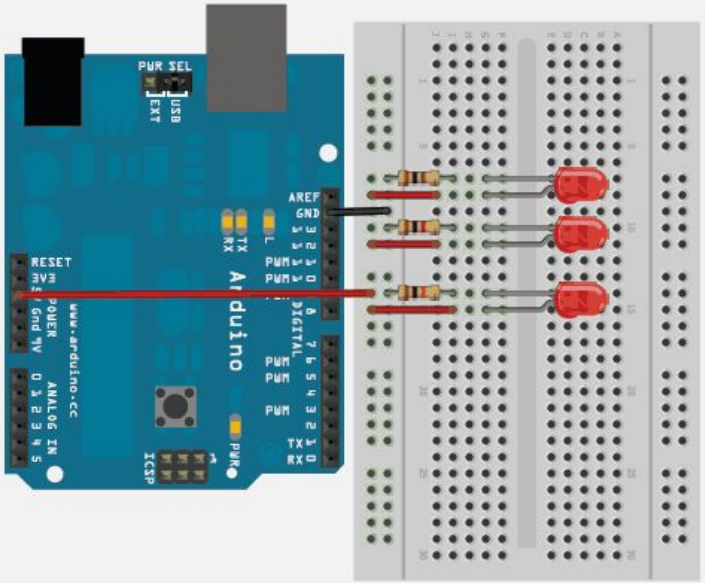
HARDWARE//
RESISTORS



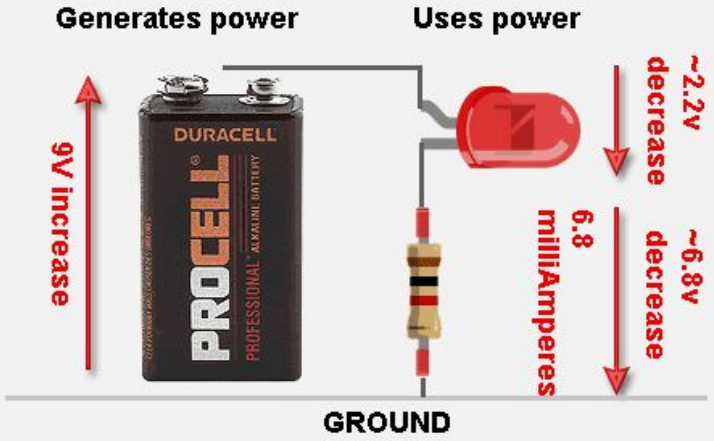
HARDWARE//
RESISTORS

¿Por qué resistencias?

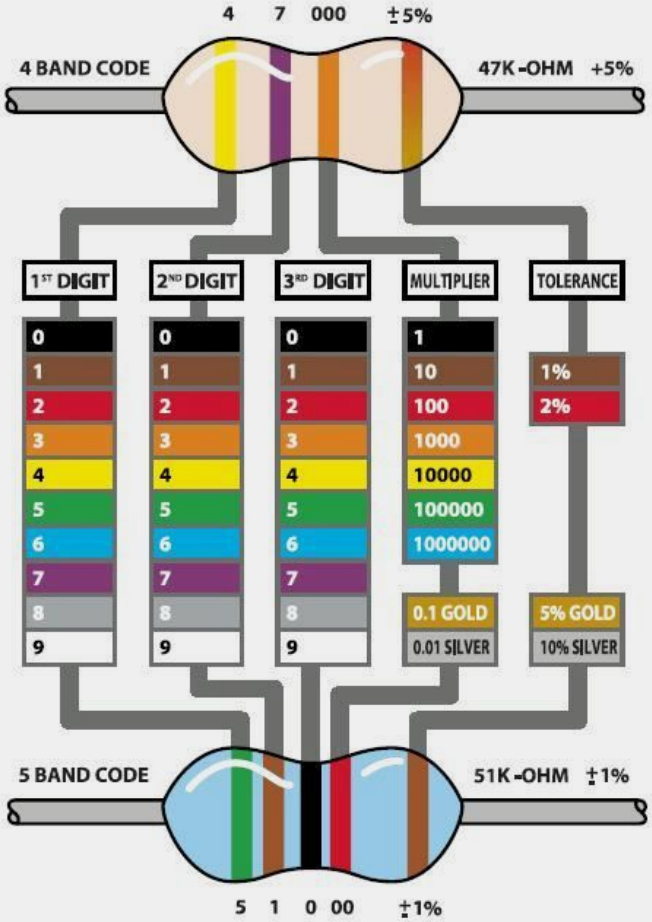
La resistencia es tu amigo.

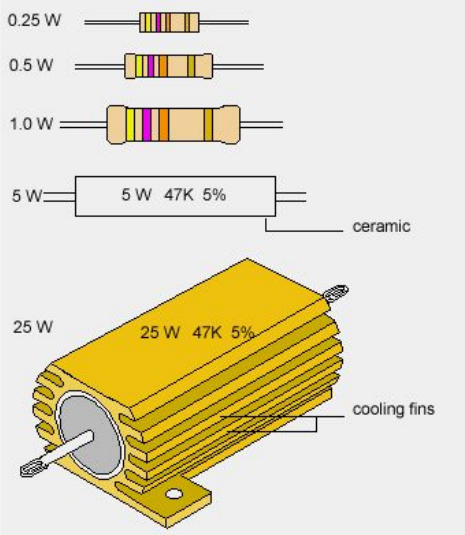


5V
Max 40mA x PIN



HARDWARE//
RESISTORS





http://www.dannyg.com/examples/res2/resistor.htm
http://www.csgnetwork.com/resistcolcalc.html
http://www.hebeiltd.com.cn/?p=zz.led.resistor.calculatorext

ARDUINO
“HELLO WORLD”

ARDUINO // 101

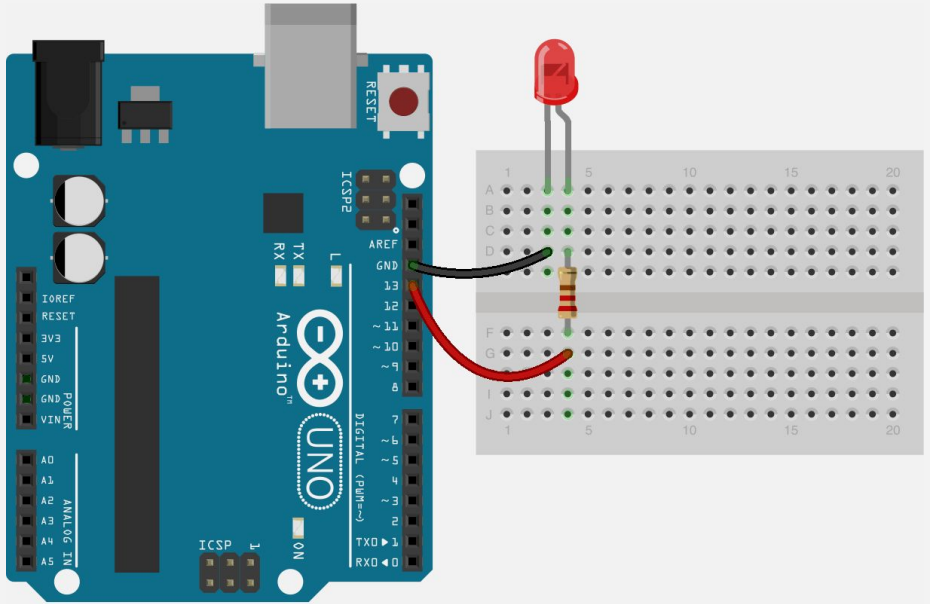
Tres cosas para recordar

1. ¿INPUT/OUTPUT? pinMode ()

2. Pin de encendido / apagado con digitalWrite ()

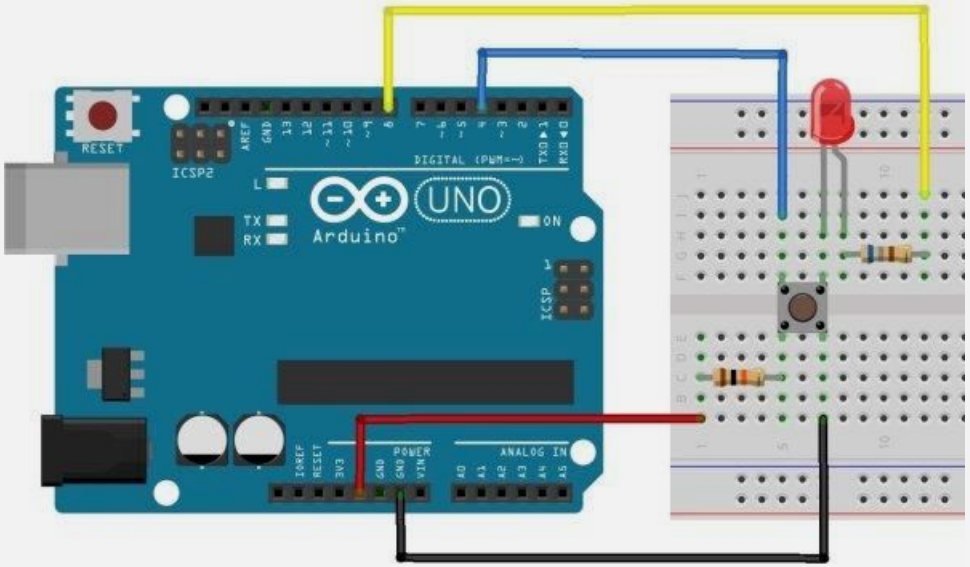
3. Leer el estado del botón con digitalRead ()

```
void setup() {
    // Set pin 13 as output
  pinMode(13, OUTPUT);
}

// Loop runs forever
void loop() {
    // Voltage up in pin 13
    digitalWrite(13, HIGH);
    // Wait 200ms with pin 12 HIGH
    delay(200);
    // Voltage down in pin 13
    digitalWrite(13, LOW);
    // Wait 200ms with pin 13 LOW
    delay(200);
}
```



