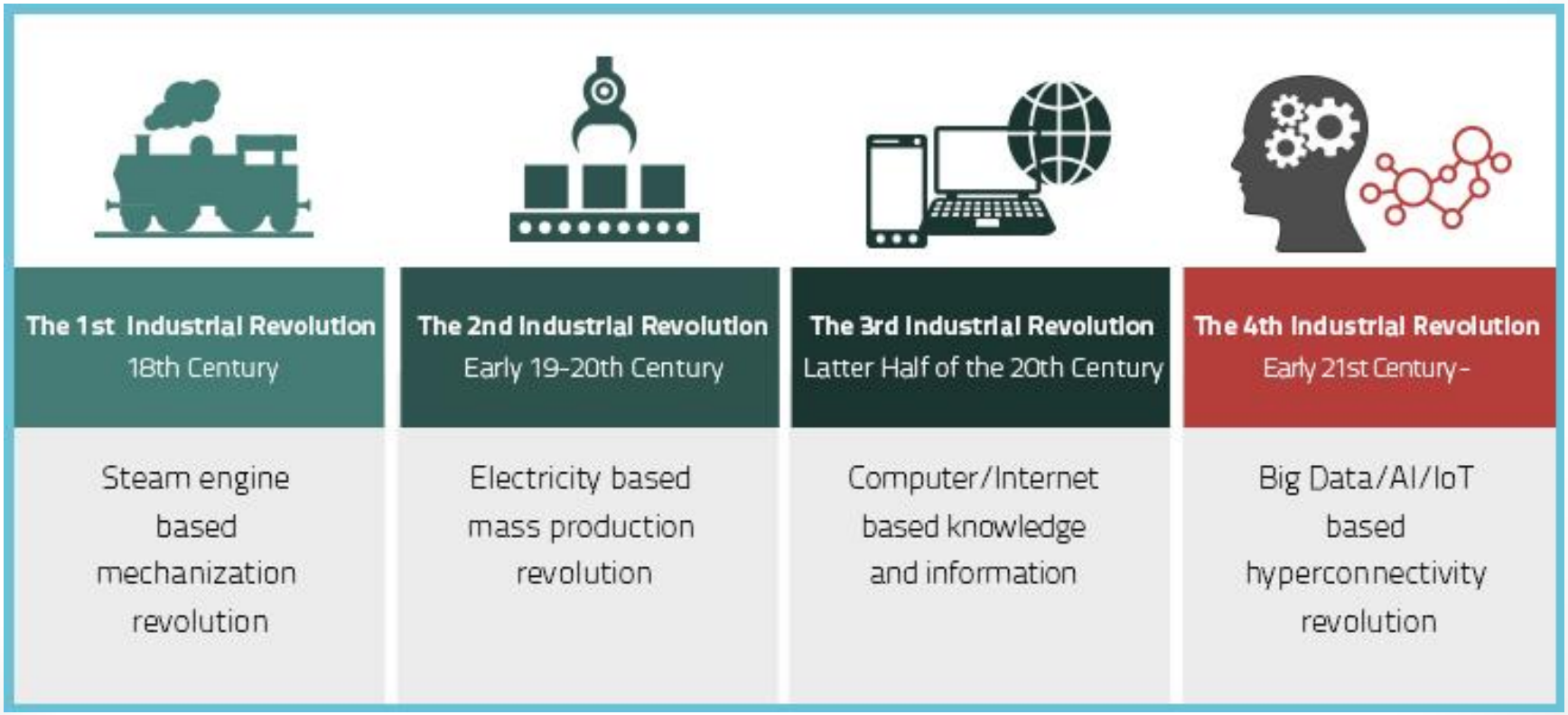
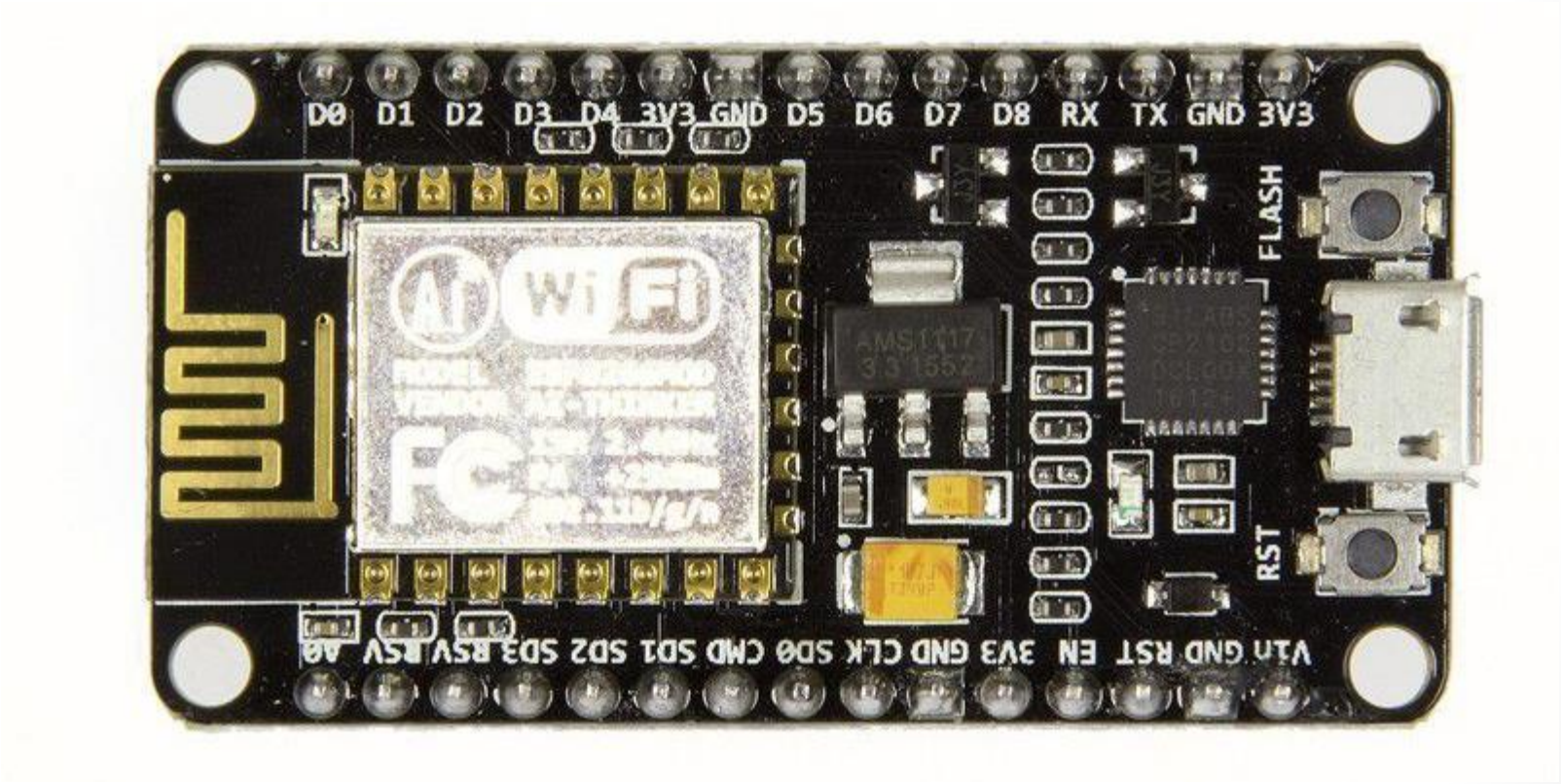
Introduction

4th Industrial Revolution



Mini Computer



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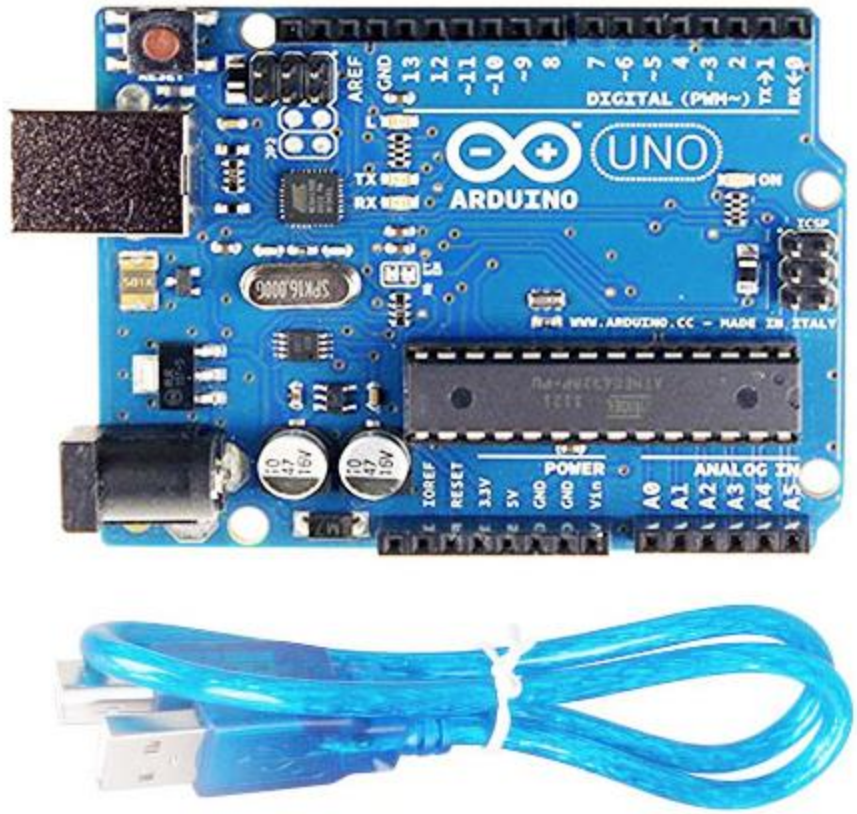
Mini Computer



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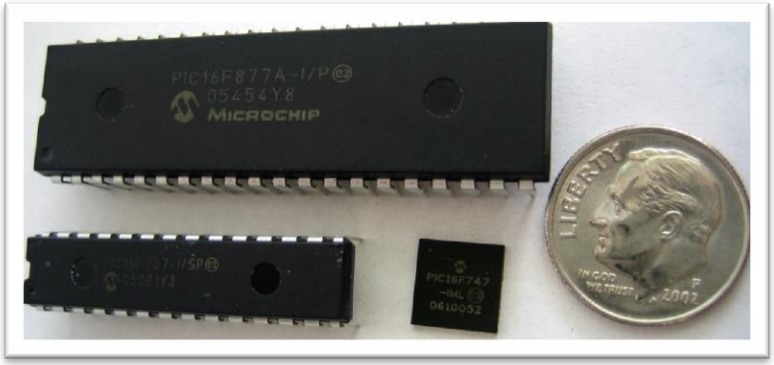
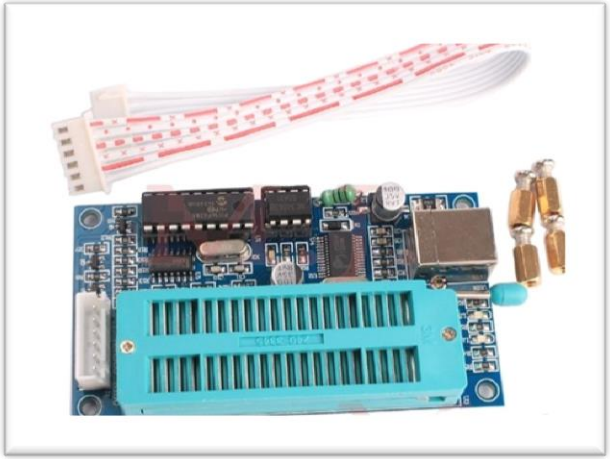
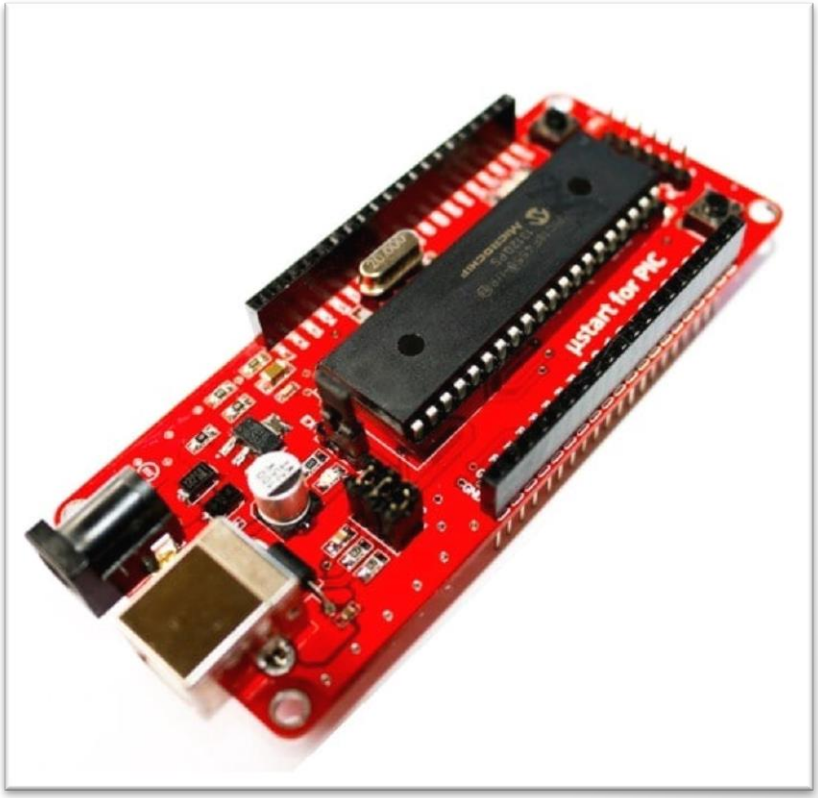
Microcontrollers







