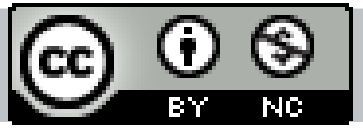
OPEN HARDWARE

BY

V.Sai Madhu

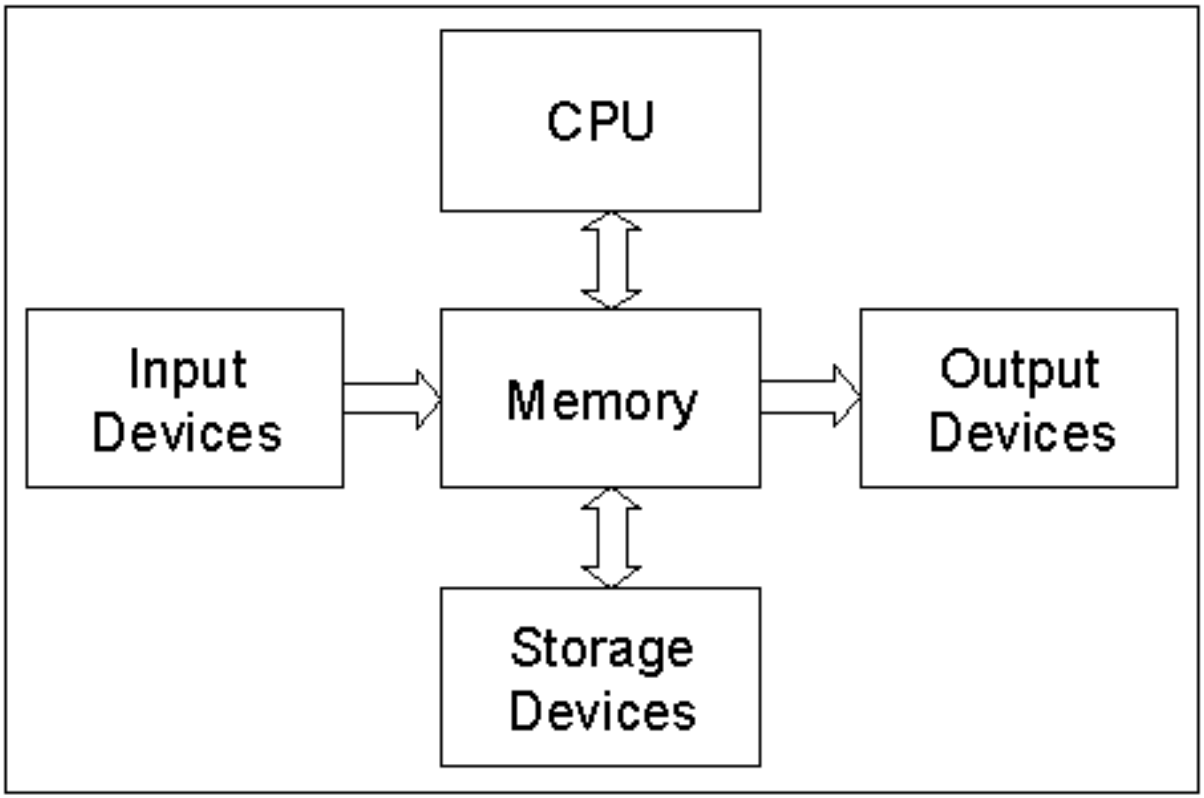


Electronics

- Digital Electronics
- Integrated Circuits
- Components of a computer
- Memories
- Microprocessor
- Microcontroller
- System On Chip

KEY CONCEPTS

Components of a computer (RAM,ROM,Memory etc)



Ports and Drivers

Design Of IC

- Layout
- HDL-Hardware Discriptive Language
- Synthesis
- Simulation
- Placement
- Routings
- Manufacture

What is Open Hardware?

- **Information about the hardware is easily discerned**
  - **Hardware Design**
  - **Mechanical Drawings**
  - **Schematics**
  - **Bills of Material**
  - **PCB Layout Data**
  - **HDL Source Code**
  - **IC Layout Data**
- **Software that drives hardware (Simulator, Compiler etc)**
- **Open Source Hardware Projects**

What is Open Hardware?

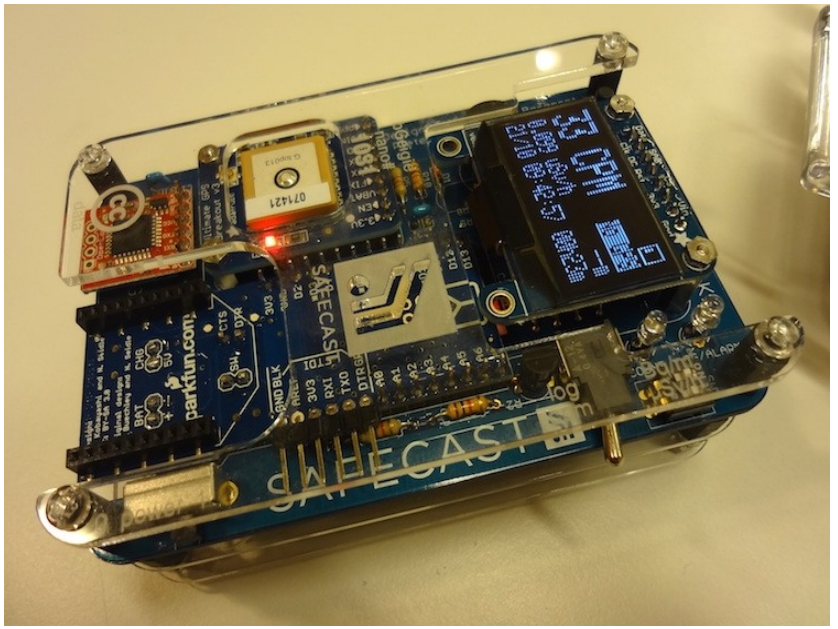
“Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. The hardware’s source, the design from which it is made, is available in the preferred format for making modifications to it.”