ARDUINO // 101

```
// Our variable for checking if it's pressed or not
bool pressed = false;

// the setup function runs once when you press reset or power the board
void setup() {

  pinMode(8, OUTPUT);
  pinMode(4, INPUT);
  // Turn the LED off
  digitalWrite(8, LOW);
}

// Loop runs forever
void loop() {
  // Read the pin
  if (digitalRead(4)) {
    // pressed!
    pressed = false;
  } else {
    // not pressed!
    pressed = true;
  }

  if (pressed) {
    // Turn it on
    digitalWrite(8, HIGH);
  } else {
    // Turn it off
    digitalWrite(8, LOW);
  }
}
```



LIBRERIAS

ARDUINO // 101

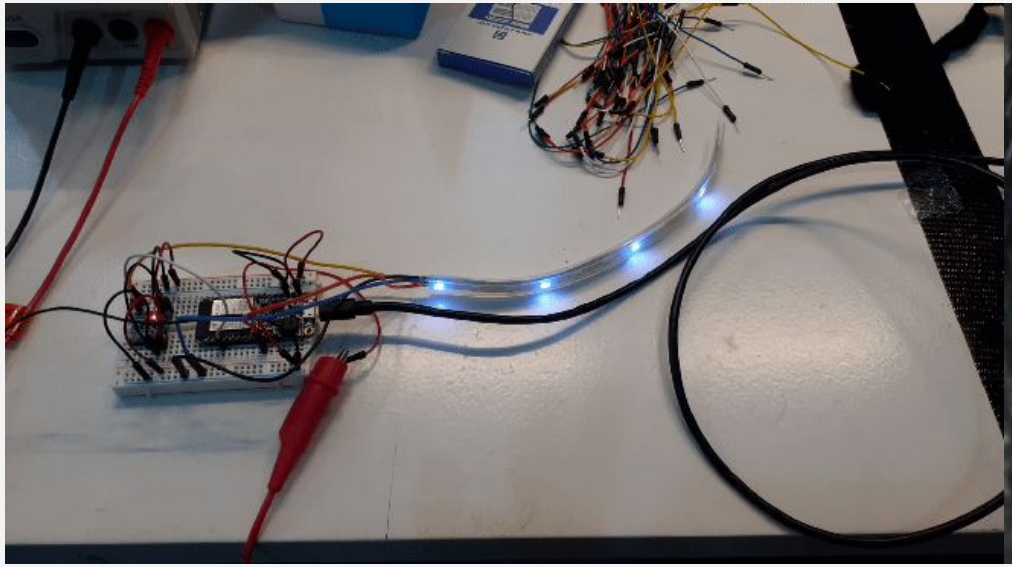
Las bibliotecas son conjuntos de herramientas que alguien ha creado para facilitar ciertas tareas, por ejemplo, leer pines en un microcontrolador o controlar los LED.

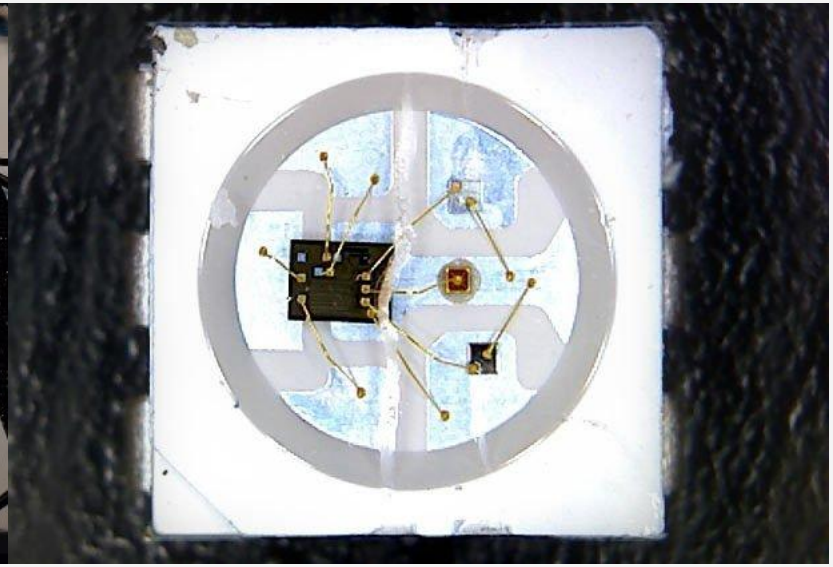
Para usar una tira de LED “NEOPIXEL”, necesitaremos instalar una biblioteca.

!!!Instalación de la biblioteca"

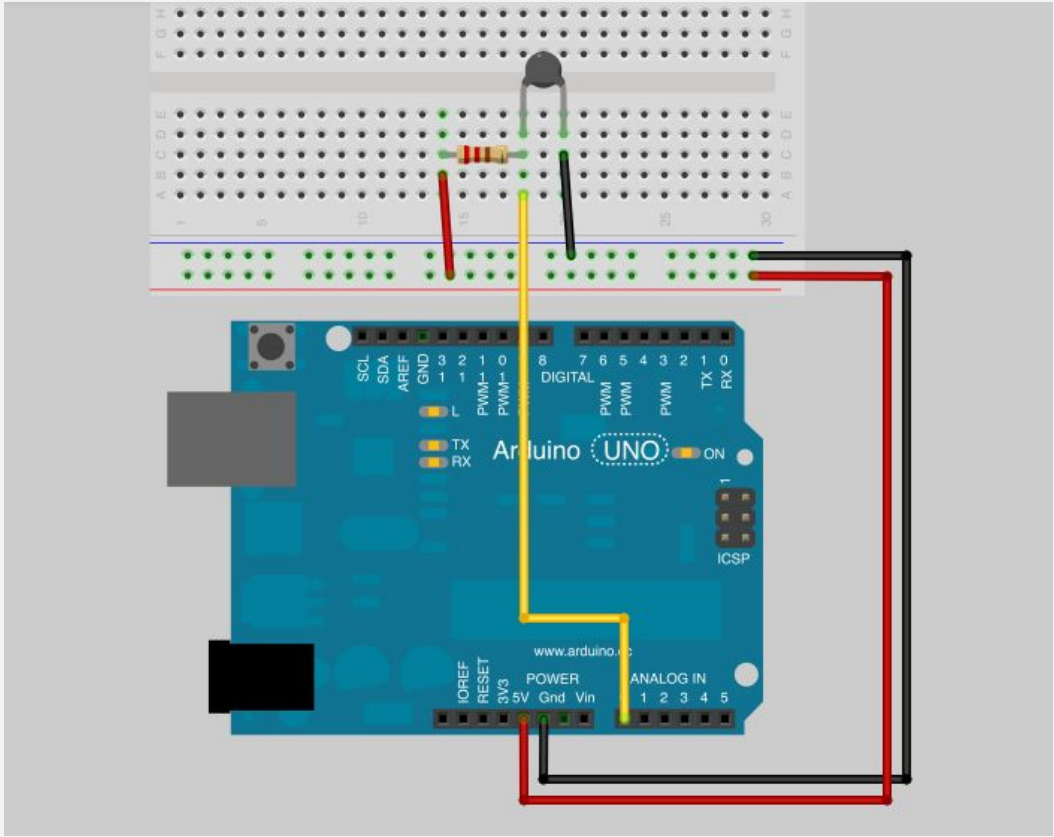
Siga esta guía para instalar la biblioteca FastLED