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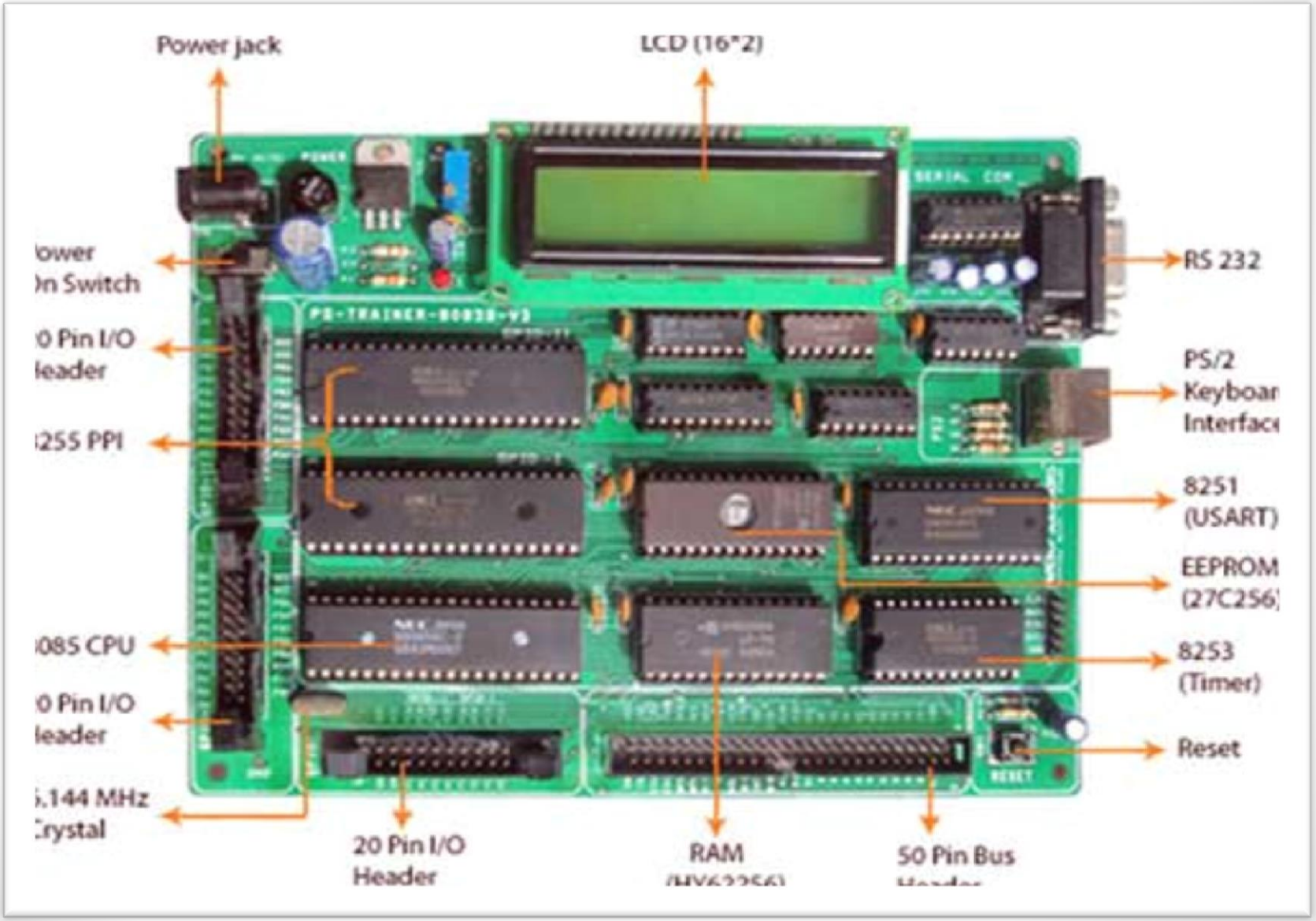
Micro Processor



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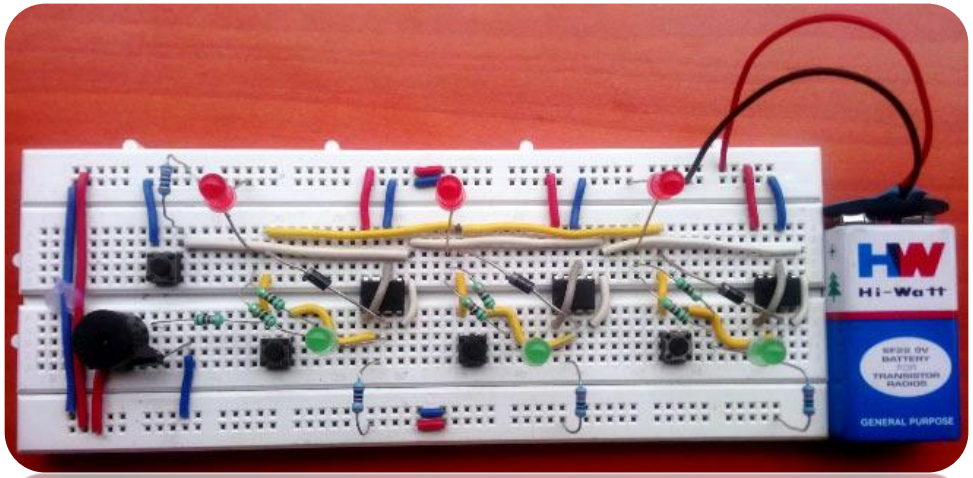
Introduction to Arduino



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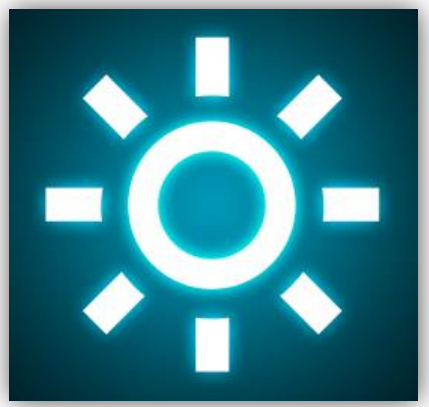
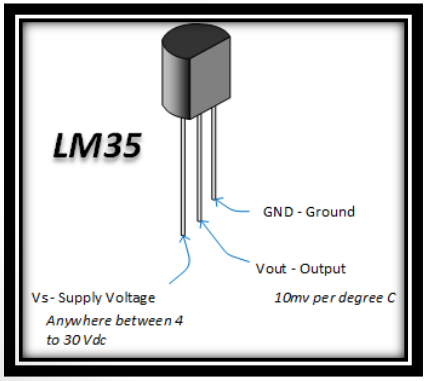
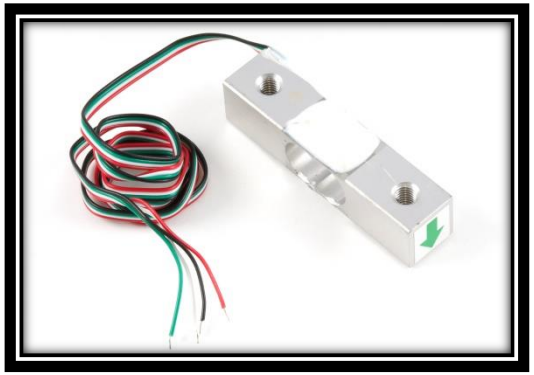
What are Things

- What Are Things ?
  - Sensors







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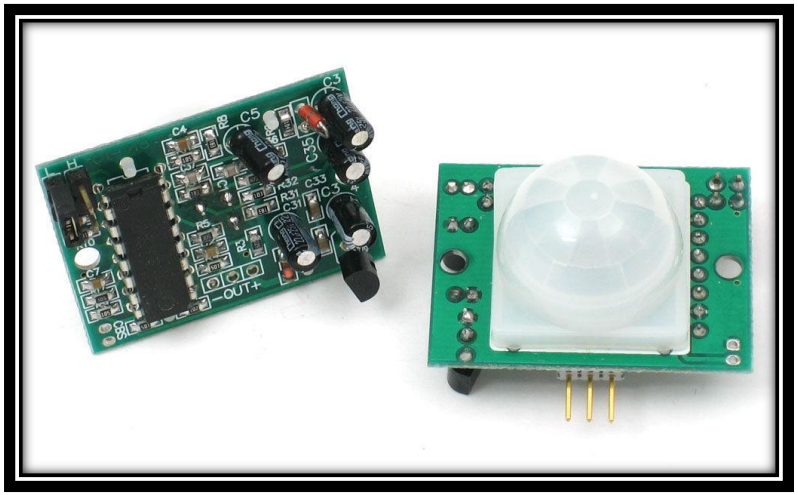
What are Things

- What Are Things ?
  - Sensors



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What are Things

- What Are Things ?
  - Other sensors : youtube video

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What are Things

- What Are Things ?
  - Sensors
  - Actuators

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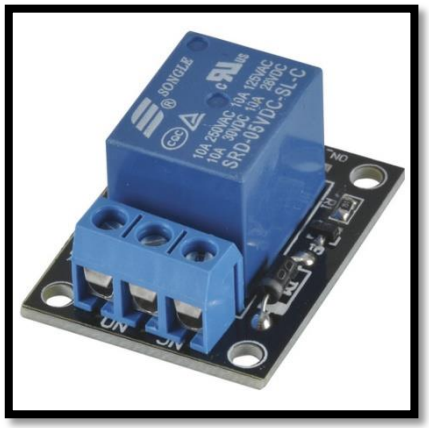
What are Things

- What Are Things ?
  - Sensors
  - Actuators



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What are Things

- What Are Things ?
  - Sensors
  - Actuators

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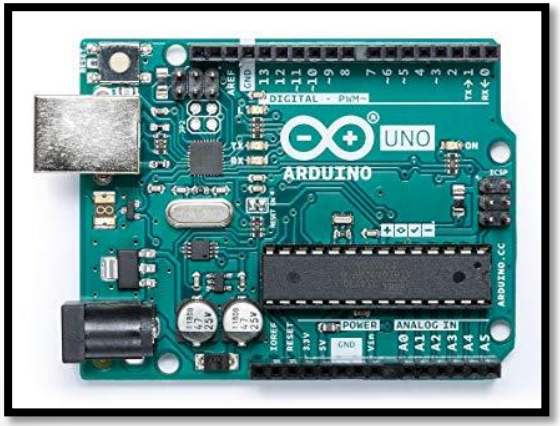
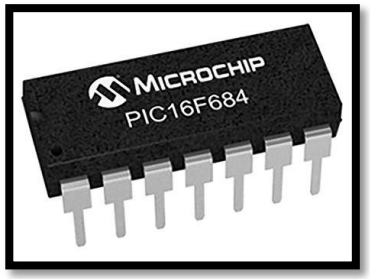
What are Things

- What Are Things ?
  - Sensors
  - Actuators
  - Electronic parts

    Embedded with Microcontroller, Which is a Mini Computer.





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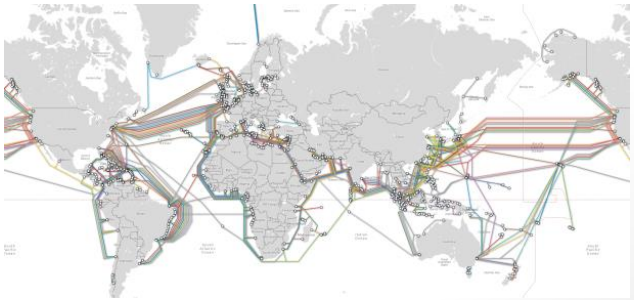
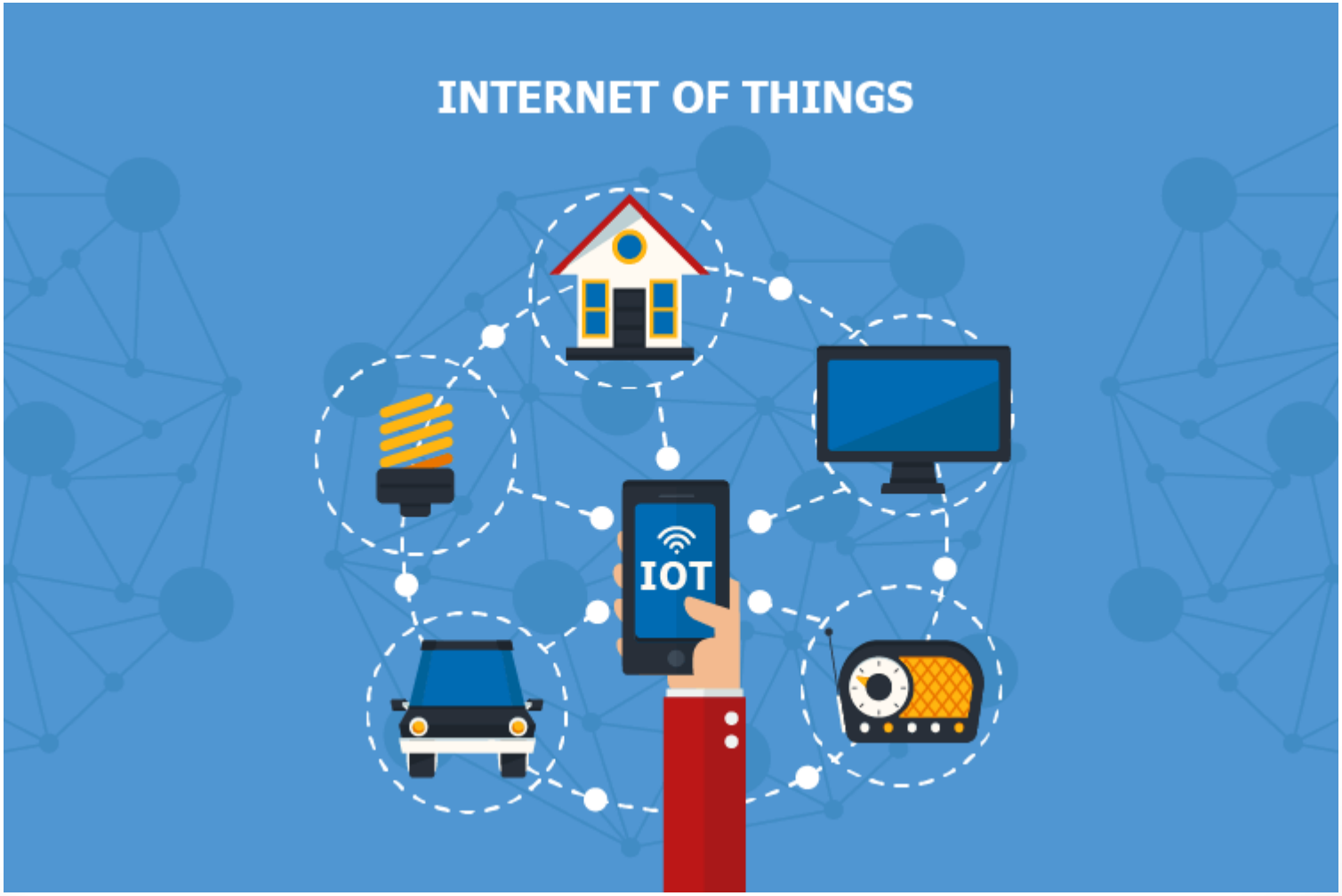
What Is … ?
Internet of Things

- What is Internet ?