Is it Necessary???

- **Time to Market**
- **Design Reuse**
- **Collaboration**
- **Efficiency in Cores**
- **IP Cores vs Open Cores**
- **Reconfigurability**
- **Support for Programming Languages**

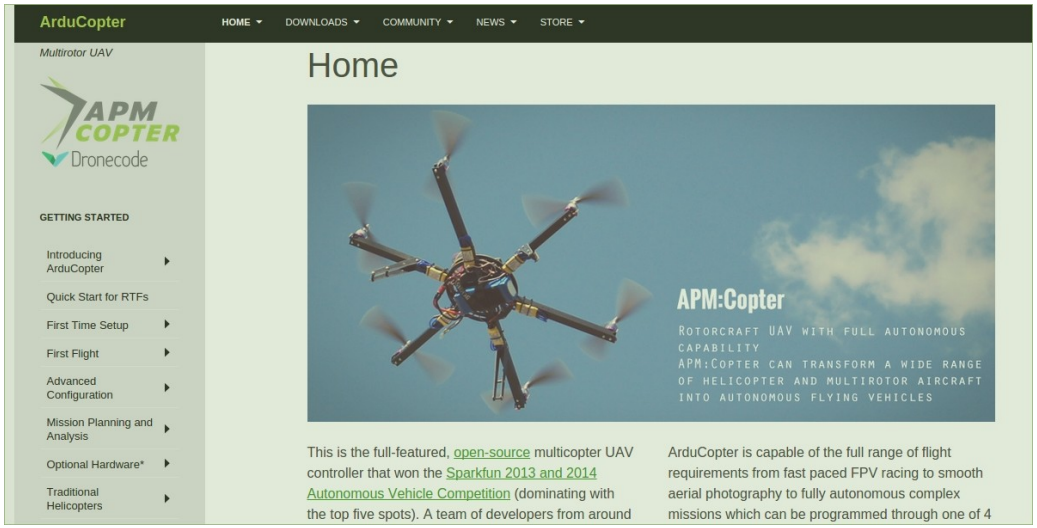
Spectrum of Open Source Hardware

- Arduino
- Sparkfun Electronics
- Thingiverse
- Instructables
- Fukushima Gieger Counter
- Open Sensors
- ArduSat – An Open Source Satellite



Spectrum of Open Source Hardware

- **Adafruit**
- **Makezine**
- **DIY Drones – Arducopter**
- **Matternet**



Talking Plants

GIZMODO

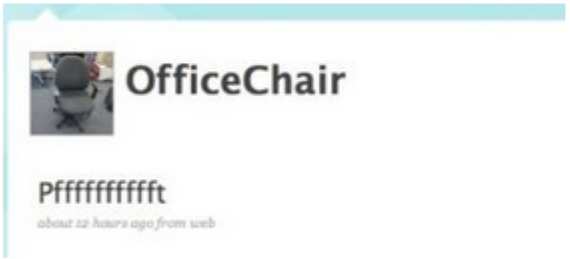
+ Follow

Man Builds Chair That Tweets His Farts, Single-Handedly Justifies Twitter's Existence