OUTPUTS//
NEOPIXEL

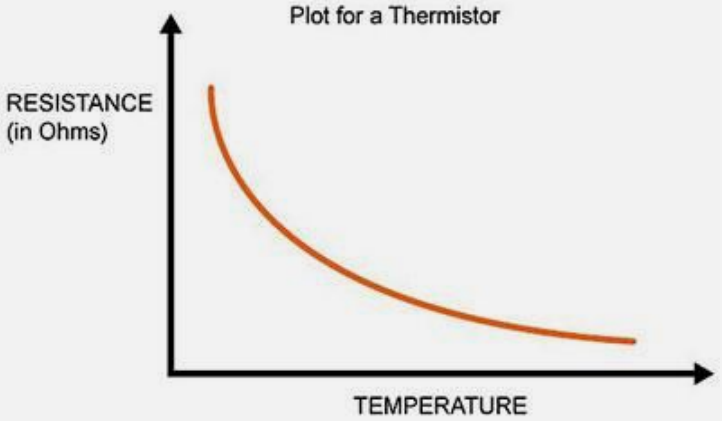




INPUTS



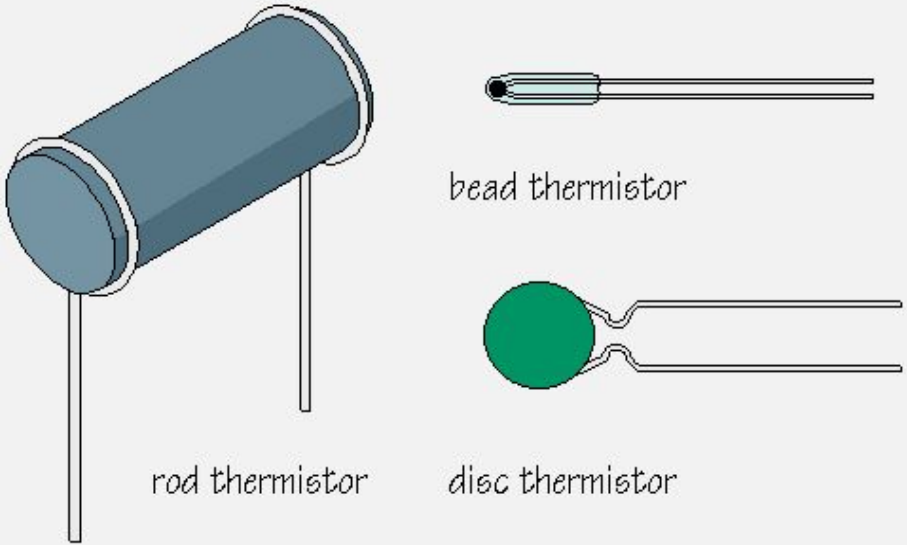
INPUTS//
THERMISTOR

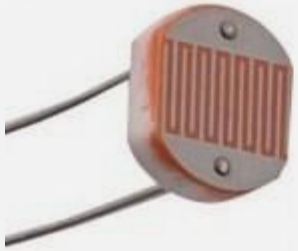


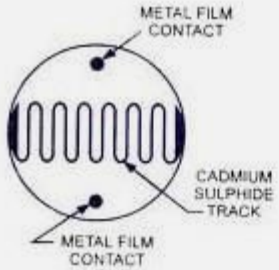
http://learn.adafruit.com/thermistor

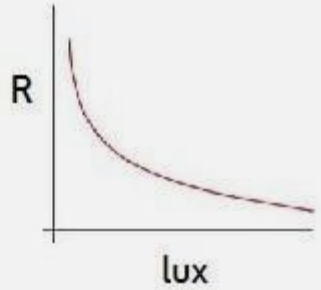
http://pastie.org/8467723

INPUTS//
RESISTANCE

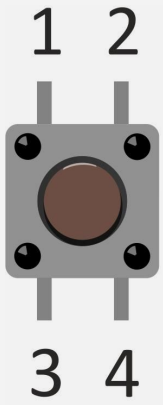


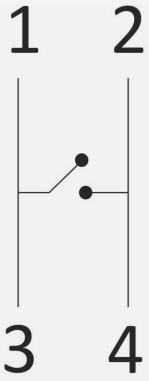




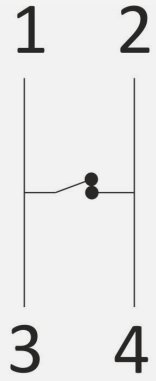


INPUTS//
BUTTON

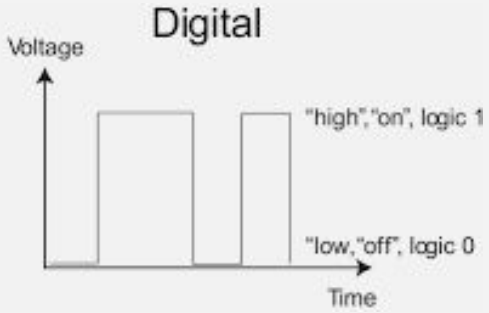




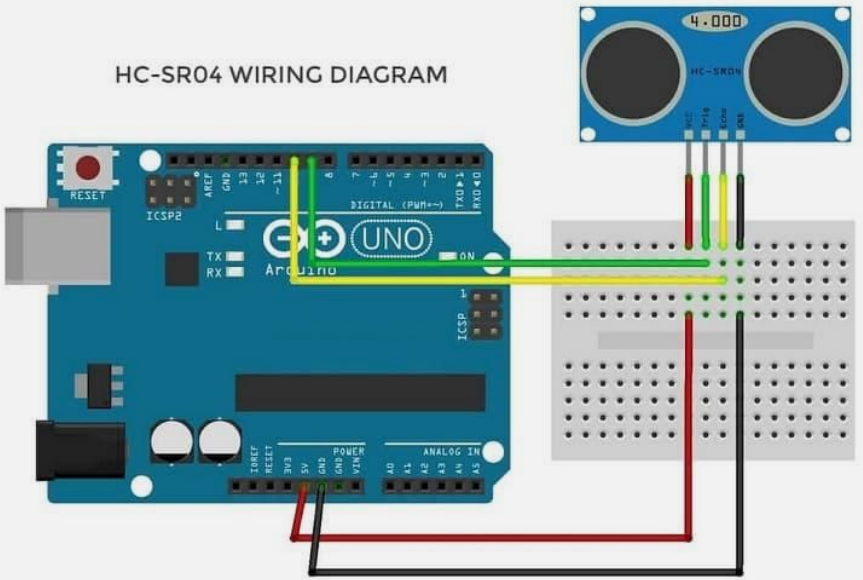
NORMAL

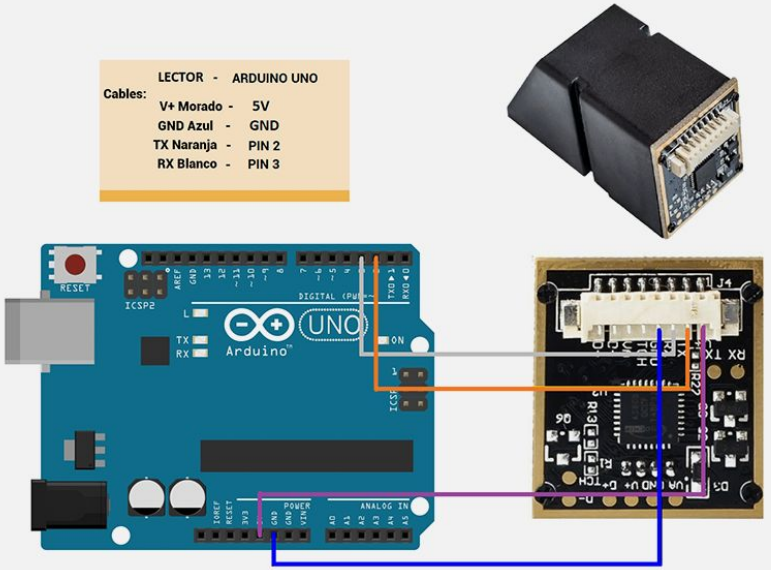


BUTTON PRESSED



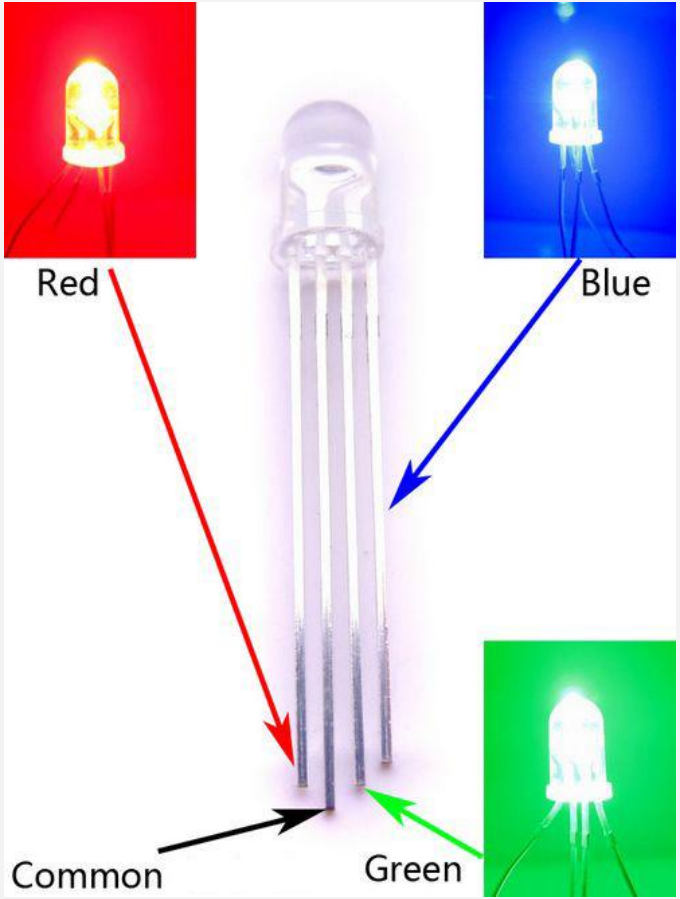
INPUTS//
DIGITALS

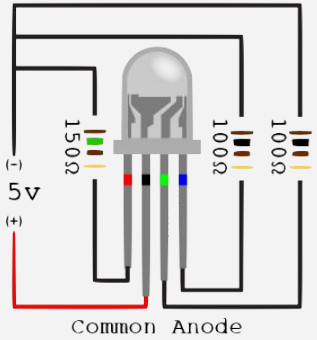




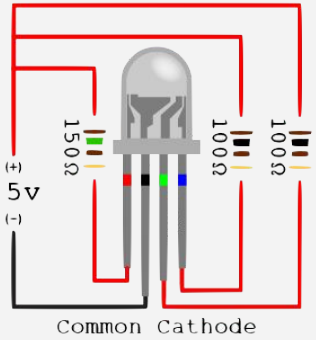
OUTPUTS

OUTPUTS//
RGB LEDS





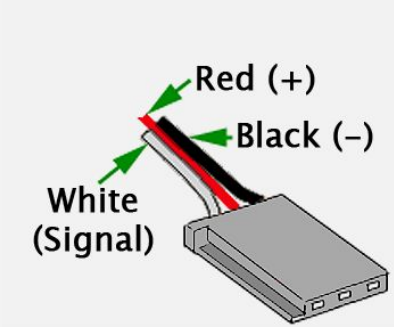
255-value

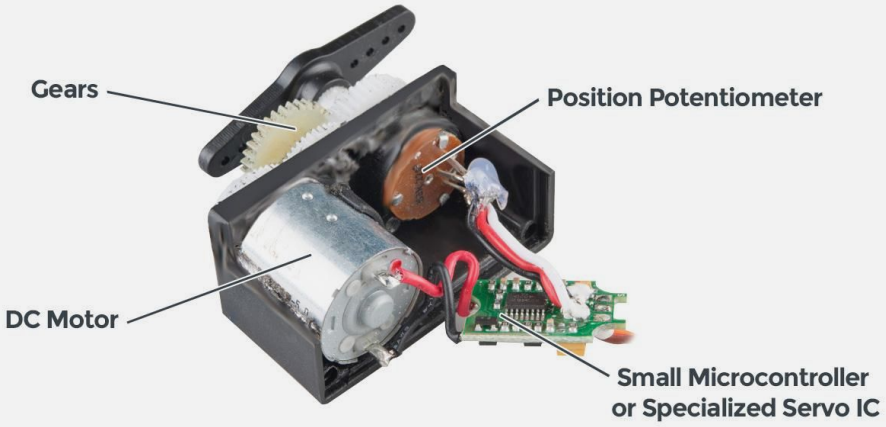


0-255

http://learn.adafruit.com/adafruit-arduino-lesson-3-rgb-leds