- Is a worldwide system of computer networks - a network of networks in which users at any one computer can, get information from any other computer (and sometimes talk directly to users at other computers).

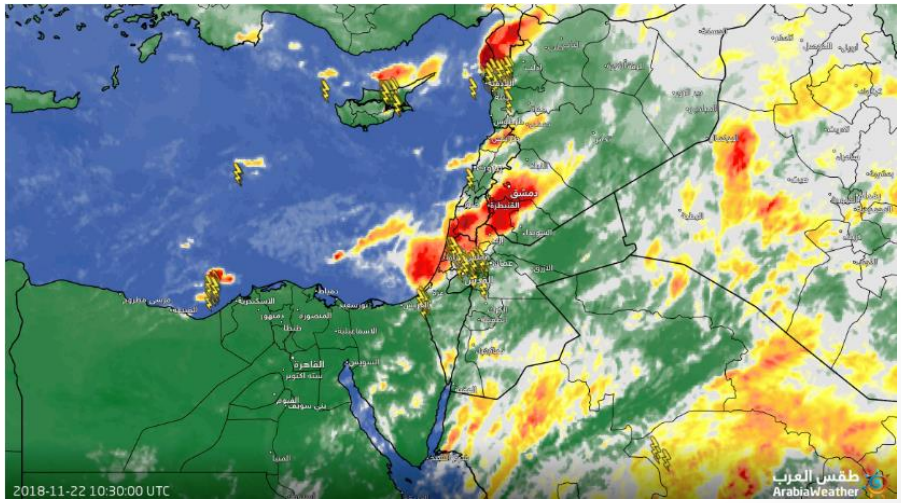
Video : How the internet works

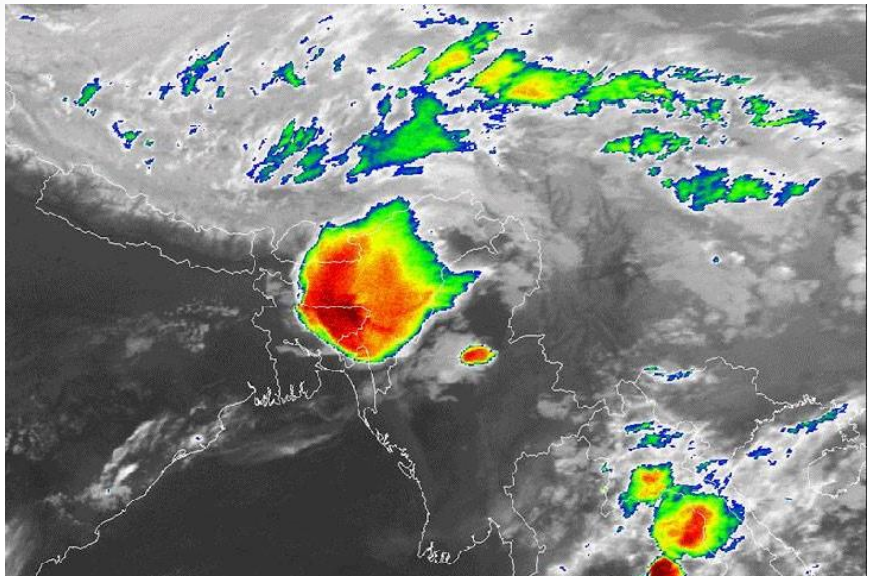



INTERNET OF THINGS
IOT

Real Example of IoT

- Arab Weather



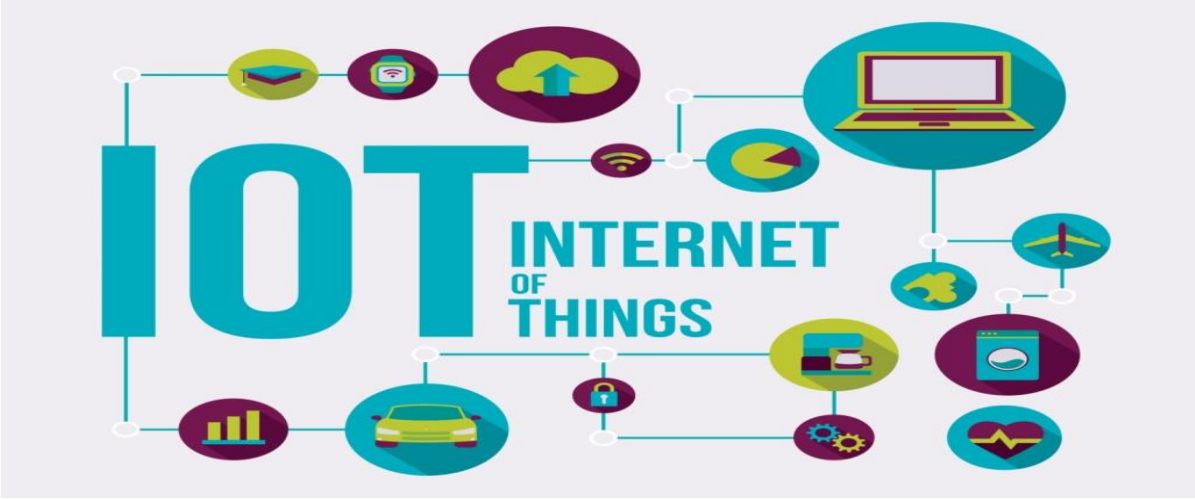


Weather Satellite

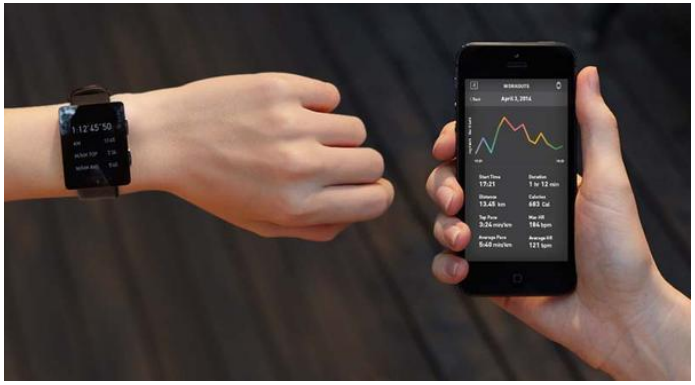
Weather Station

Introduction to IoT

- Internet of Things is the network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data.

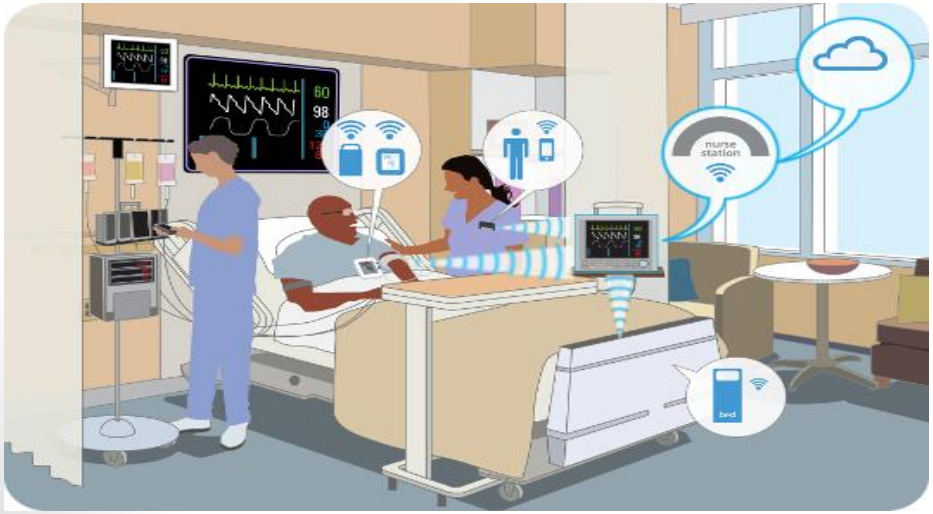


Examples of IoT



Wearable Tech

Smart Appliances



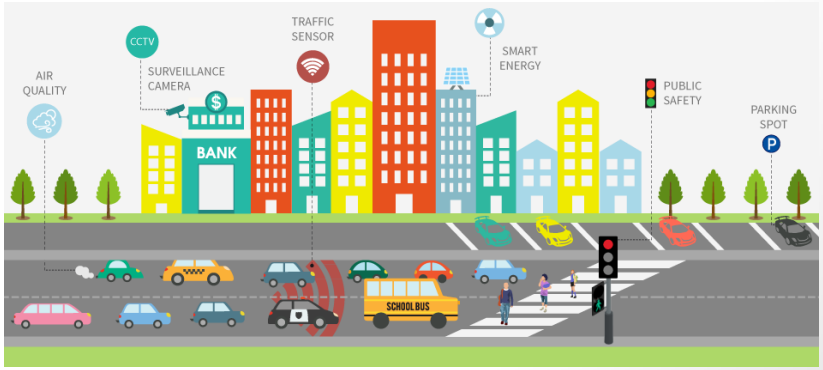
Healthcare

Examples of IoT

Smart Home

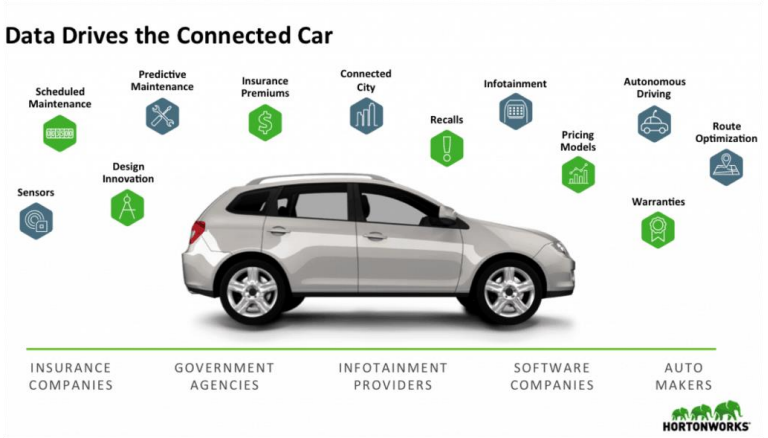
Introduction to IoT

- Home
  - Automation
  - Monitoring
- Health and fitness
  - Patients
  - Players
- City
  - Traffic
  - Security