John Herrman

Filed to: FARTS 4/14/09 5:20am

124,766

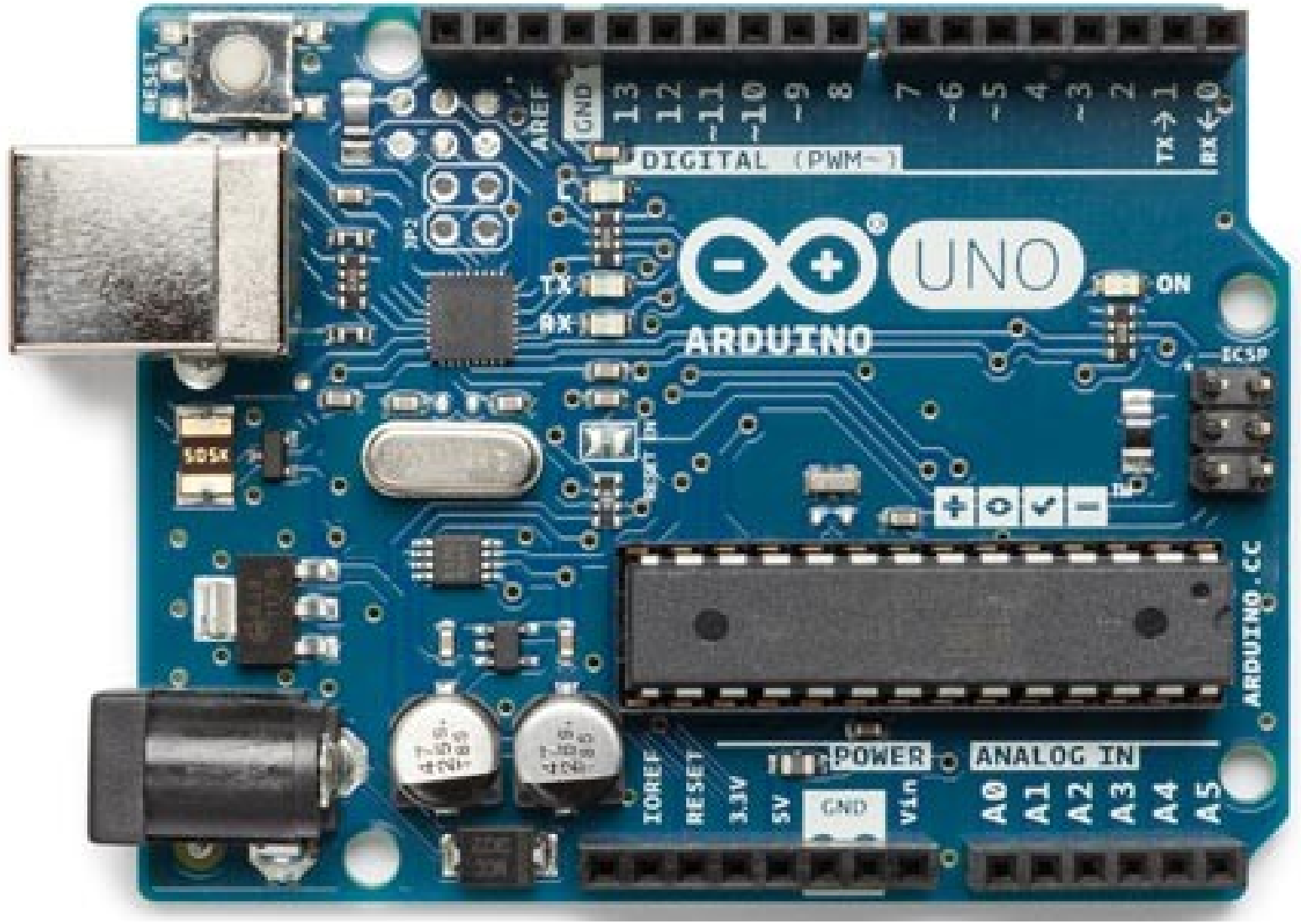


You know those guys (and gals?) who are just, like, *super* proud of their farts? Thanks to this cool guy and Twitter, these assholes can indulge their disgusting habit without wrecking our noses.

Known Gentleman Randy Sarafan decided to make this office chair to help "accurately document and share [his] life as it happens," which is as admirable a cause as there ever has been to open a Twitter account. The setup is surprisingly complex: A natural gas sensor does the sniffing; an Arduino does the thinking; an Squidbee wireless module does the communicating; Twitter does the sharing. It's a feat, to be sure.

Kickbee

PIN DISCRIPTION



Arduino Features

- Atmega 328 Microcontroller
- 14 Digital input/output pins(6 PWM)
- 32 KB flash of which 0.5KB used by bootloader
- 16Mhz Clock(Timing)
- EEPROM 1KB
- SPI
- Analog Inputs
- **Schematic**

CODING CONCEPTS

- LED Blink
- Button
- Serial Communication
- Sensor Value in serial Moniter
- Fun with Sensors and Actuators