OUTPUTS // SERVOMOTOR

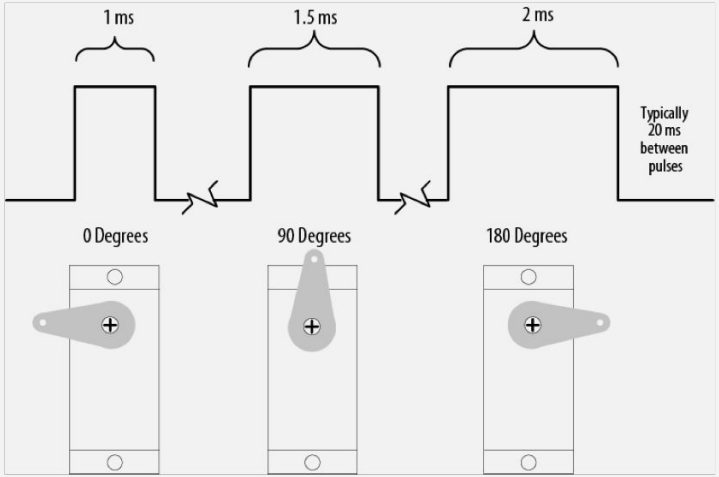


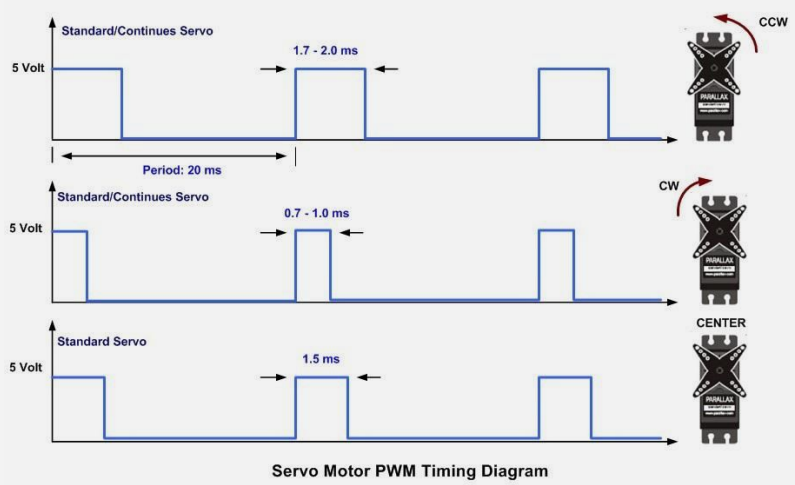



```
#include <Servo.h>

Servo myservo;

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

void loop() {

myservo.write(pos);              // tell servo to go to
position in variable 'pos'
}
```

http://arduino.cc/en/Reference/Servo

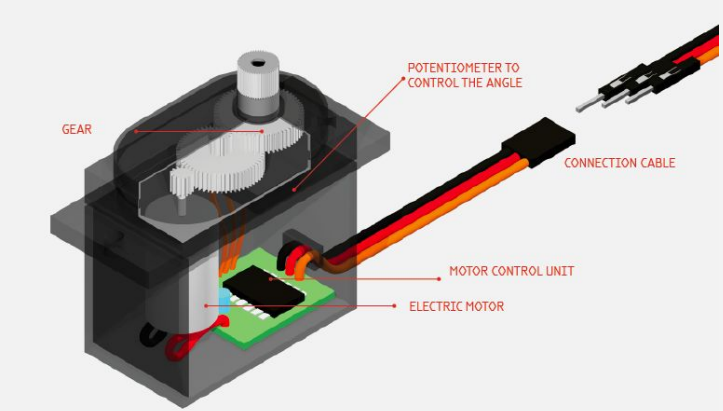
OUTPUTS //
SERVOMOTOR



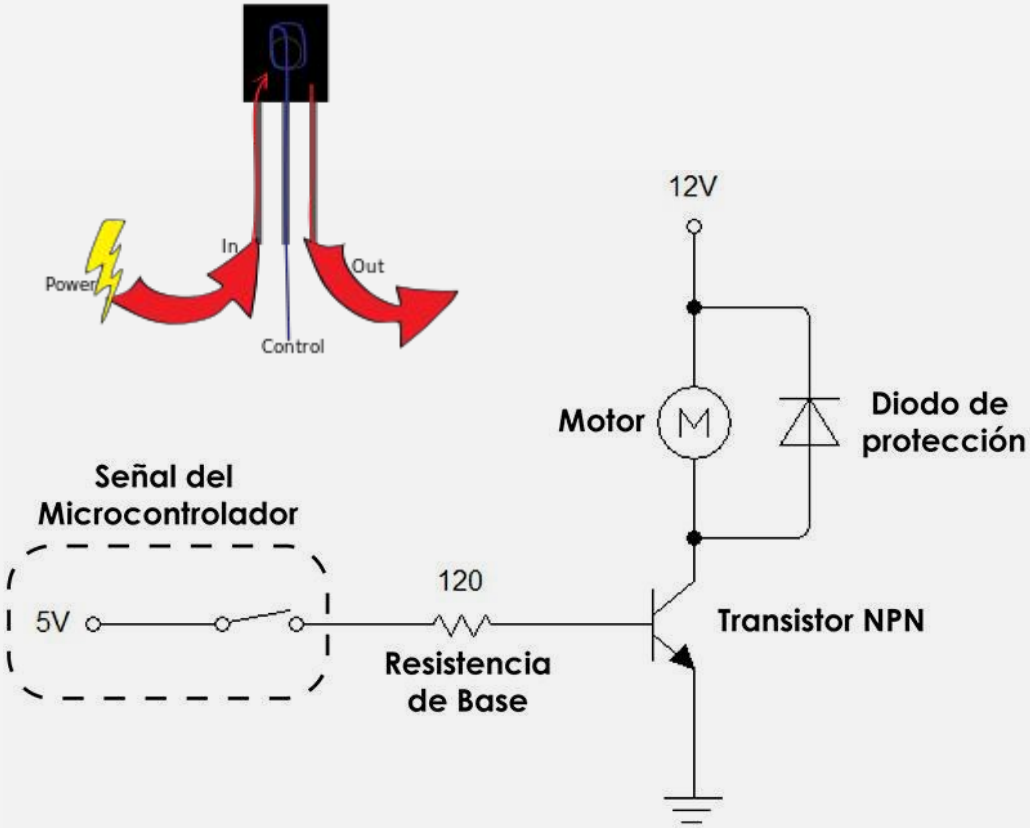


Servo Motor PWM Timing Diagram

Close loop control



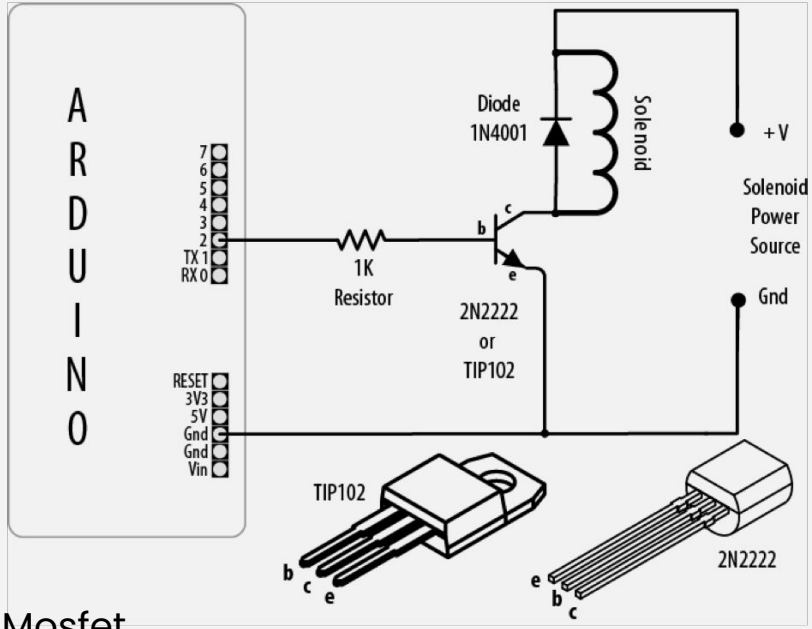
OUTPUTS //
MOSFETS



Un mosfet (Metal Oxide Semiconductor Field Effect Transistor)tambien conocido Insulated Gate Field Effect Transistor (IGFET)consiste en una fina capa de oxido de silicona entre puerta y canal.

Funciona como un interruptor digital accionado por una variación de voltaje. Permitiendo activaciones muy rapidas comparados con un relé que se basa en componentes mecanicos moviles.