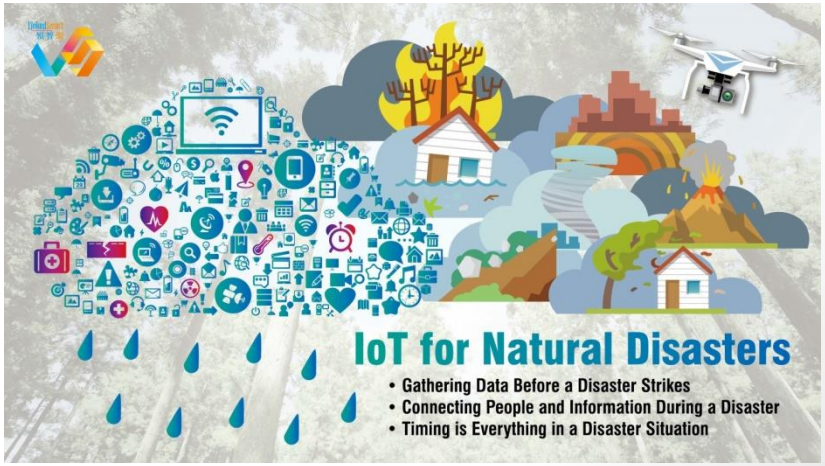


Introduction to IoT

- Connected cars
  - Insurance companies
  - Repair centers
  - Car tracking

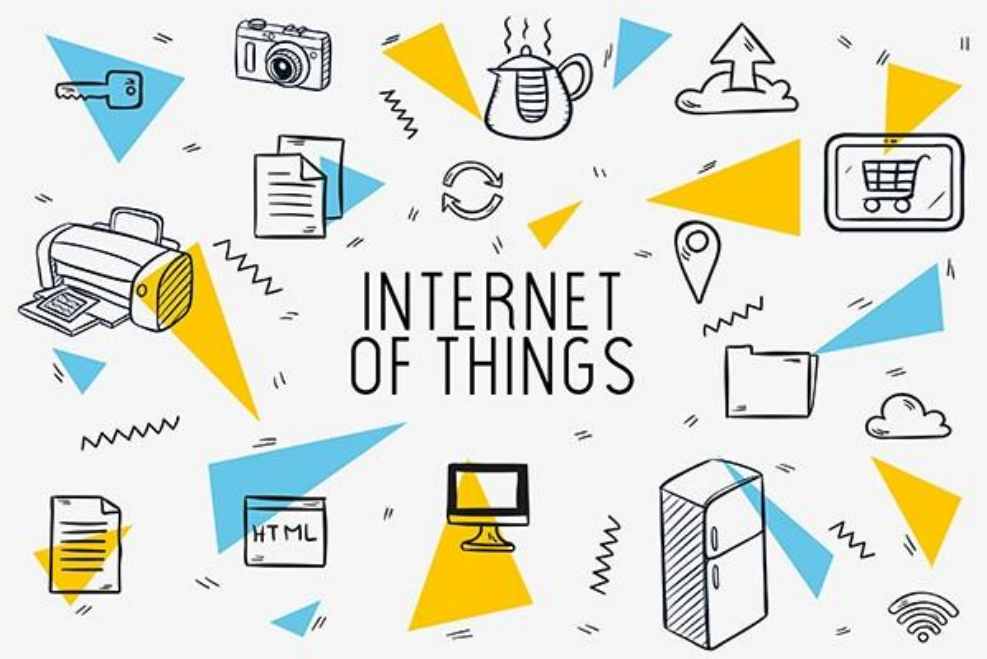


- Environment
  - Global warming
  - Natural disasters
  - Pollution



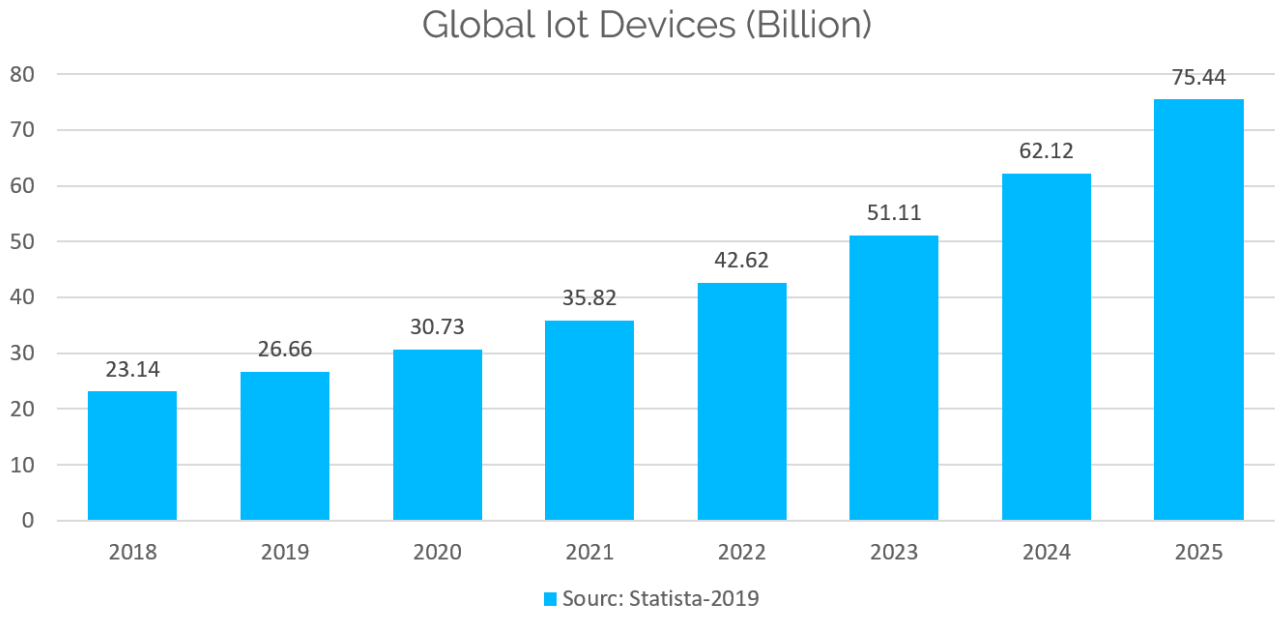
Introduction to IoT

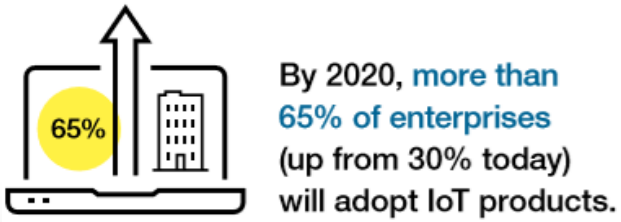
- Home
- Health and fitness
- Business
- City
- Connected Cars
- Environment



Info about IoT field

- Future and Growth of IoT.





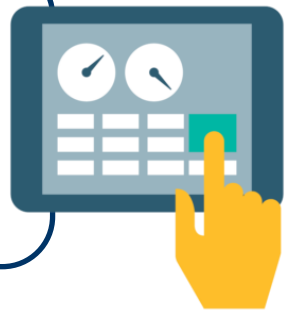
By 2020, more than 65% of enterprises (up from 30% today) will adopt IoT products.

Gartner Insights on How to Lead in a Connected World

IoT Overview

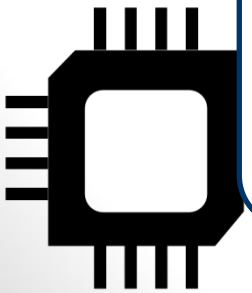
User Interface (UI):

-Web development
-Mobile Application

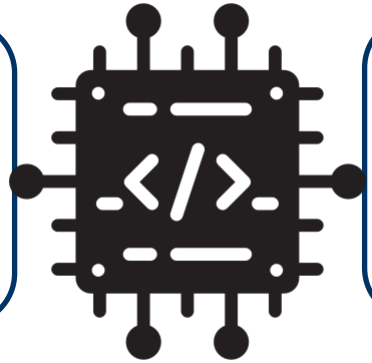


Networking

- LAN
- Internet

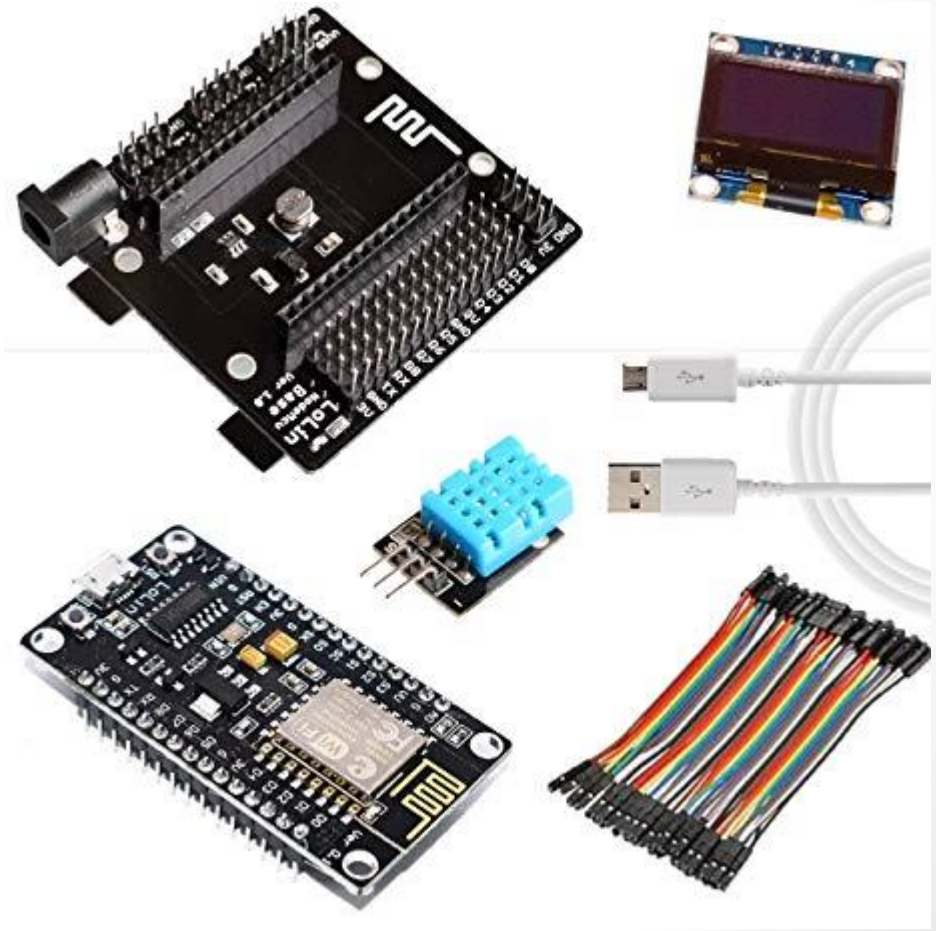


Electronics
Sensors
Actuators



Programming
Skills and tools

Let’s go !



Installation

- Arduino IDE

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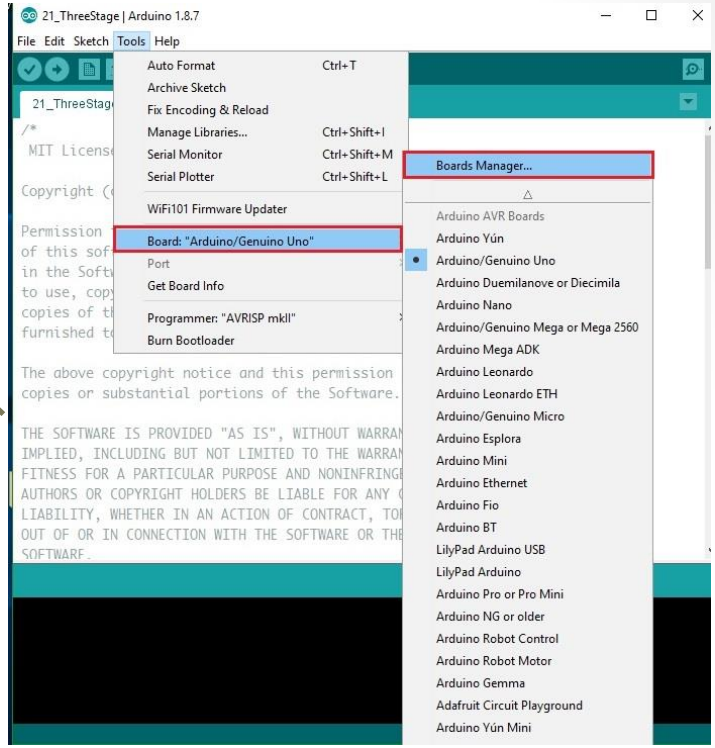
Installation

- Arduino IDE
- ESP8266 core

1



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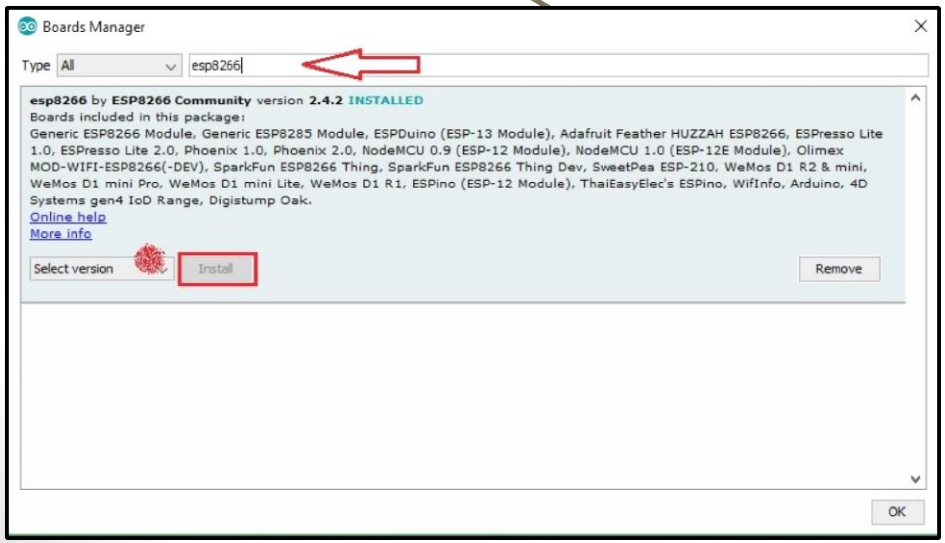


Beginning with ESP8266

- **Install board :**
  - Add link to Preferences → Additional Boards
  - Go to Tools → Board → Boards Manager and install esp8266

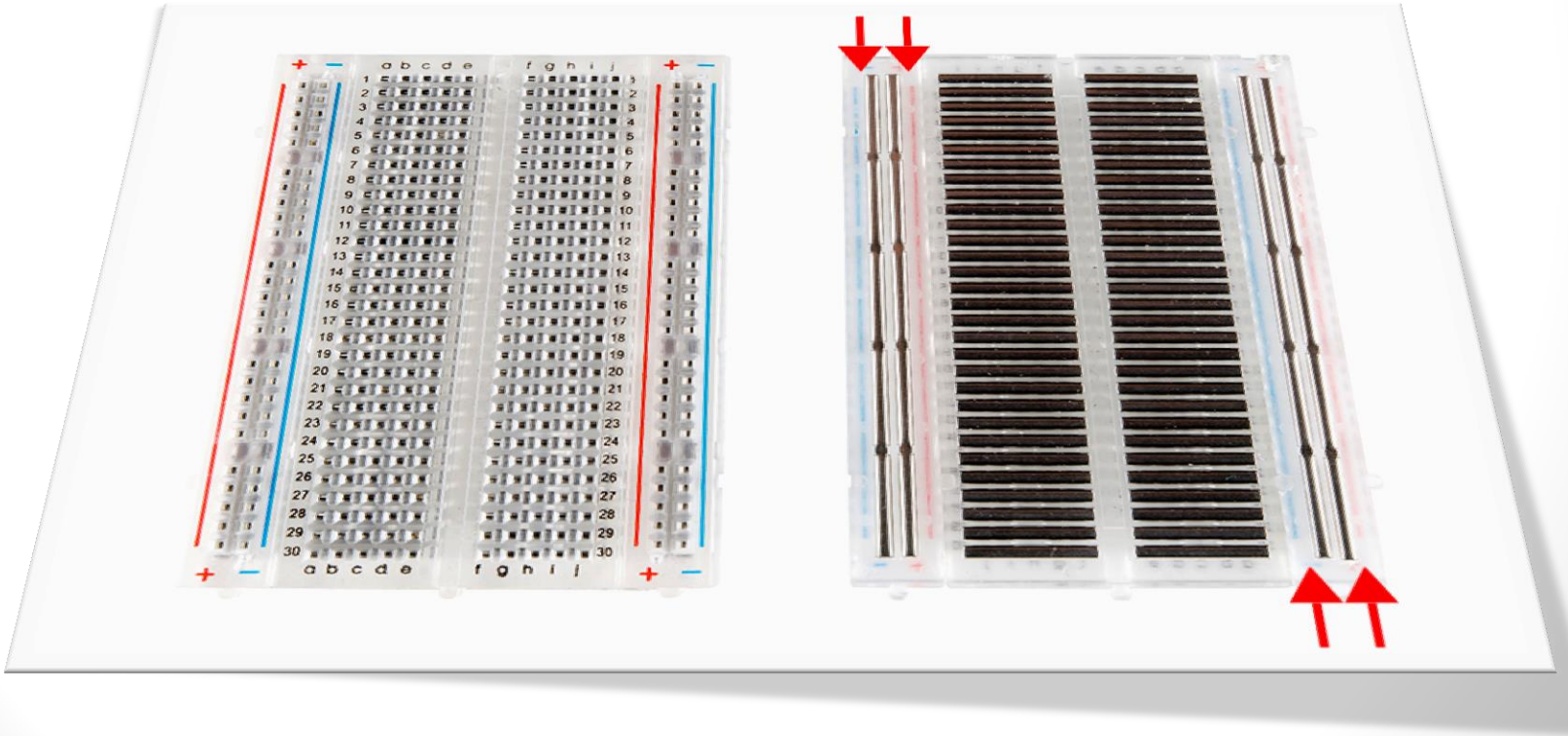
- **Blink** :
  - Open File → Examples -> Blink
  - Select “NodeMCU 1.0” from Tools → Board:
  - Hit Upload.