Sensors and Actuators

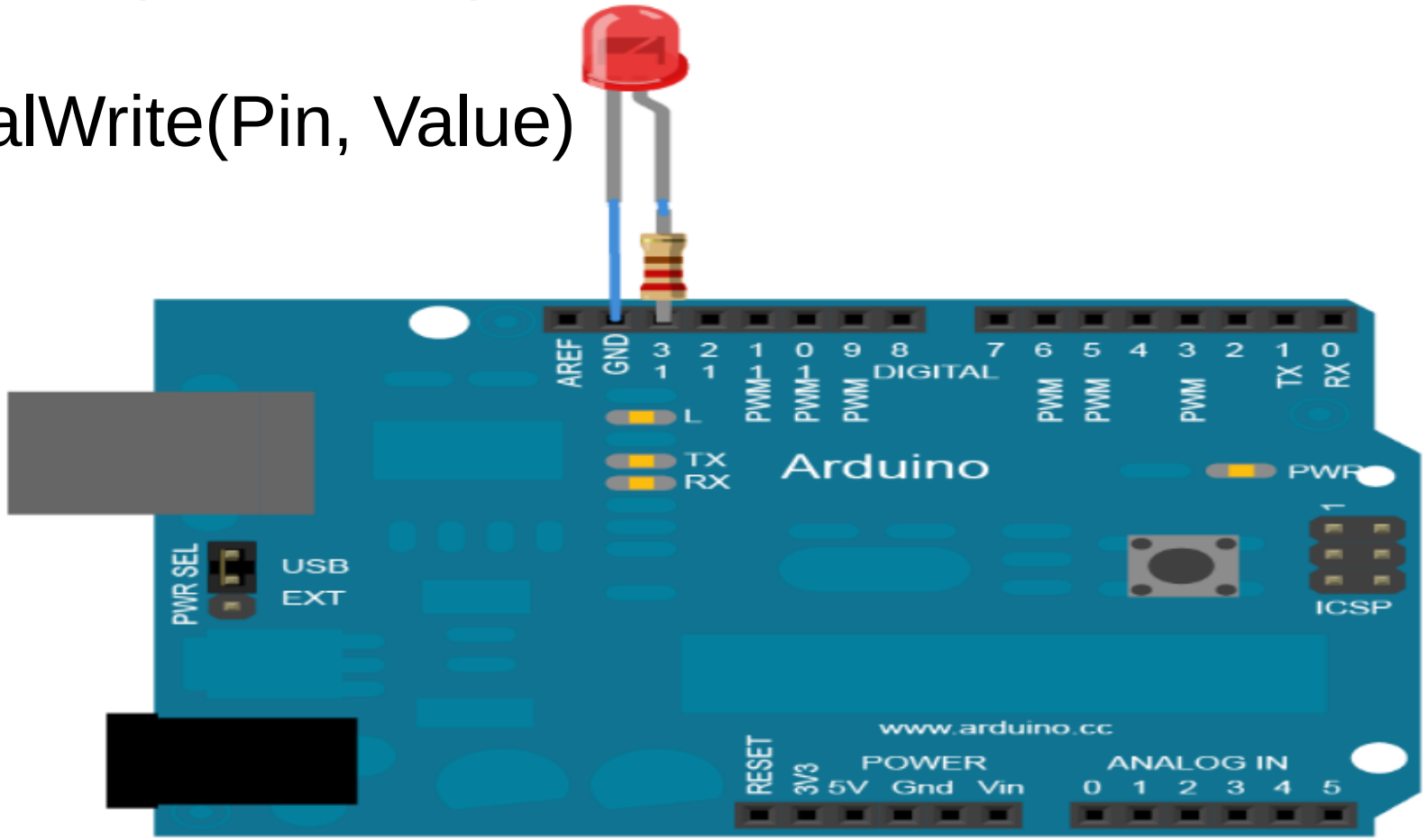
- DHT11
- Moisture sensor
- RF 434 Pair
- UV Sensor
- Gas sensor
- Photo resistor

- LCD Module
- motor
- Stepper motor

LED Blink

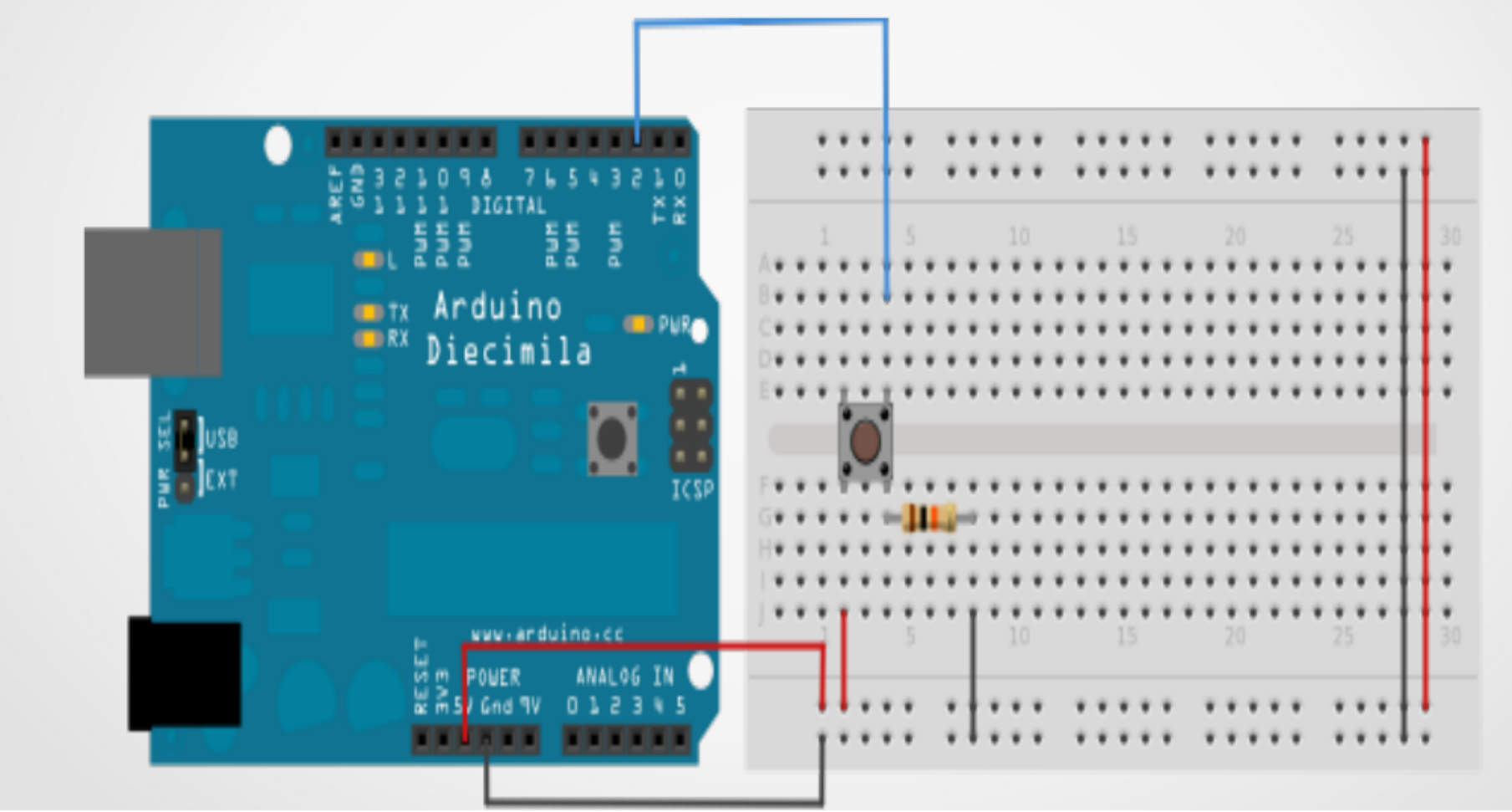
PinMode(Pin, Mode);