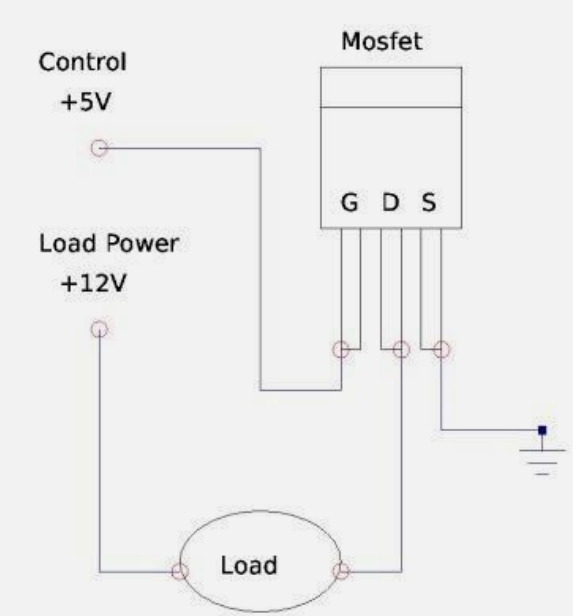
OUTPUTS//
MOSFETS



Mosfet

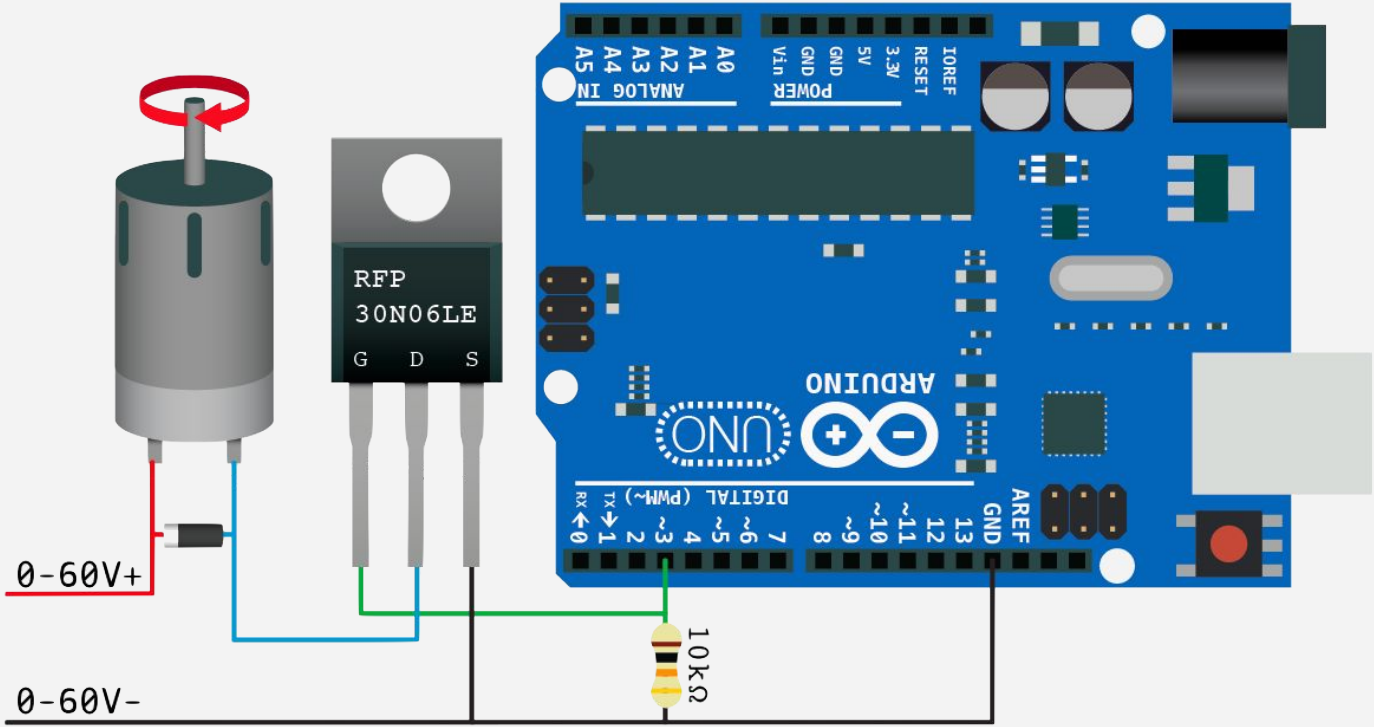
> 40mA or > 5V

on/off or PWM (digitalWrite / analogWrite)

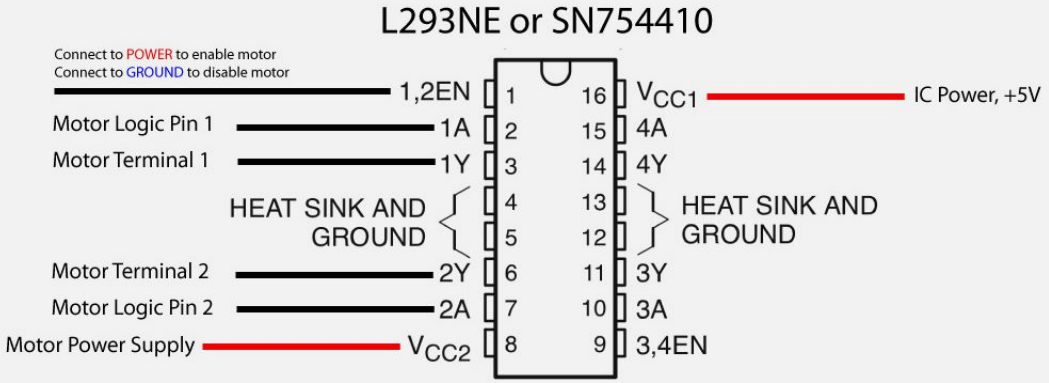


http://bildr.org/2012/03/rfp30n06le-arduino/

OUTPUT //
MOSFET



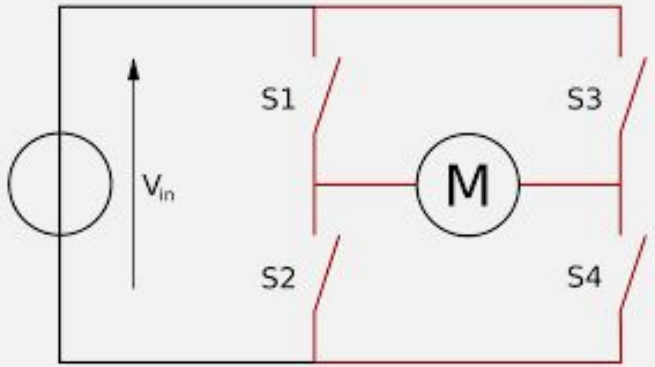
OUTPUTS//
H-BRIDGE



EN	1A	2A	FUNCTION
H	L	H	Turn right
H	H	L	Turn left
H	L	L	Fast motor stop
H	H	H	Fast motor stop
L	X	X	Fast motor stop

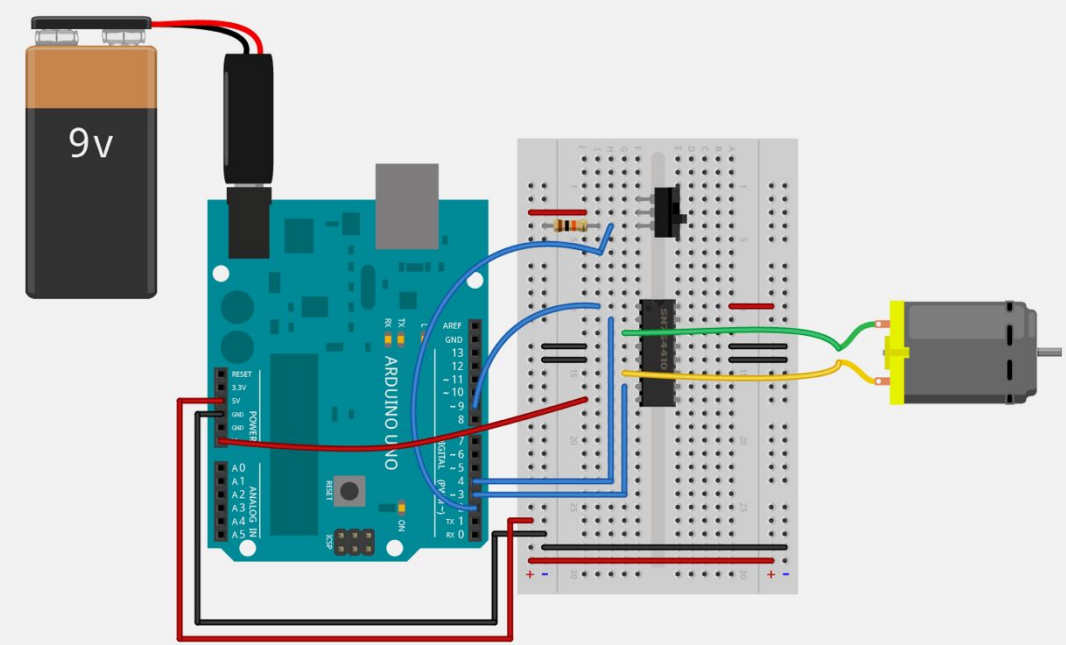
L = low, H = high, X = don't care

> 40mA or > 5V + DC motor control (+-/-+)