Start

- Blinking LED.

Electronics and Wiring

- Bread board



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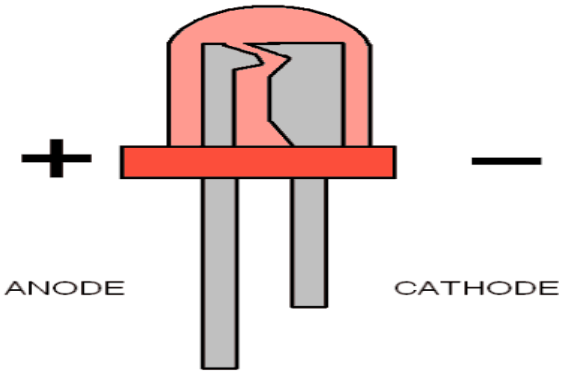
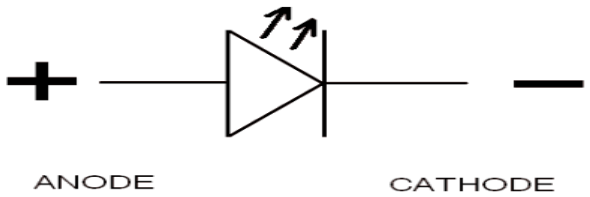
Electronics and Wiring

- Bread board
- LEDs





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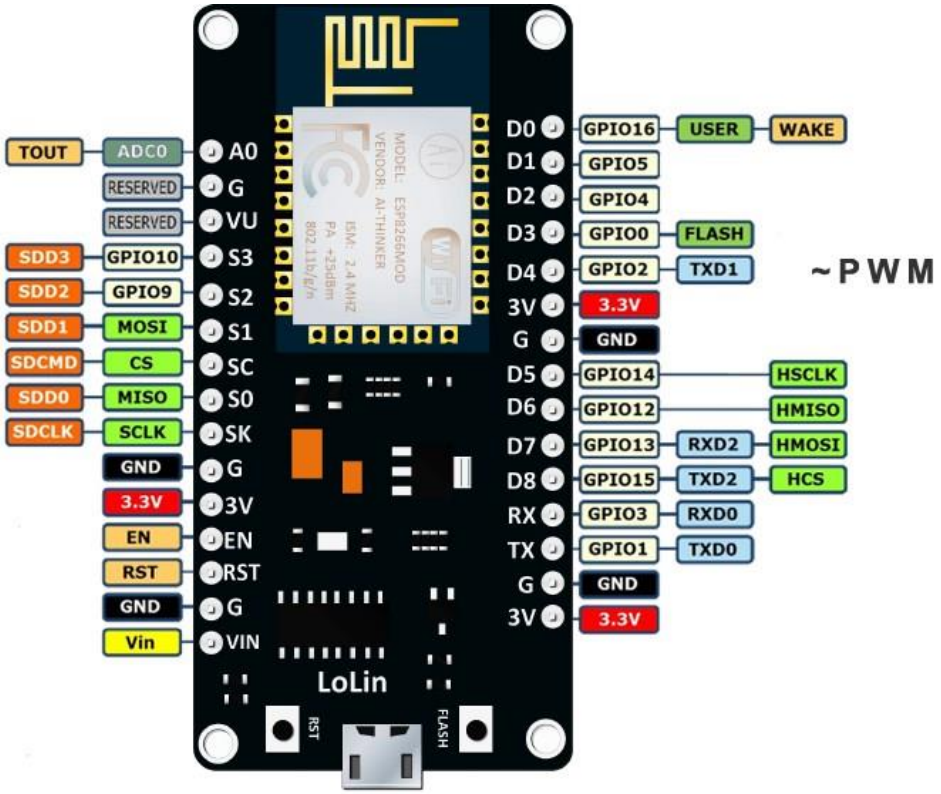
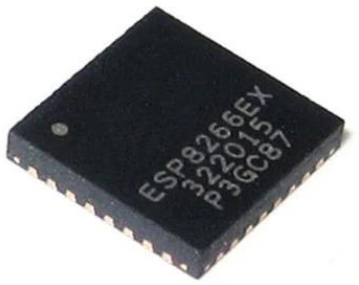
Electronics and Wiring

- Bread board
- LEDs
- ESP8266 NodeMCU pin map

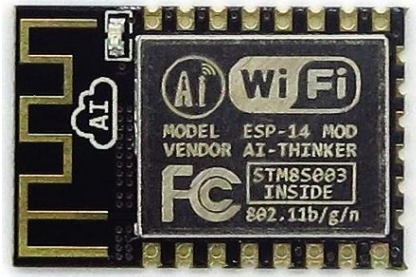


About ESP8266

- **Chip**
- Module
  - Flash memory
  - Antenna
- **ESP-01**
- **NodeMCU**
  - 3.3 V regulator
  - USB to UART

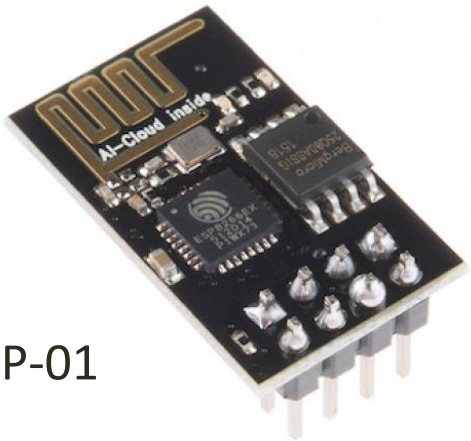


ESP8266ex



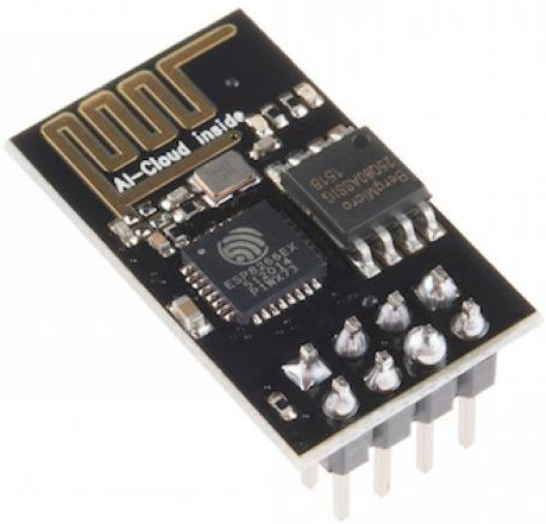
ESP-12

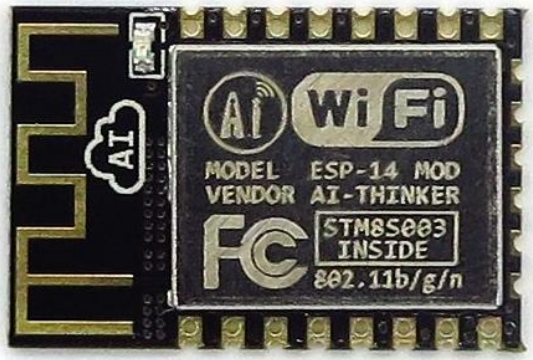
NodeMCU



ESP-01

On a scale


Ai-Cloud inside


Ai
Wi Fi
MODEL ESP-14 MOD
VENDOR AI-THINKER
STM8S003
INSIDE
802.11b/g/n

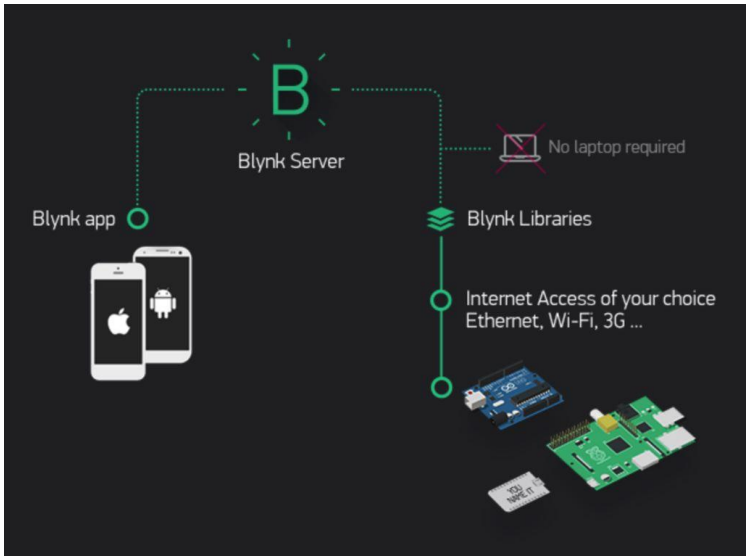

D0 D1 D2 D3 D4 3V3 GND D5 D6 D7 D8 RX TX GND 3V3
Wi Fi
MODEL ESP8266MOD
VENDOR
ISM 2.4GHz
PA +25dBm
802.11b/g/n
FLASH
RST

Comparison :

Specification \ MCU	Arduino UNO	ESP8266 NodeMCU
Connectivity	None	WiFi
Clock Frequency	16 MHz	80/160 MHz
Flash Memory	32 KB	4 MB
RAM	2 KB	64 SRAM / 96 KB DRAM
GPIO (Available)	14 (14)	16 (10)
Analog Inputs	6	1
PWM	6	9
EEPROM	1KB	None
Power Supply	5 V to 12 V	3.3 V to 20 V
Current Consumption (max)	40 mA	70 mA

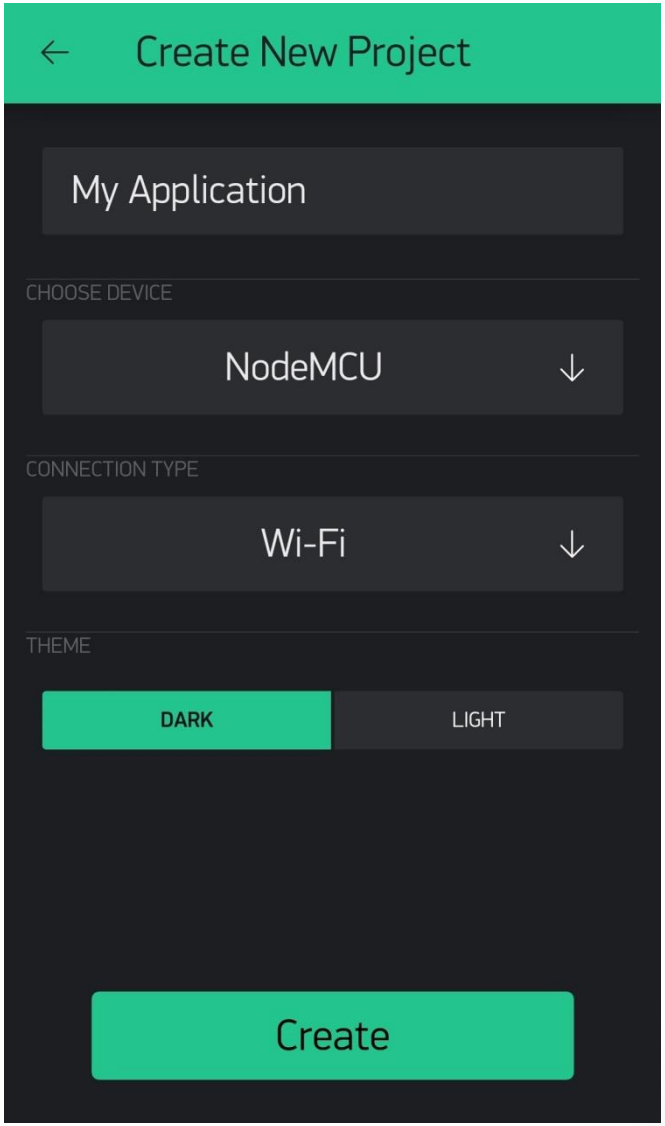
Blynk App

- **Blynk** is an Internet of Things platform with a drag-n-drop mobile application builder that allows to visualize sensor data and control electronics remotely.
- **Platforms**
  - **platform** is a group of technologies that are used as a base upon which other applications, processes or technologies are developed.