DigitalWrite(Pin, Value)



Button

DigitalRead (ButtonPin)



Serial Communication

Serial.Begin(9600)

Serial.Println(“Hello World”);

Transferring Analog and Digital Status over Serial

analogRead(pin)

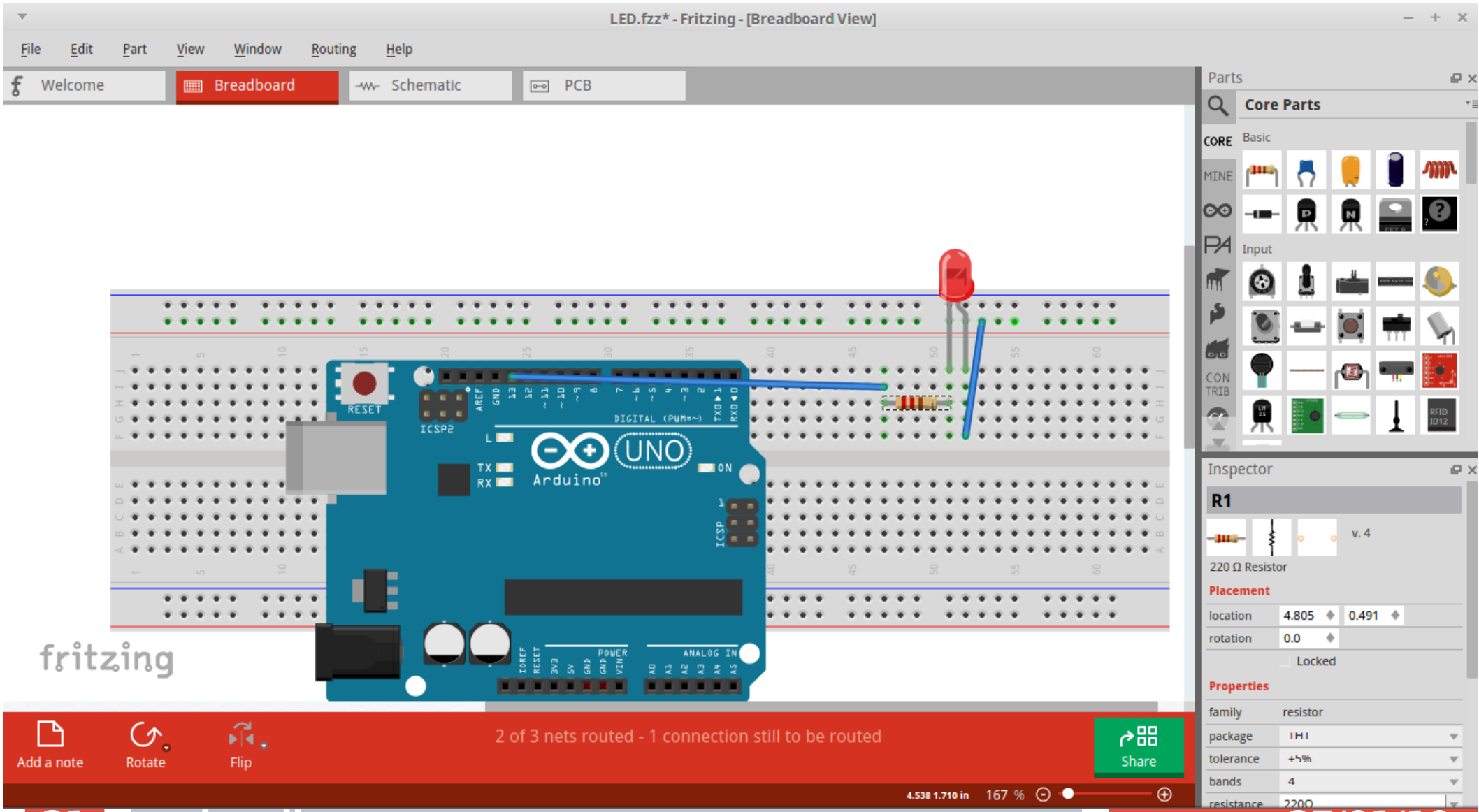
analogWrite(pin,value);PWM

Further References and Libraries.....