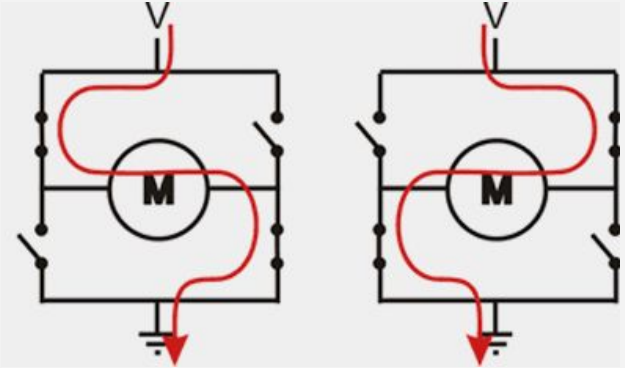


http://learn.adafruit.com/adafruit-arduino-lesson-15-dc-motor-reversing/lm293d

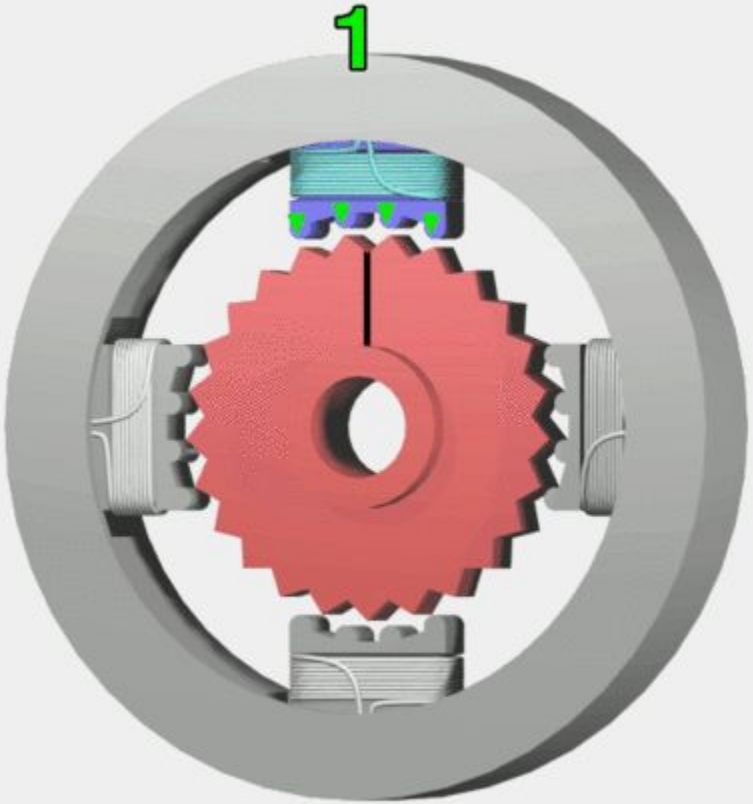
OUTPUTS//
H-BRIDGE

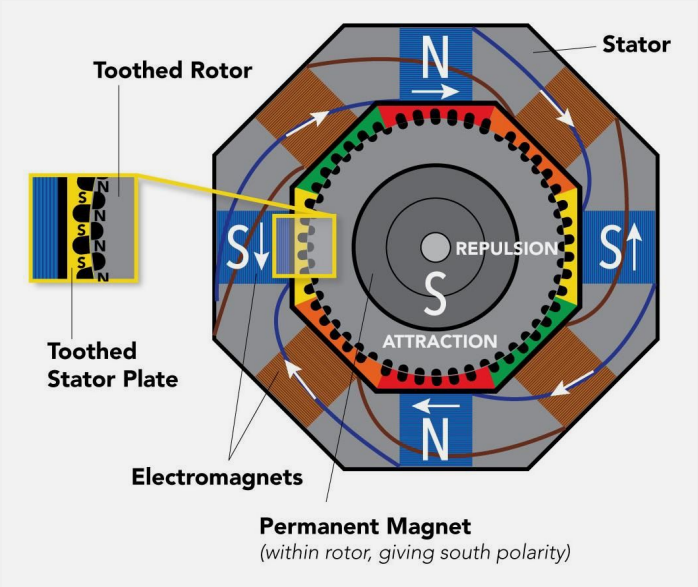


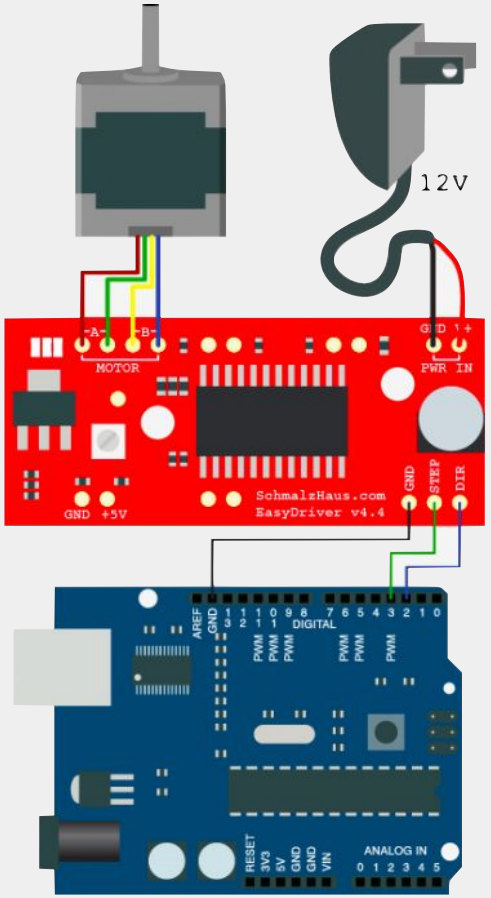
on/off or PWM
(digitalWrite
/analogWrite)

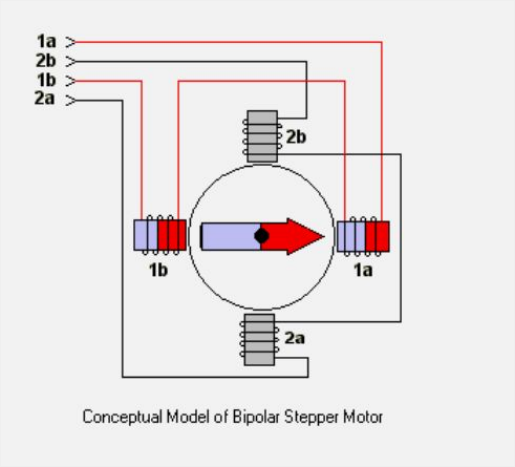


OUTPUTS//
STEPPERS





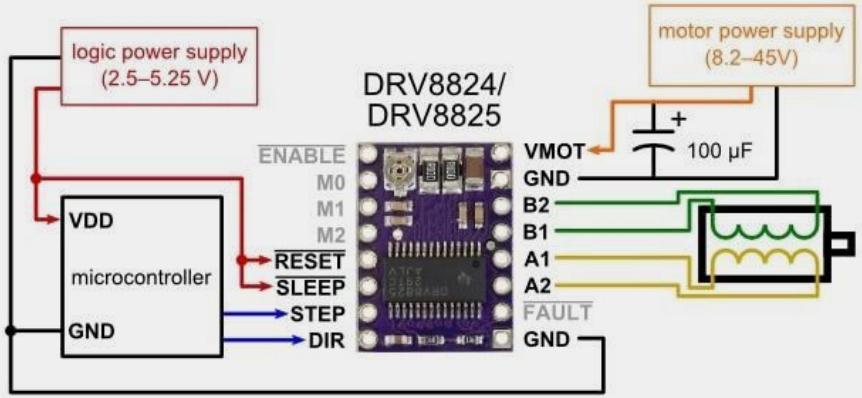




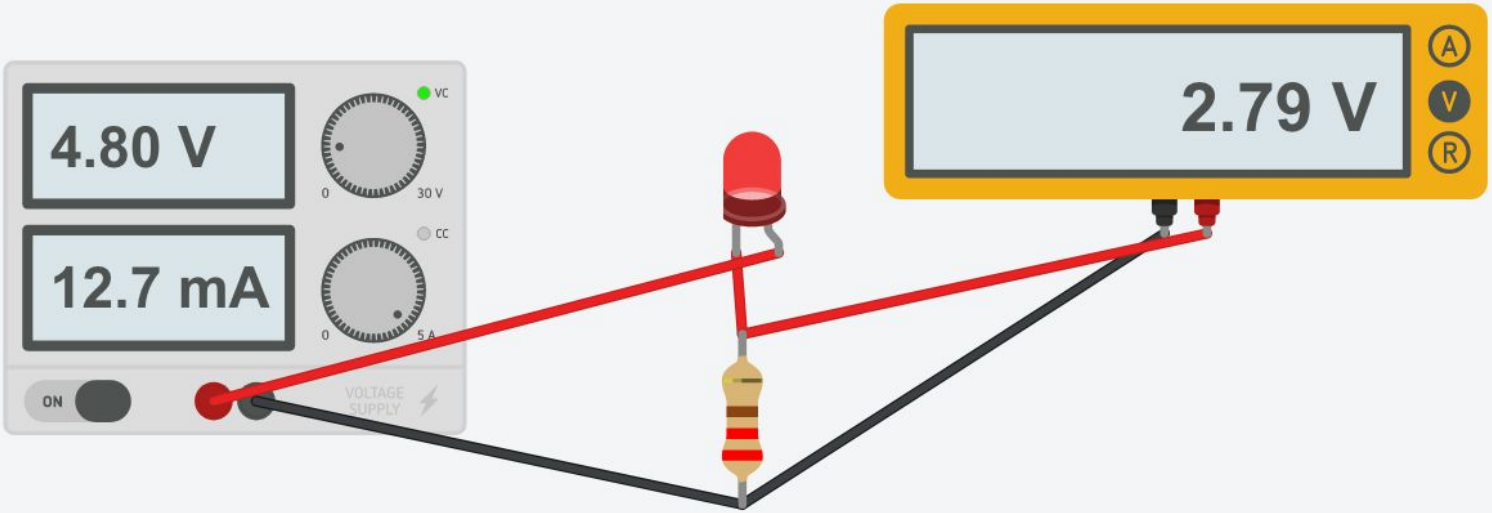
Conceptual Model of Bipolar Stepper Motor

OUTPUTS//
STEPPERS

http://bildr.org/2011/06/easydriver/
Libraries
- https://www.arduino.cc/en/Reference/Stepper
- http://www.airspayce.com/mikem/arduino/AccelStepper/