Blynk App

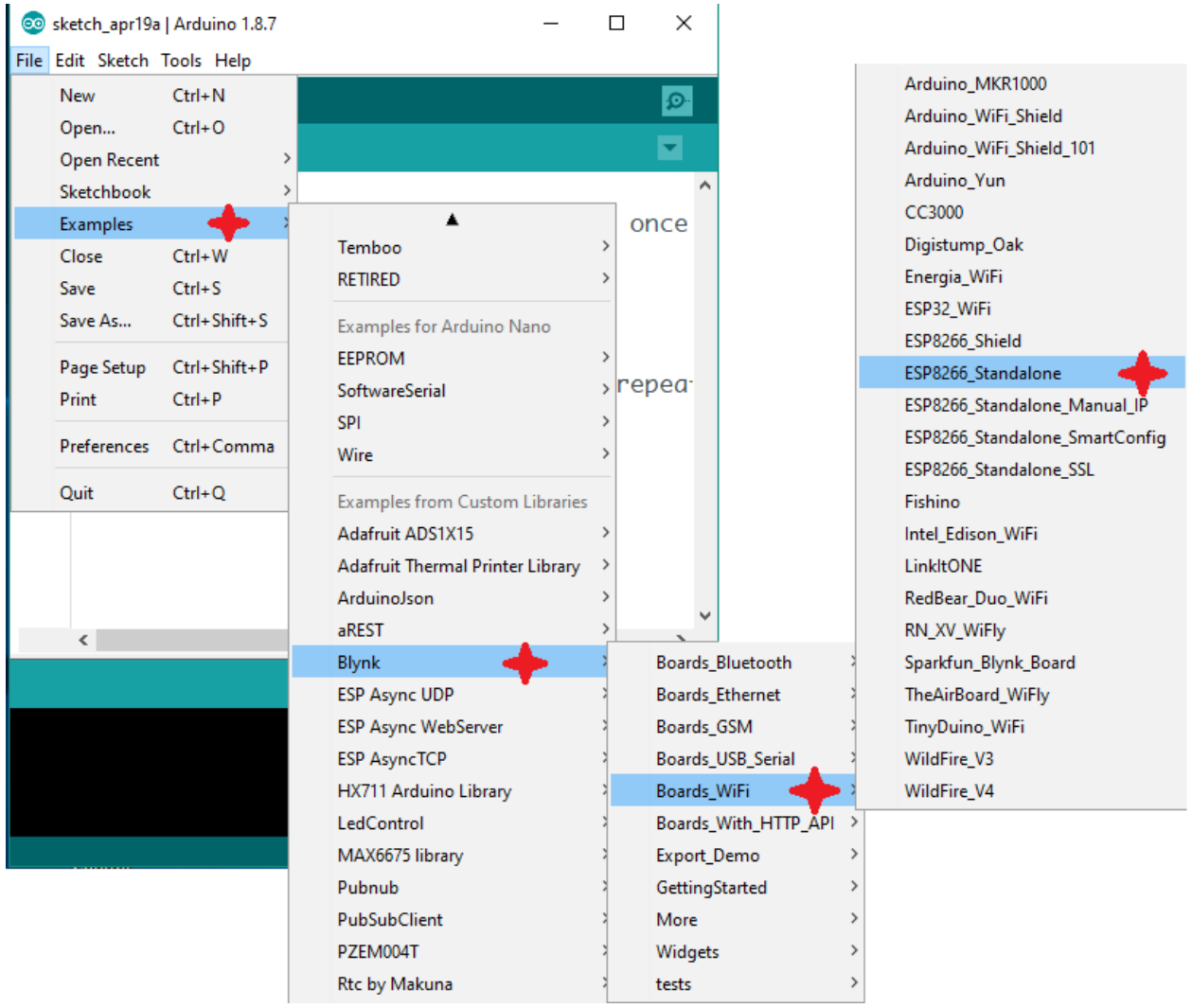
- Install blynk app.
- Instantiate new project



Blynk App

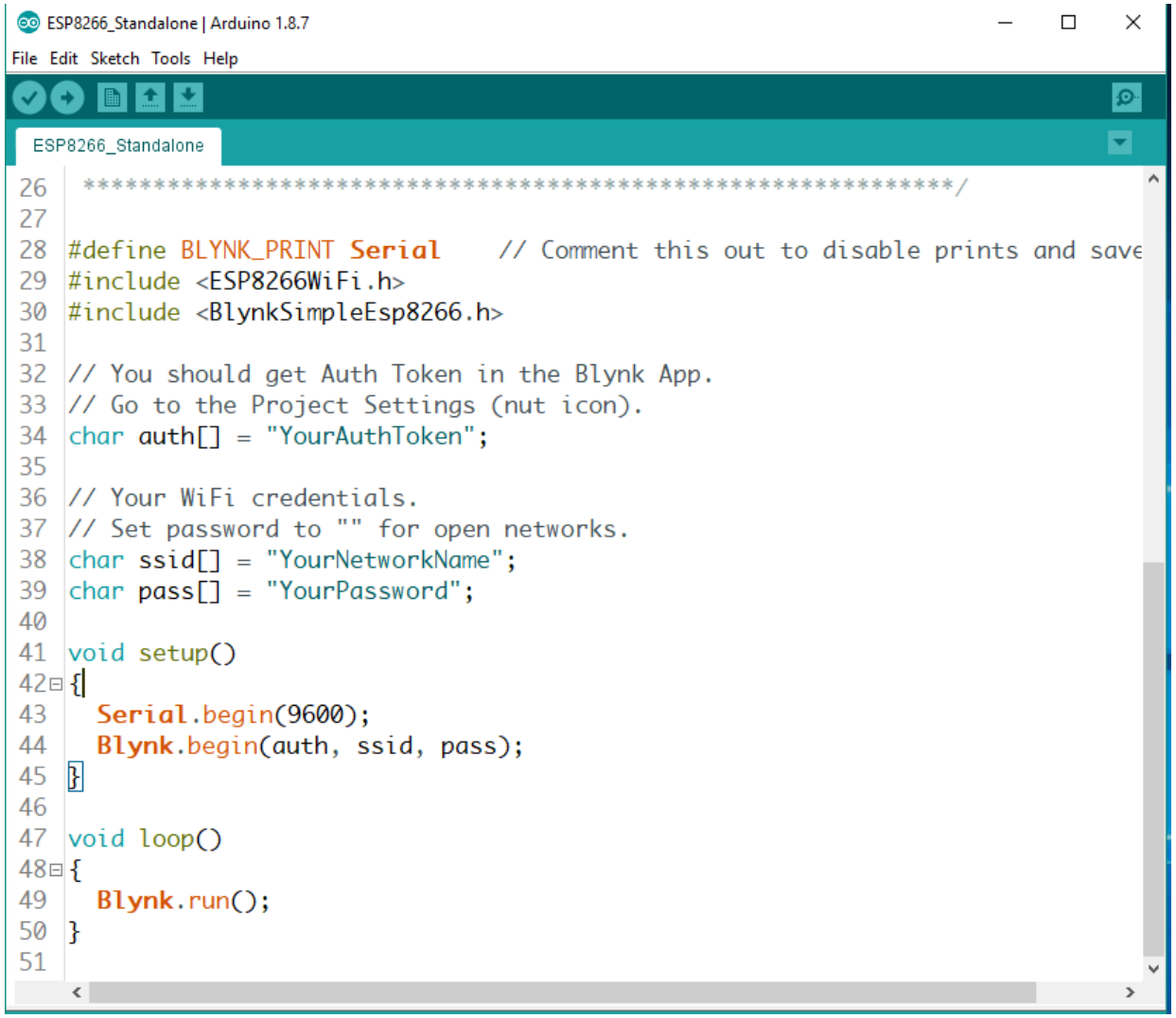
- Install blynk app.
- Instantiate new project
- Copy Auth Token to paste in Arduino example.
- Open Arduino Example

Blynk App



File -> Examples -> Blynk -> Boards_WiFi -> ESP8266_Standalone

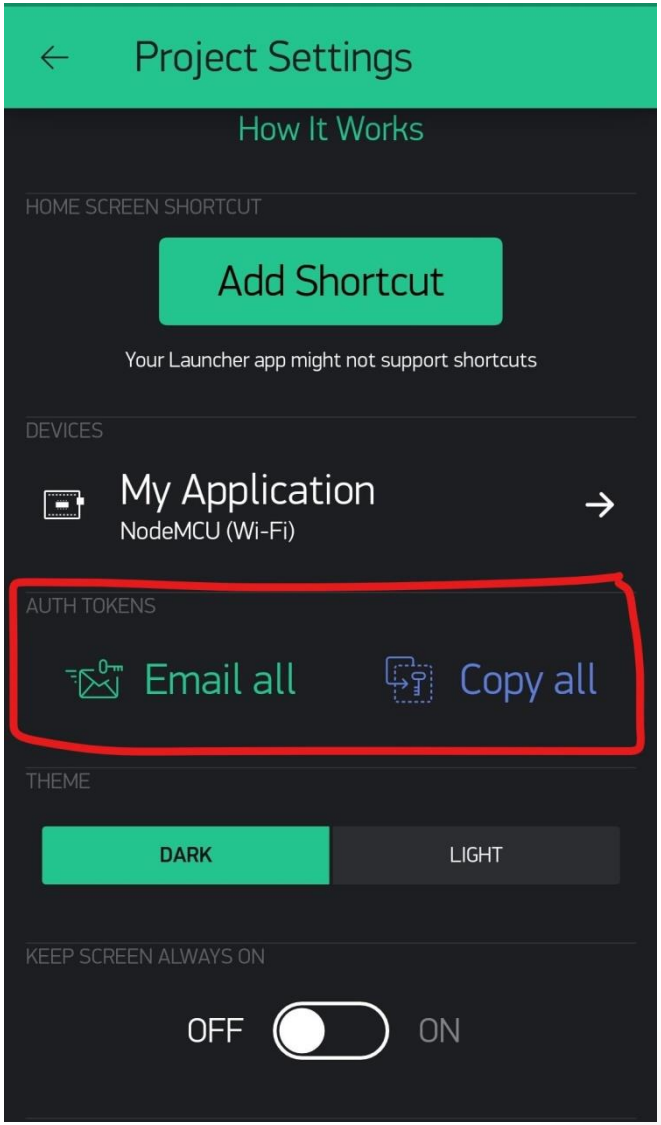
Blynk App



https://github.com/HamzaHajeir/IoT_16h

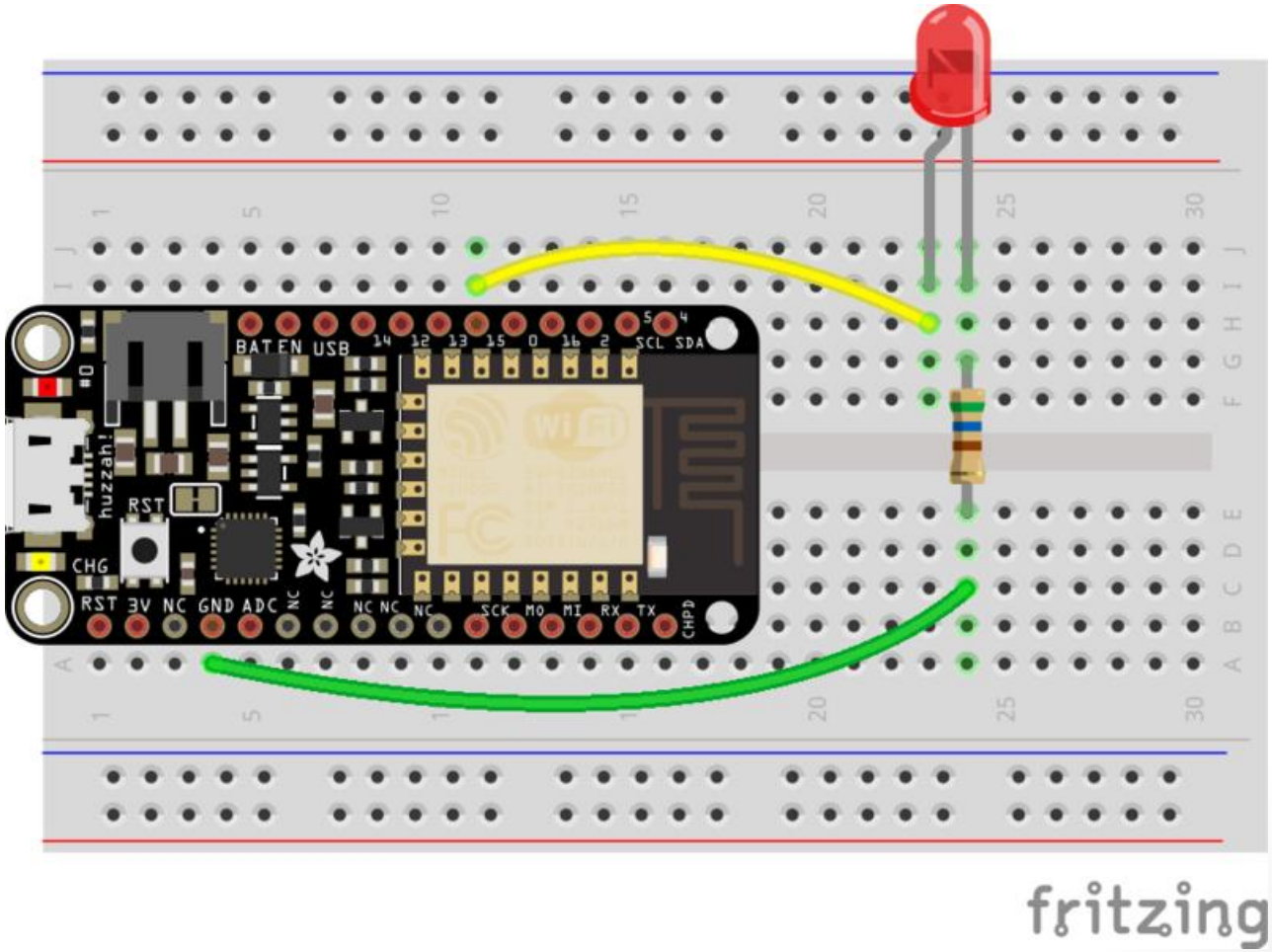
Blynk App

- Install blynk app.
- Instantiate new project
- Copy Auth Token to paste in Arduino example.