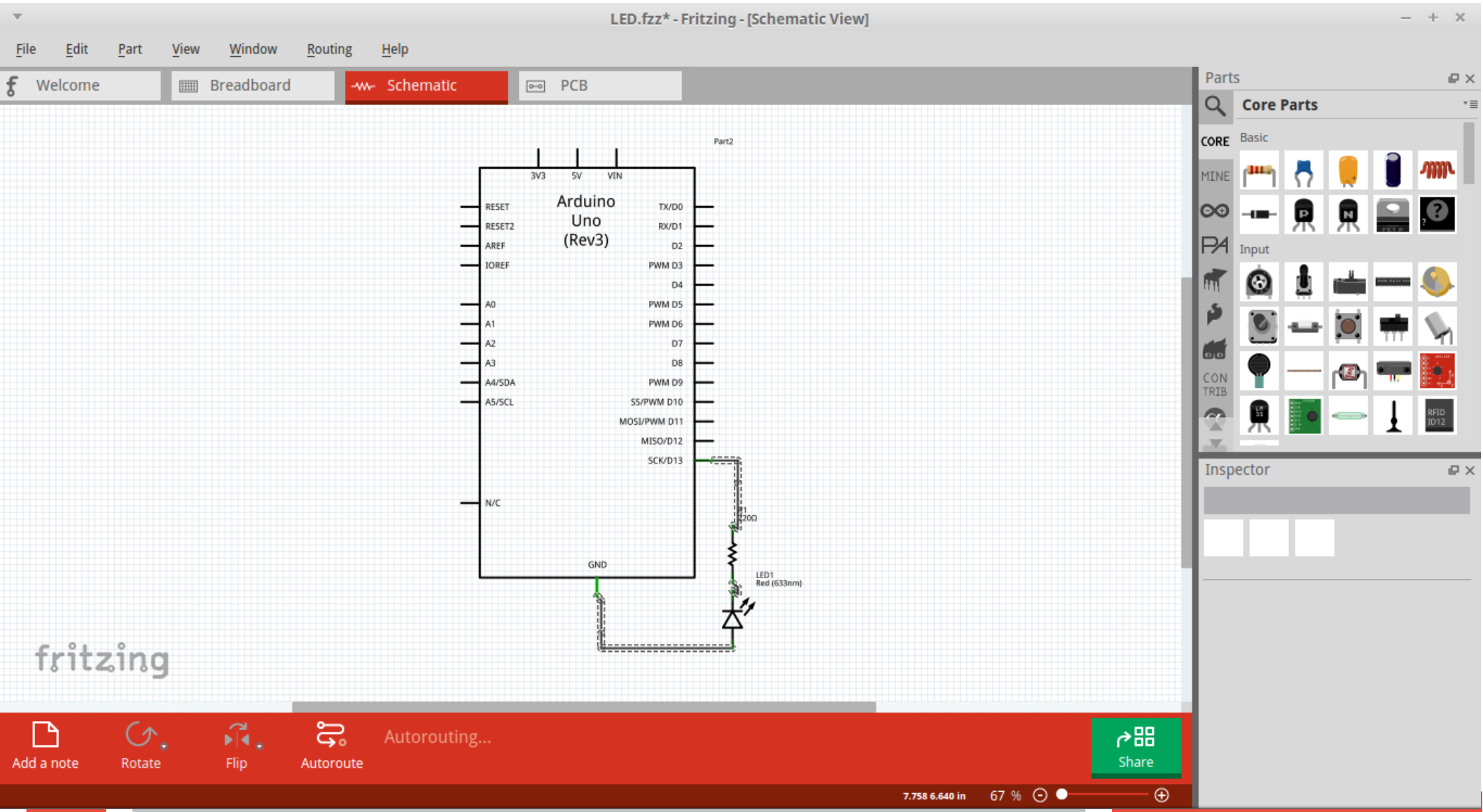
Further more to play

- Fritzing and circuits.io
- Other Boards we have
    - Raspberrypi
    - Beagle Bone Black
    - Panda Board