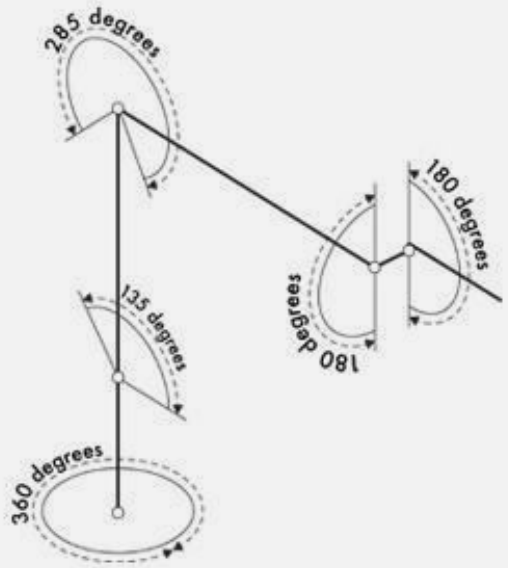


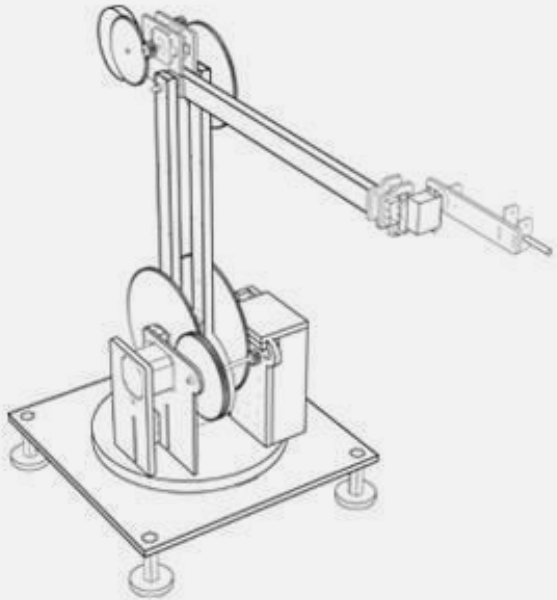
SIMULACIÓN//
TINKERCAD



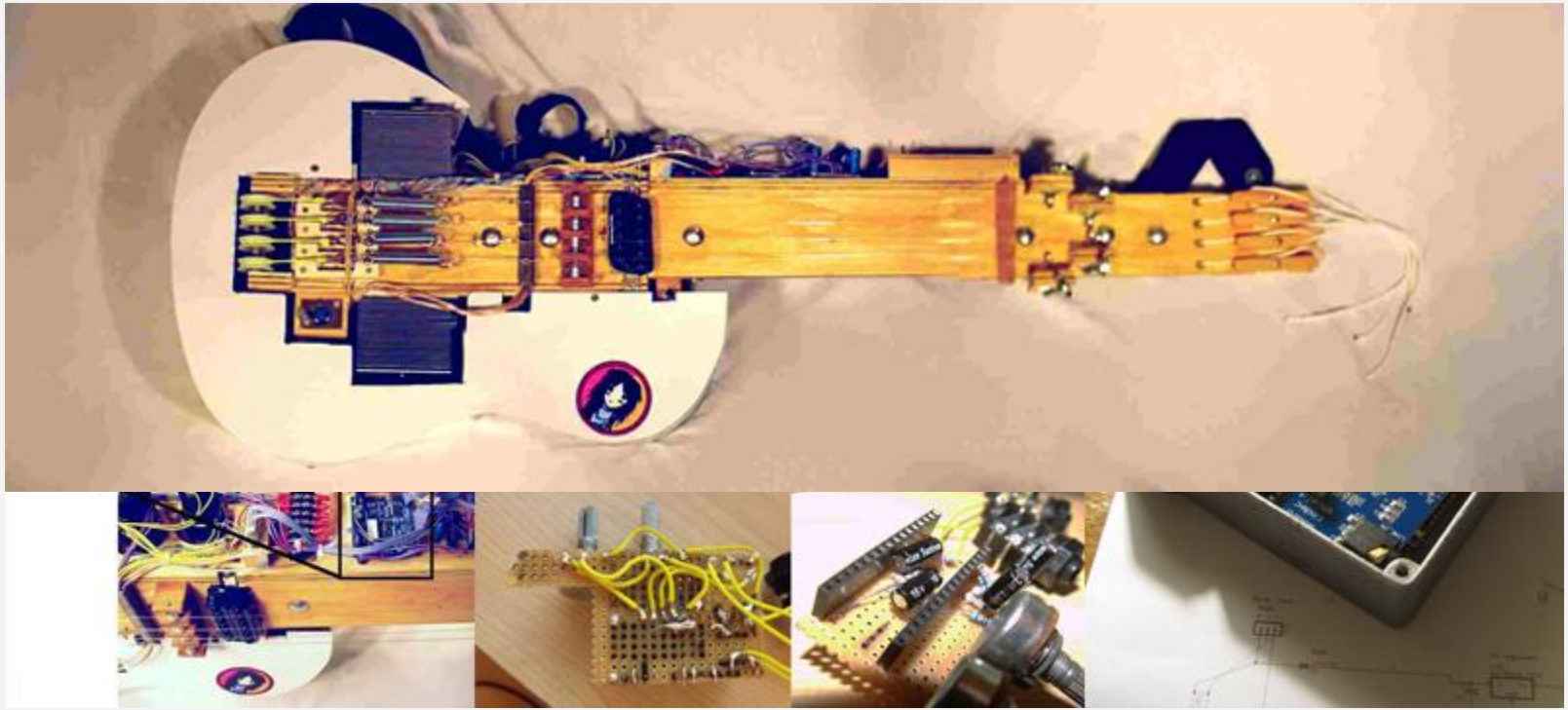
EJEMPLOS

Arduino//
Ejemplos



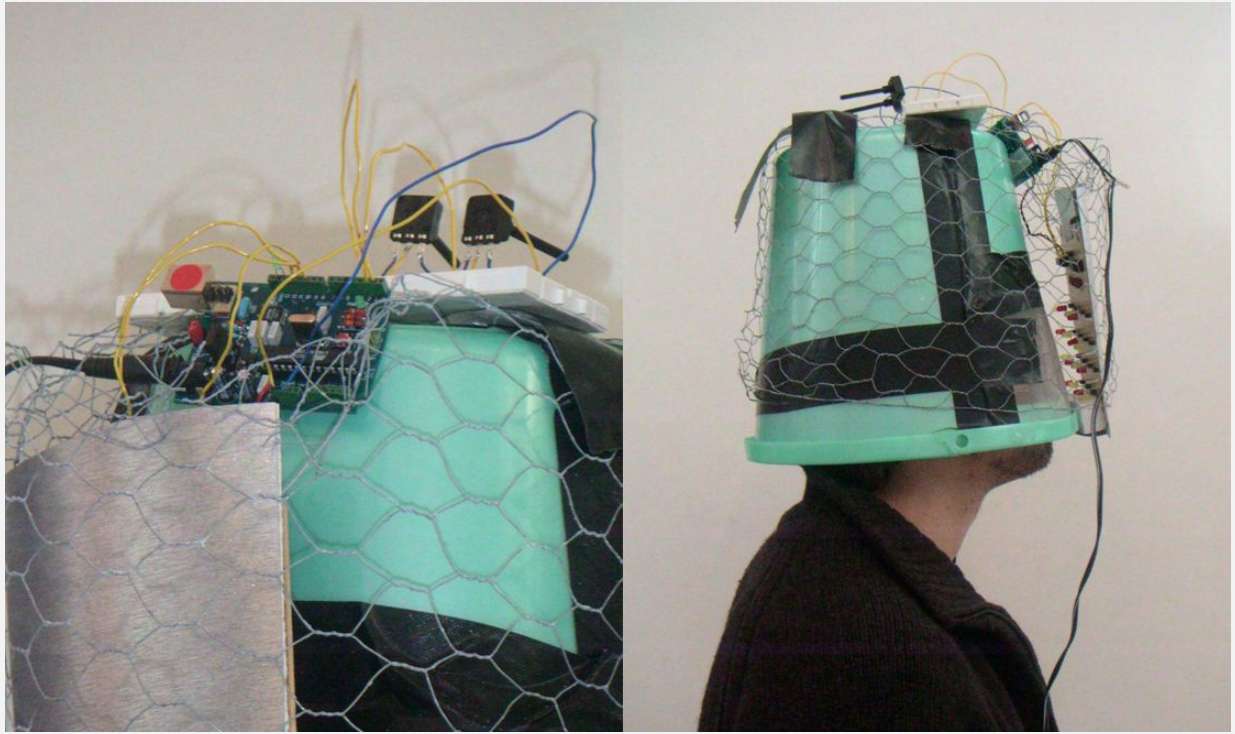


Arduino//
Ejemplos

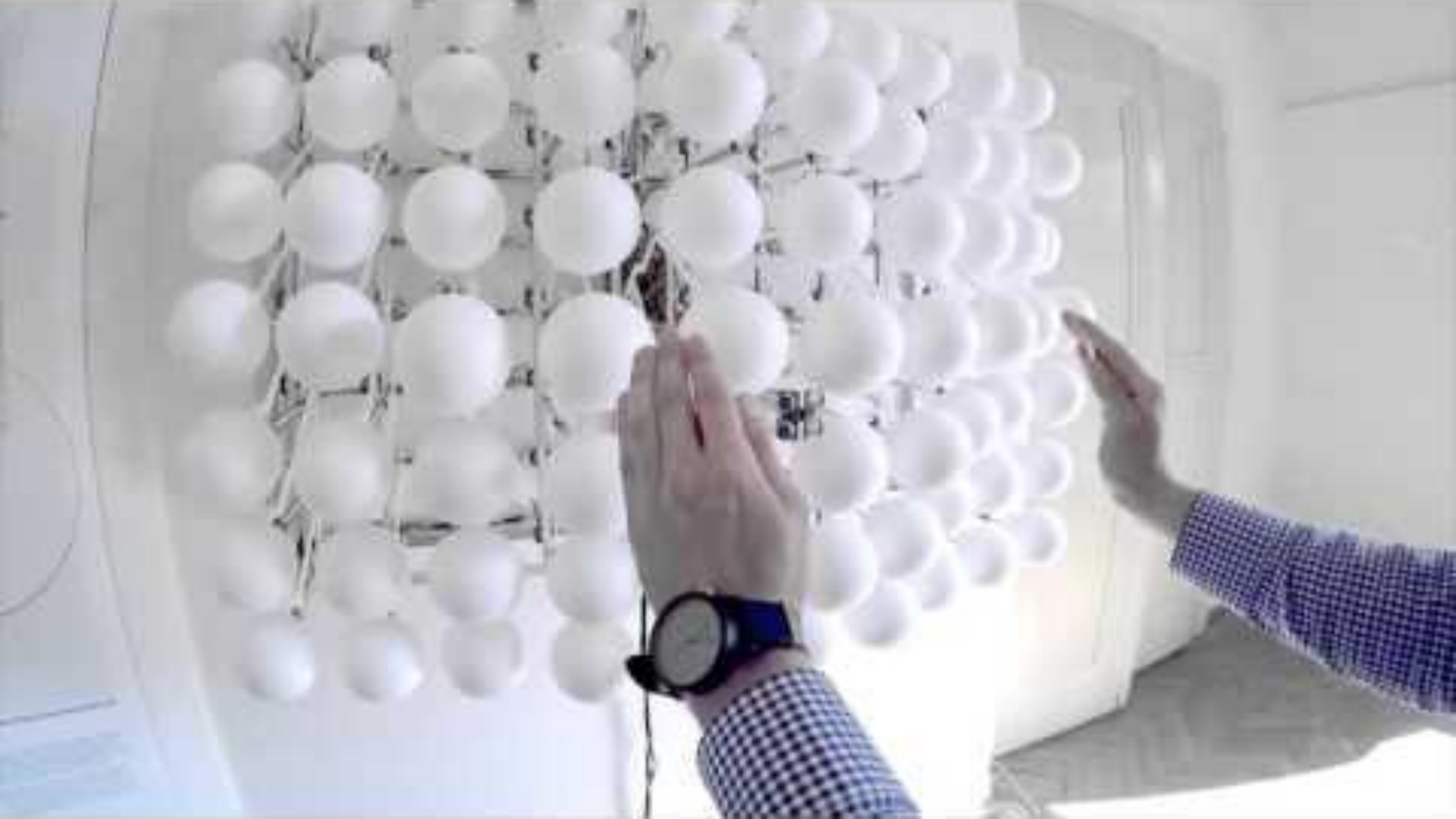


Arduino//
Ejemplos

Arduino//
Ejemplos



Arduino//
Ejemplos



SUPPLIERS


MADE IN ITALY
UNO
ARDUINO
7cubie
CubieBoard.org
2012-09-09

ARDUINO // STORES

Shops in Barcelona

Onda Radio http://www.ondaradio.es/productos/buscar.aspx?v=A000066
    Location https://plus.google.com/100101416647173159883/about?hl=en
Diotronic http://www.diotronic.com/raspberry-pi-arduino/arduino/placas_p_1080.aspx
    Location https://plus.google.com/117114665537047889067/about?hl=en
Ro-Botica http://ro-botica.com/
    Location https://plus.google.com/110636064159550584786/about?hl=en

On-Line Shops near Barcelona (2-4 day shipping)

Cooking Hacks http://www.cooking-hacks.com (Zaragoza)
SnootLab http://snootlab.com/ (Toulouse)
BricoGeek http://www.bricogeek.com/shop/ (Carballo, Galicia)
Reflexiona http://www.reflexiona.biz/ (Bilbao)
Electan http://www.electan.com/ (Alicante)

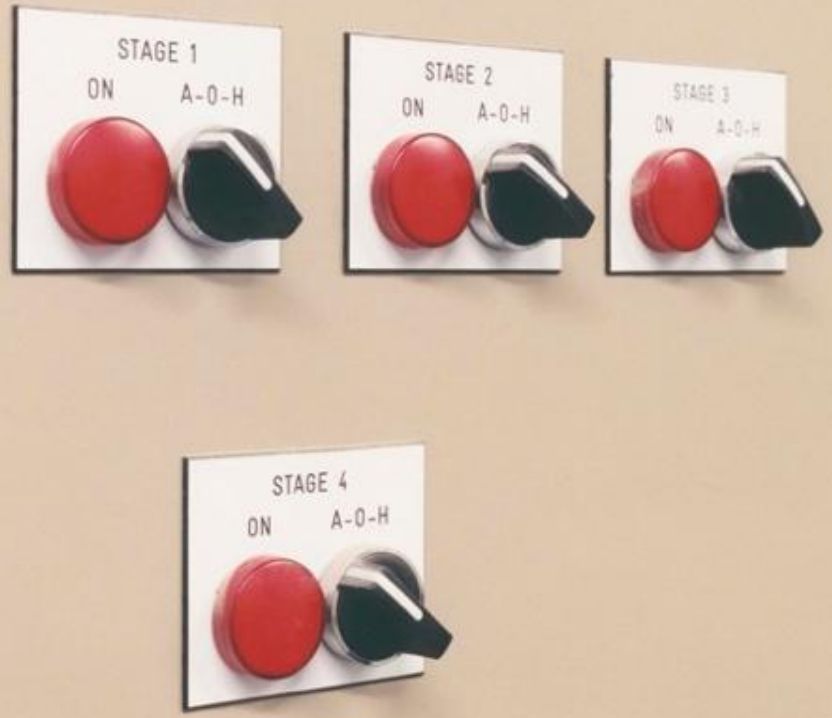
International

SparkFun http://www.sparkfun.com/
Adafruit http://adafruit.com/
Liquid Ware http://www.liquidware.com/shop
Itead Studio http://iteadstudio.com/store/
Seeed Studio http://seeedstudio.com/
Modern Device http://shop.moderndevice.com/

TUTORIALS

ARDUINO // STORES

* **[Teoría de la información]**
(https://www.youtube.com/watch?v=p0ASFxKS9sg&list=PLP6PHJ8SLR6D4ytpHhZBdylPNcazU5m7o)
* **[Más información sobre teoría y codificación (para aquellos que disfrutaron de los videos anteriores)]**
(https://www.youtube.com/playlist?list=PLzH6n4zXuckpKAj1_88VS-8Z6yn9zX_P6)