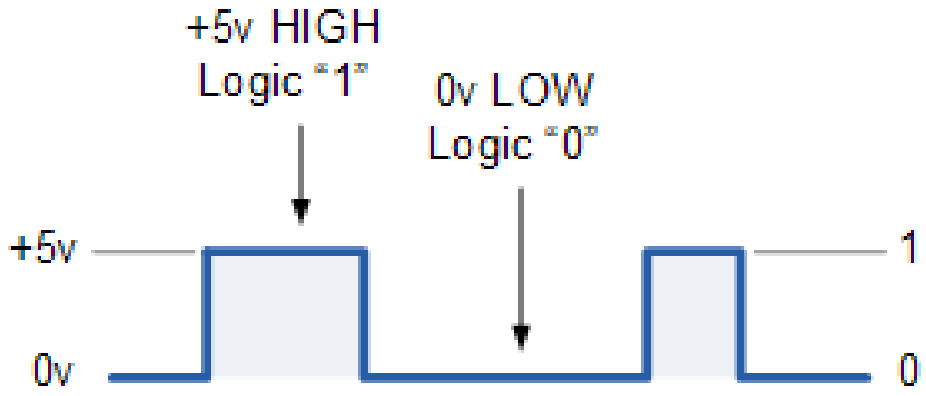


Electronics and Wiring

Circuit wiring



Voltage/Digital relationship



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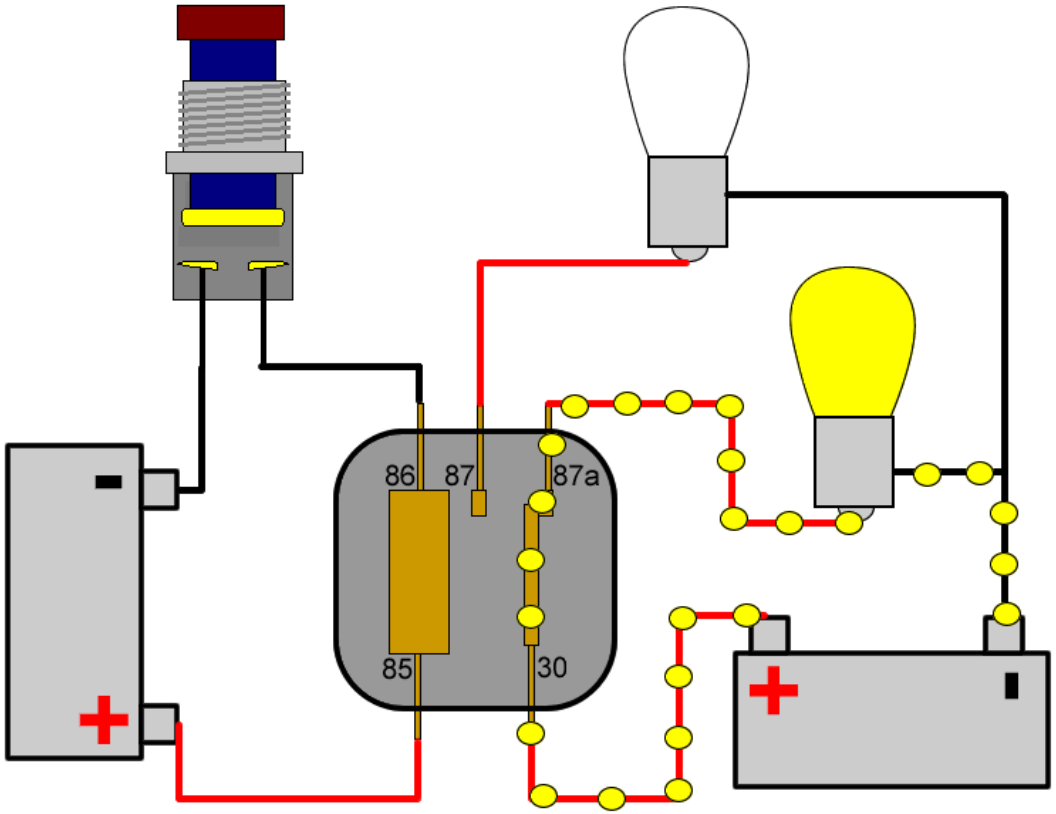
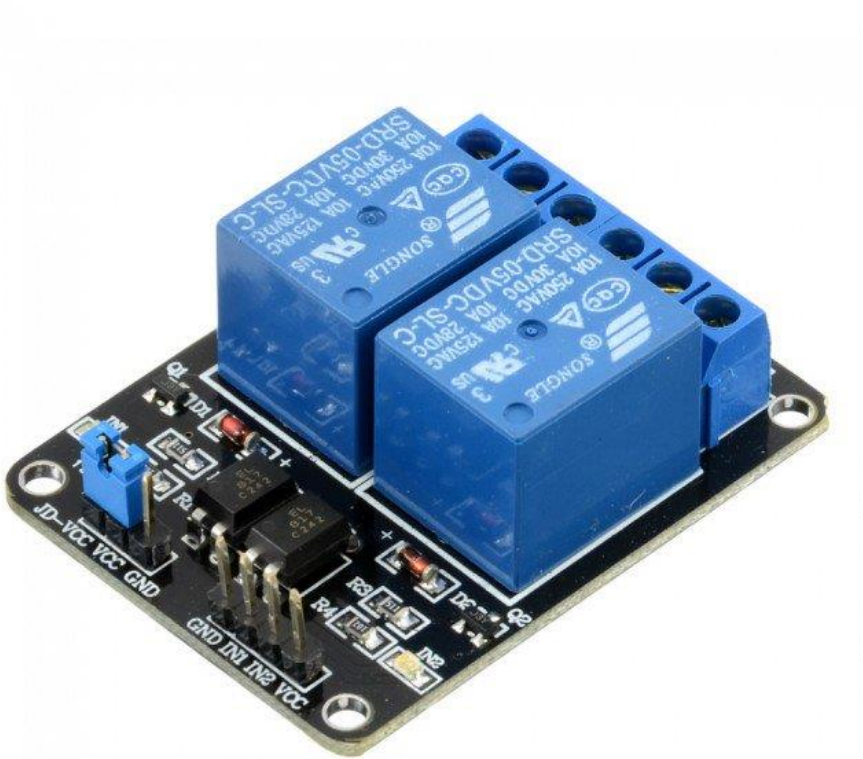
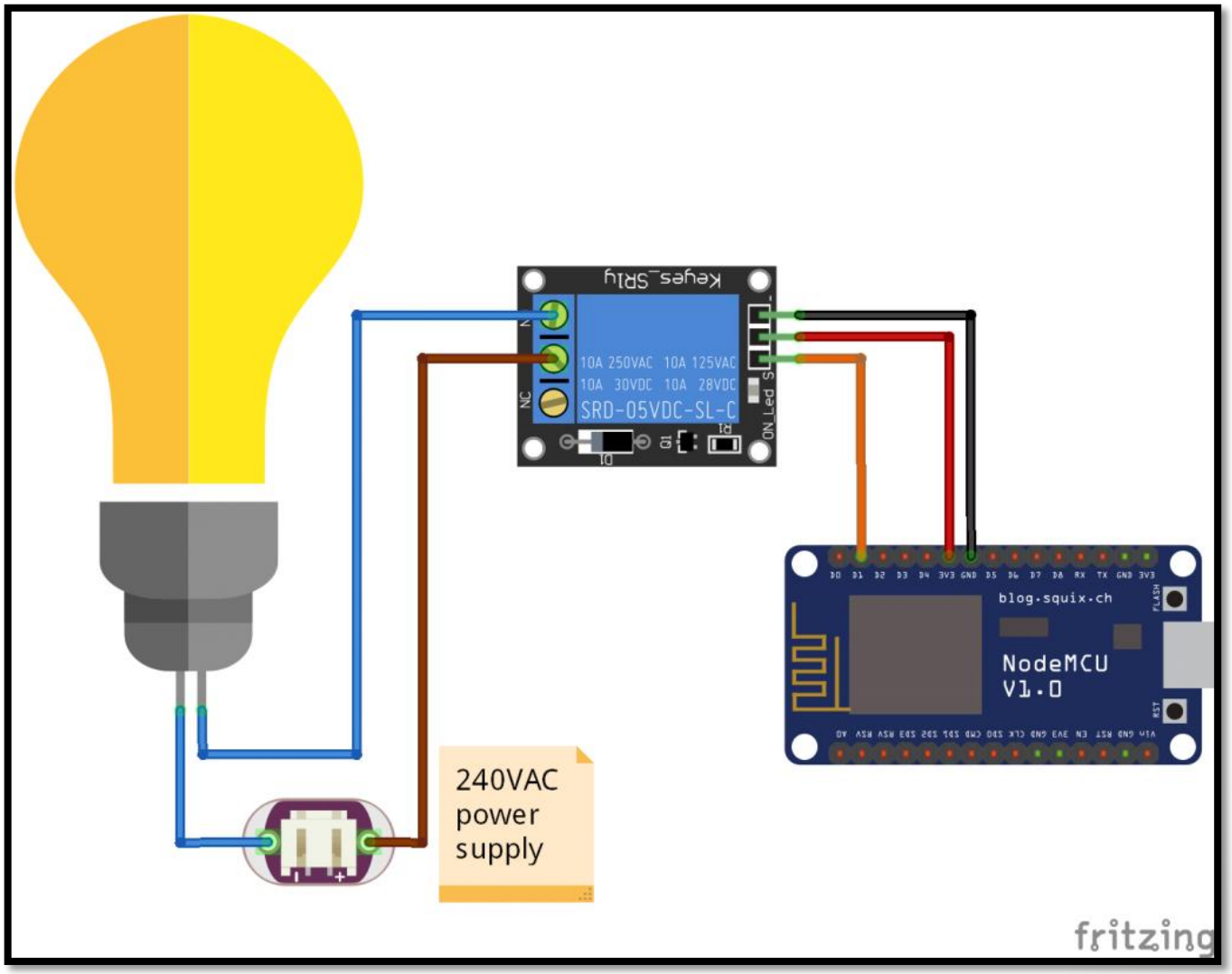
In Real Life :

Relay

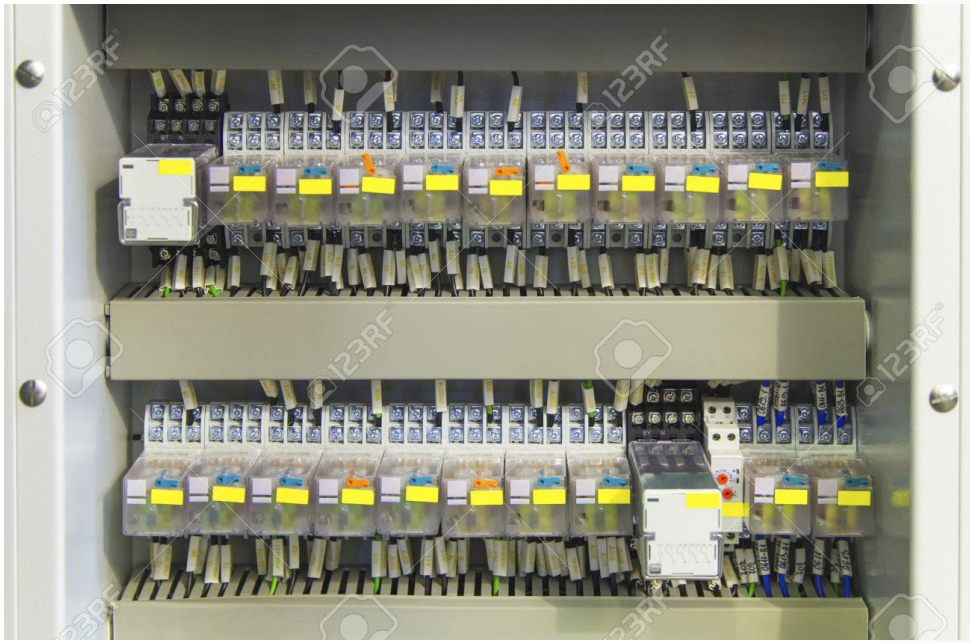


Relay



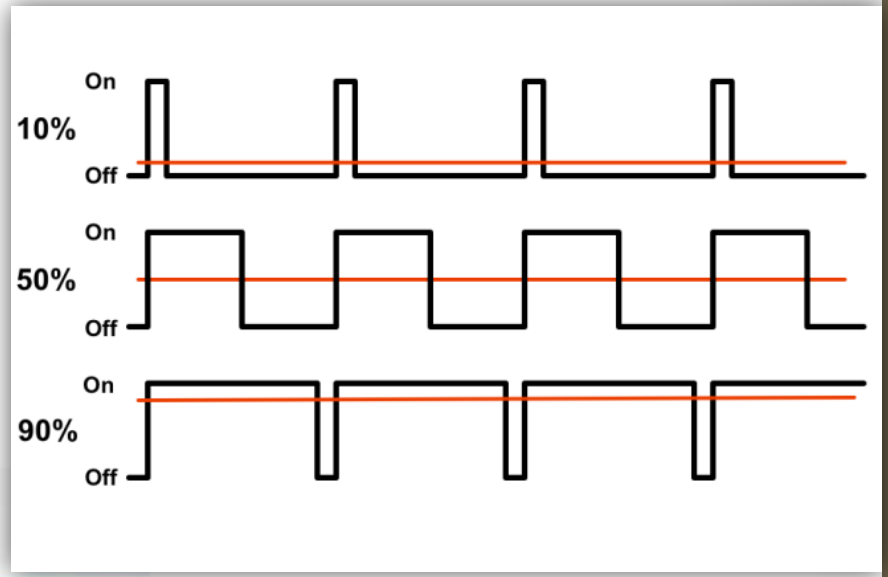

Keyes_SR1y
10A 250VAC 10A 125VAC
10A 30VDC 10A 28VDC
SRD-05VDC-SL-C
NC
ON Led SL
blog.squix.ch
NodeMCU
V1.0
240VAC
power
supply
fritzing