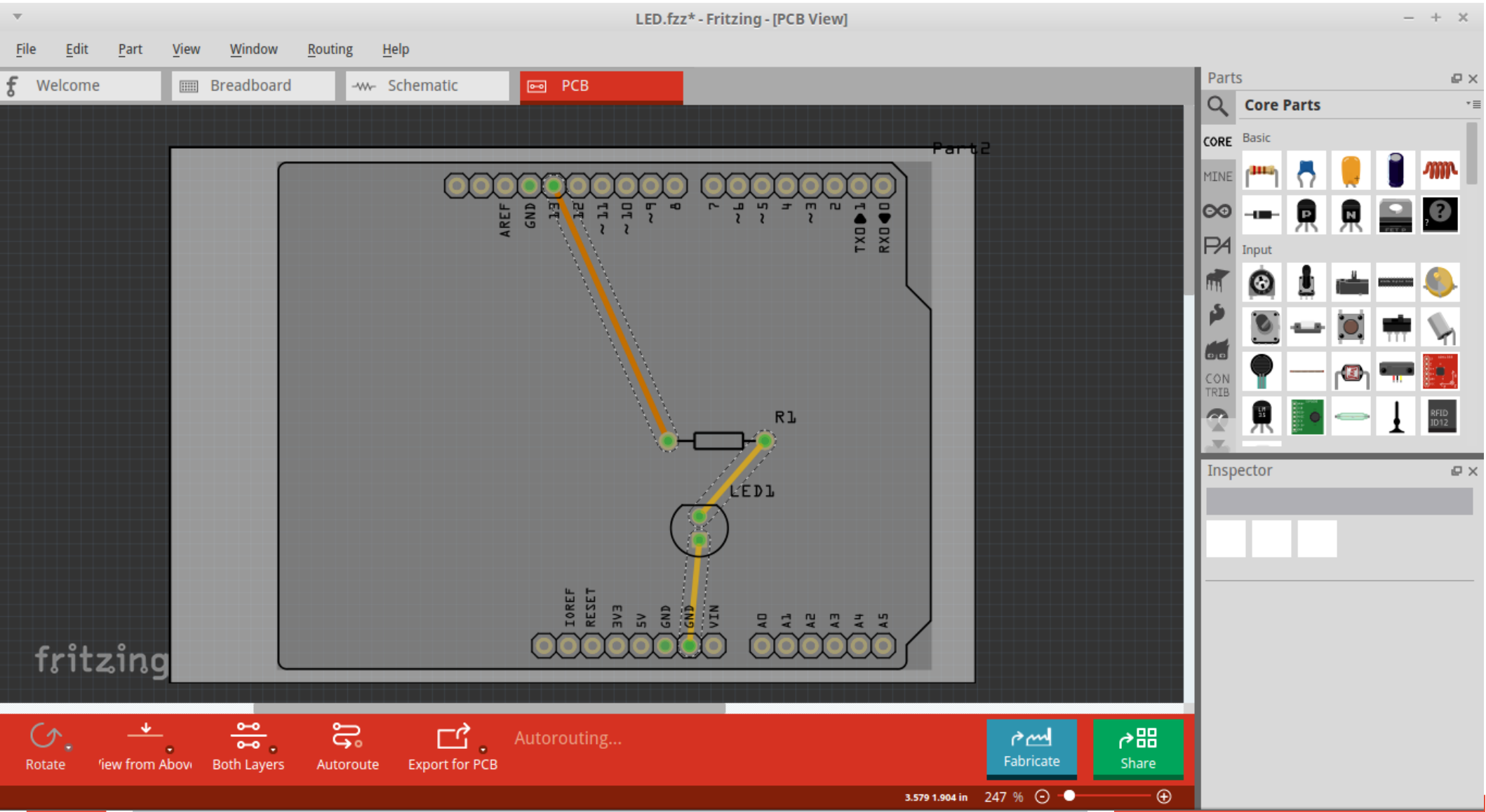
Fritzing


LED.fzz* - Fritzing - [Breadboard View]
File
Edit
Part
View
Window
Routing
Help
Welcome
Breadboard
Schematic
PCB
Parts
Core Parts
Basic
Input
Inspector
R1
v. 4
220 Ω Resistor
Placement
location
4.805
0.491
rotation
0.0
Locked
Properties
family
resistor
package
tolerance
bands
4
resistance
2200
RESET
ICSP2
UNO
Arduino
DIGITAL (PWM=~)
POWER
ANALOG IN
ICSP
fritzing
Add a note
Rotate
Flip
2 of 3 nets routed - 1 connection still to be routed
Share
4.538 1.710 in
167 %

Fritzing


LED.fzz* - Fritzing - [Schematic View]
File
Edit
Part
View
Window
Routing
Help
Welcome
Breadboard
Schematic
PCB
Part2
3V3
5V
VIN
Arduino
Uno
(Rev3)
RESET
RESET2
AREF
IOREF
A0
A1
A2
A3
A4/SDA
A5/SCL
N/C
TX/D0
RX/D1
D2
PWM D3
D4
PWM D5
PWM D6
D7
D8
PWM D9
SS/PWM D10
MOSI/PWM D11
MISO/D12
SCK/D13
GND
R1
220Ω
LED1
Red (633nm)
fritzing
Parts
Core Parts
CORE
Basic
MINE
Input
CONTRIB
Inspector
Add a note
Rotate
Flip
Autoroute
Autorouting...
Share
7.758 6.640 in
67 %