* **[Cómo piensan las computadoras]** (https://www.youtube.com/watch?v=dNRDvLACg5Q)
* **[Por qué usamos binario]** (https://www.youtube.com/watch?v=thrx3SBEpL8)
* **[Cómo funcionan las computadoras]** (https://www.youtube.com/watch?v=nN9wNvEnn-Q)
* **[Cómo funciona la memoria de la computadora en el interior]**
(https://www.youtube.com/watch?v=XETZoRYdtkw&t=6s)
* **[Colossus, la primera computadora electrónica]** (https://www.youtube.com/watch?v=knXWMjIA59c)
* **[Cómo diseñaron las computadoras que llevaron a los astronautas a la luna]**
(https://www.youtube.com/watch?v=xQ1O0XR_cA0)
* **[UNIX o lo que hace un sistema operativo]** (https://www.youtube.com/watch?v=tc4ROCJYbm0)
* **[Observa cómo se construyen y funcionan las cosas para aprender a diseñar]**
(https://www.youtube.com/playlist?list=PLvOlSehNtuHsy89OdSxBajult8e5srVLA)
* **[Una introducción a Arduino para futuras asignaciones]**
(https://www.youtube.com/watch?v=_h1m6R9YW8c)
* **[La vida secreta de las máquinas]**
(https://www.youtube.com/watch?v=KDpNQQqdSh8&list=PLByTa5duIolYRtq45Cz_GmtzfWJyA4bik)


STAGE 1
ON
A-O-H
STAGE 2
ON
A-O-H
STAGE 3
ON
A-O-H
STAGE 4
ON
A-O-H

REF

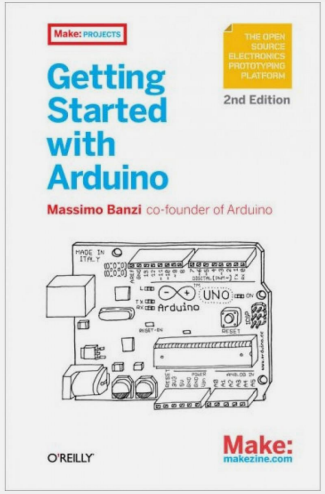
learn.adafruit.com

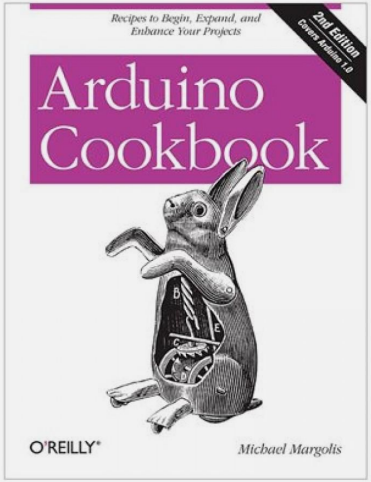
learn.sparkfun.com

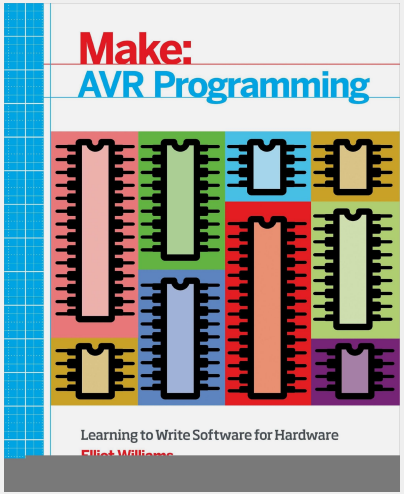
arduino.cc/en/Tutorial/HomePage

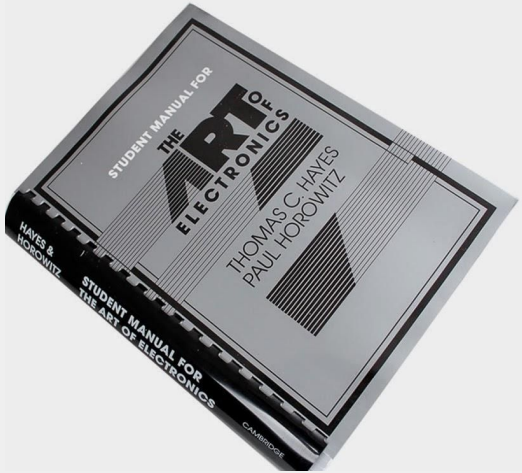
bildr.org

COMPUTING//
REF









THANK YOU

MT06 - Desafío

LEER MINIMO DOS INPUTS
(recomendamos Sensor de Temperatura + Fotoresistencias)

ACTUAR MINÍMO DOS OUTPUTS
(recomendamos sermotor + motor dc con transistor)

NOTA: Puntos extra por simular el circuito tambien en Thinkercad Electronics

Documentar tu proceso y publicar en tu repositorio de gitlab.

Gracias!