Fritzing


LED.fzz* - Fritzing - [PCB View]
File
Edit
Part
View
Window
Routing
Help
Welcome
Breadboard
Schematic
PCB
Part2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX0 1
RX0 0
R1
LED1
IOREF
RESET
3V3
5V
GND
GND
VIN
A0
A1
A2
A3
A4
A5
fritzing
Parts
Core Parts
CORE
Basic
MINE
Input
CON TRIB
Inspector
Rotate
View from Above
Both Layers
Autoroute
Export for PCB
Autorouting...
Fabricate
Share
3.579 1.904 in
247 %

Internet of Things(IoT)

- Types of Networks
- Electromagnetic spectrum
- Packets,TCPIP
- Server and client
- Software and hardware ports
- Mac and IP Adresses
- ssid,Types of encription
- Wifi modes

Wemos D1-Mini

Technical specs

Microcontroller	**ESP-8266EX**
Operating Voltage	3.3V
Digital I/O Pins	11
Analog Input Pins	1(Max input: 3.2V)
Clock Speed	80MHz/160MHz
Flash	4M bytes
Length	34.2mm
Width	25.6mm
Weight	3g

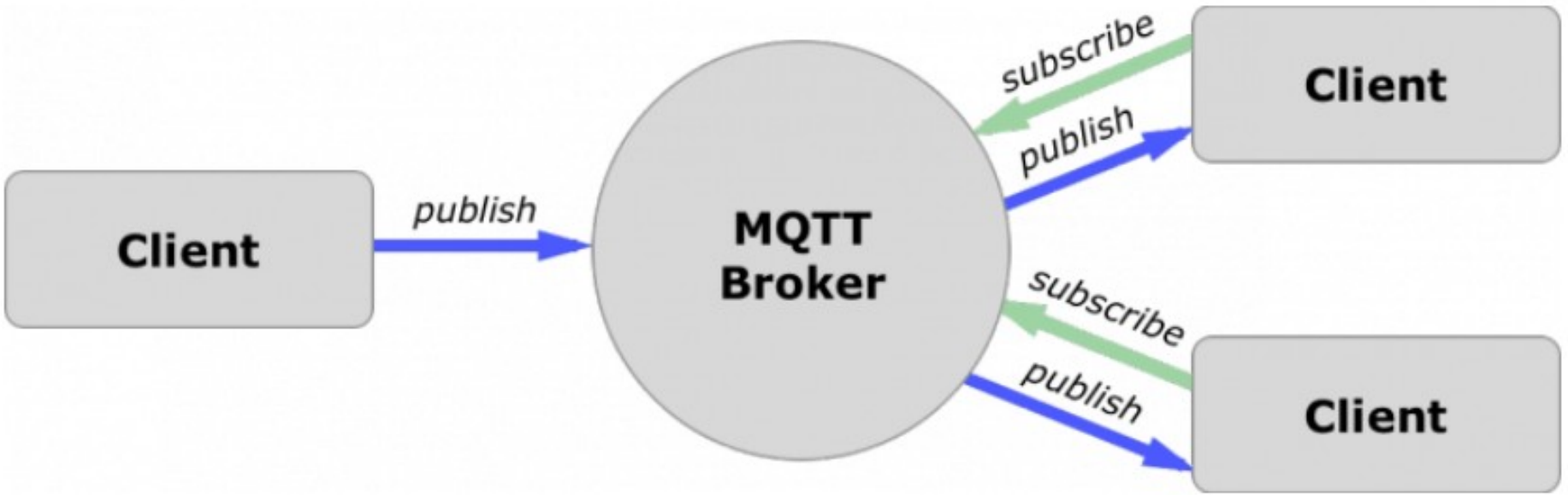
Wemos D1-Mini – Pin Specification

Pin

Pin	Function	ESP-8266 Pin
TX	TXD	TXD
RX	RXD	RXD
A0	Analog input, max 3.3V input	A0
D0	IO	GPIO16
D1	IO, SCL	GPIO5
D2	IO, SDA	GPIO4
D3	IO, 10k Pull-up	GPIO0
D4	IO, 10k Pull-up, BUILTIN_LED	GPIO2
D5	IO, SCK	GPIO14
D6	IO, MISO	GPIO12
D7	IO, MOSI	GPIO13
D8	IO, 10k Pull-down, SS	GPIO15
G	Ground	GND
5V	5V	-
3V3	3.3V	3.3V
RST	Reset	RST

MQTT

- MQTT -> Message Queuing Telemetry Transport Protocol
- 4 Terms to remember ->
- Publish
- Subscribe
- Topic
- Broker



MQTT advantages

- Light weight protocol unlike HTTP
- Very less overheads (more headers are required with HTTP)
- Perfect for limited bandwidth
- Low power consumption
- Meant to be for IoT applications

MQTT Example

- Wemos D1 Mini Interfaced with Ultrasonic sensor -> Client -> Publisher
- Mosquitto MQTT or any other open source MQTT broker -> Broker
- Local computer -> client -> Subscriber
- Topic -> Distance

Things Board

- Live Demo -> register
- URL -> demo.thingsboard.io
- Access Token -> Get from the website
- Copy the code and paste it in Arduino IDE.
- Upload the code onto Wemos.
- See the nice MQTT Data in the form of a chart!

Happy Coding