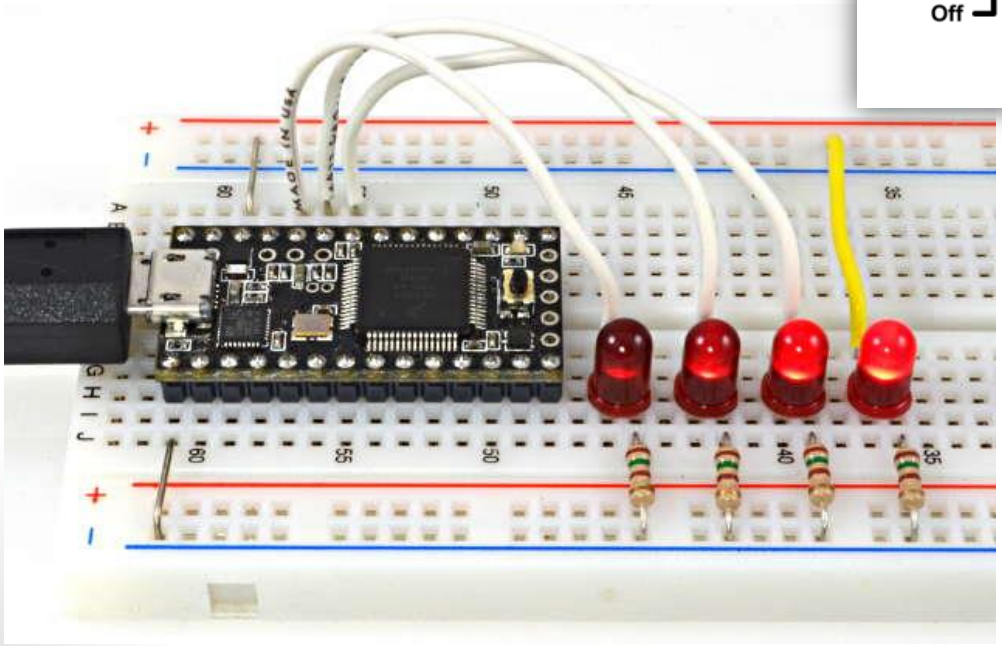
In Real Life



Analog Output - PWM

- Fade in/Show up LED:
  - PWM





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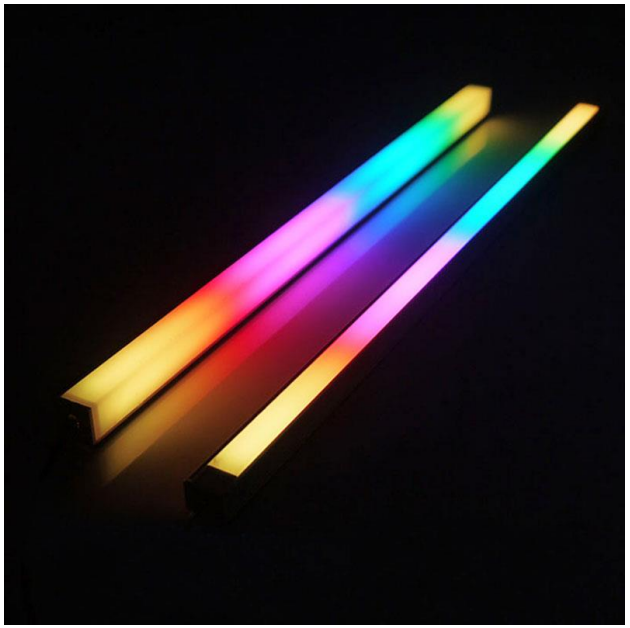
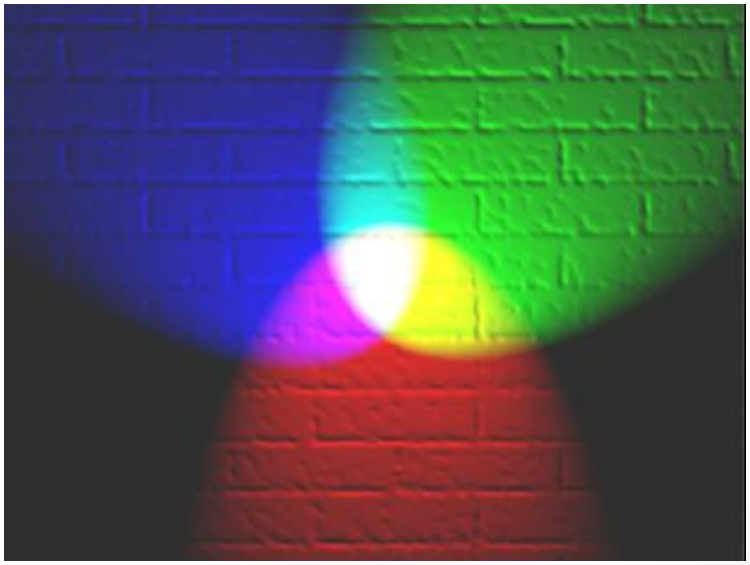
RGB LEDs

- Controlling RGB LEDs





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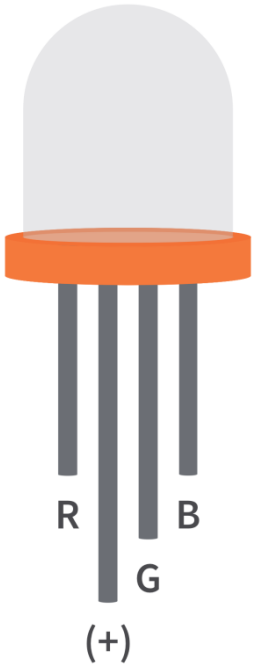
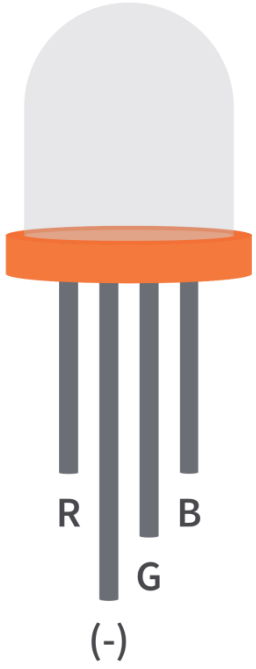
RGB LEDs

- Controlling RGB LEDs



Common Anode



Common Cathode

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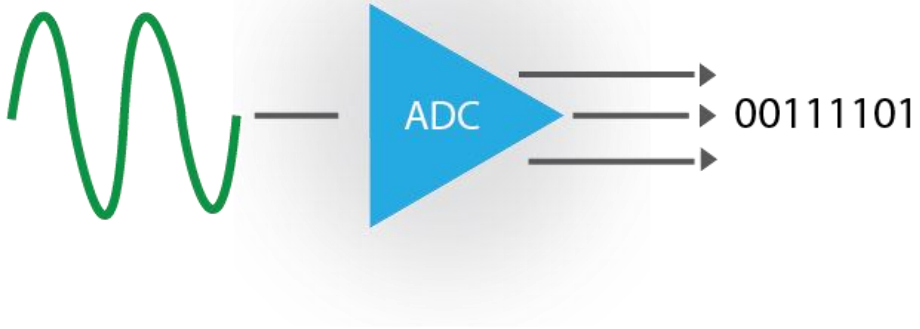
Light Sensor - LDR

- Analog :
  - Sensors :



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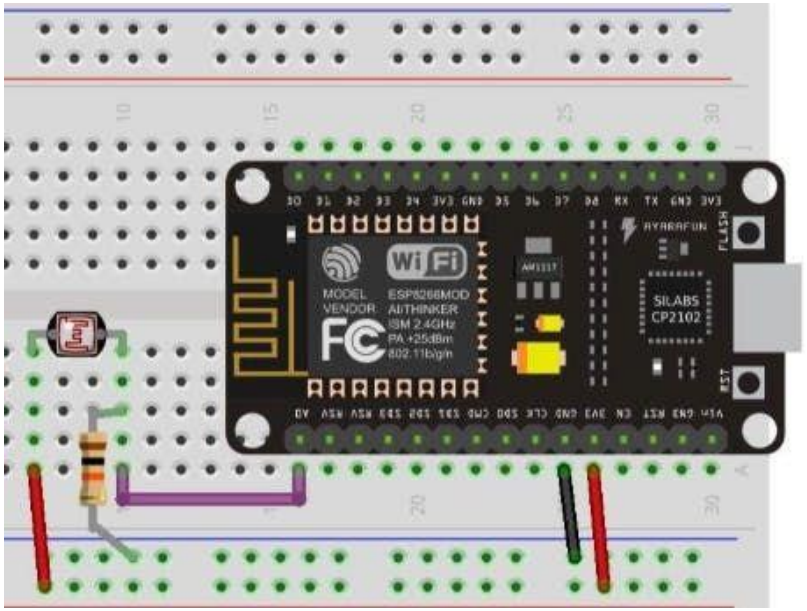
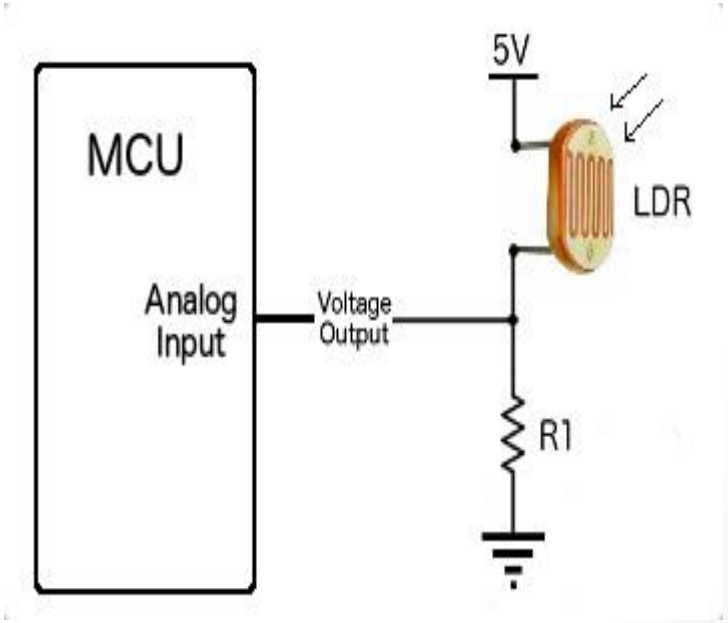
Light Sensor - LDR

- Analog :
  - Sensors :





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Blynk App

Virtual pins : push data.

```
Blynk.virtualWrite(V5, sensorData);  //sending to Blynk
```

Virtual pins : read commands.

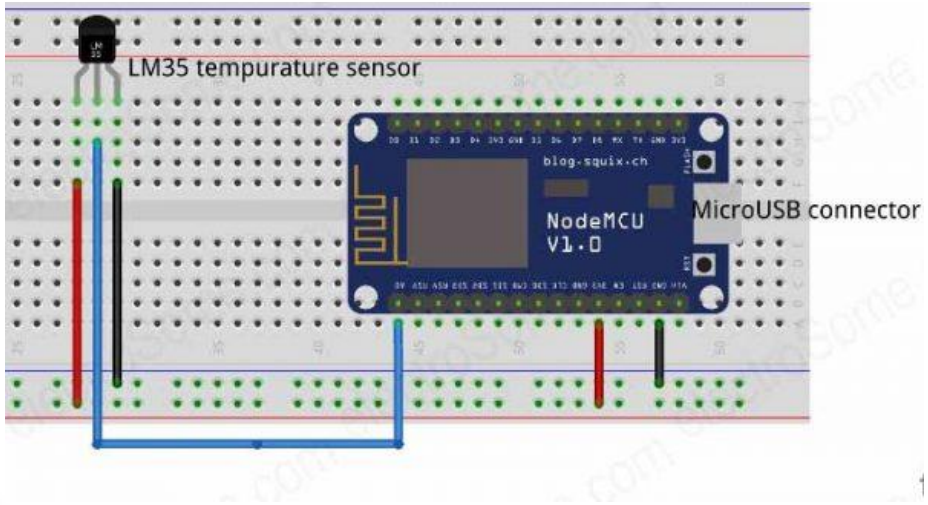
```
BLYNK_WRITE(V1)
{
  int pinValue = param.asInt();
  Serial print("V1 Slider value is: ");
  Serial println(pinValue);
}
```


AUTO
New


AUTOMATIC
STREET
LIGHTS

Temperature sensor – LM35

- Communicate with MCU:
  - Serial communication
  - Read Temperature by LM35.



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In Real Life

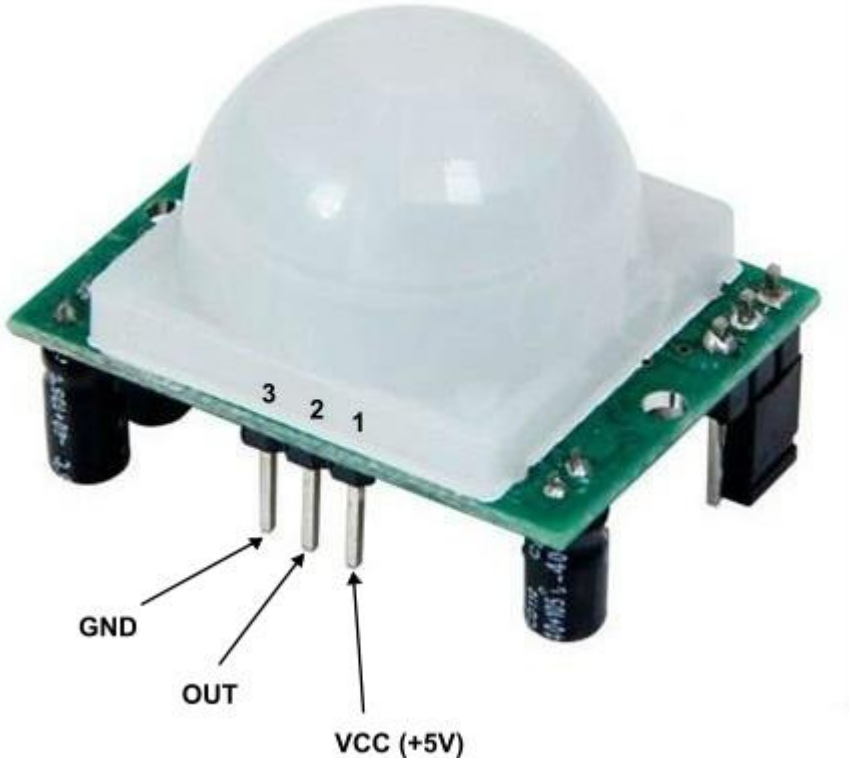

SmartPID
CONTROLLER
Flash
5:00
T1
24.9°C
SP
55.0°C
100%
PID-mode
SET
USB
S/S


SNOOZE/LIGHT
AM
12:04
TEMP
22.0°C
MONTH
1
DATE
1
AM
ALARM
6:00


2018
AC Remote
20°C
+Temp-
AC Remote
Control

Motion sensor – PIR sensor

- Reading Motion sensor



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iOS/ Android
Works With amazon alexa
IFTTT
Works with Google Assistance

Blynk App

- In-App Notification

```
Blynk.notify ("Alert !");
```

Angular motion - Servo Motors

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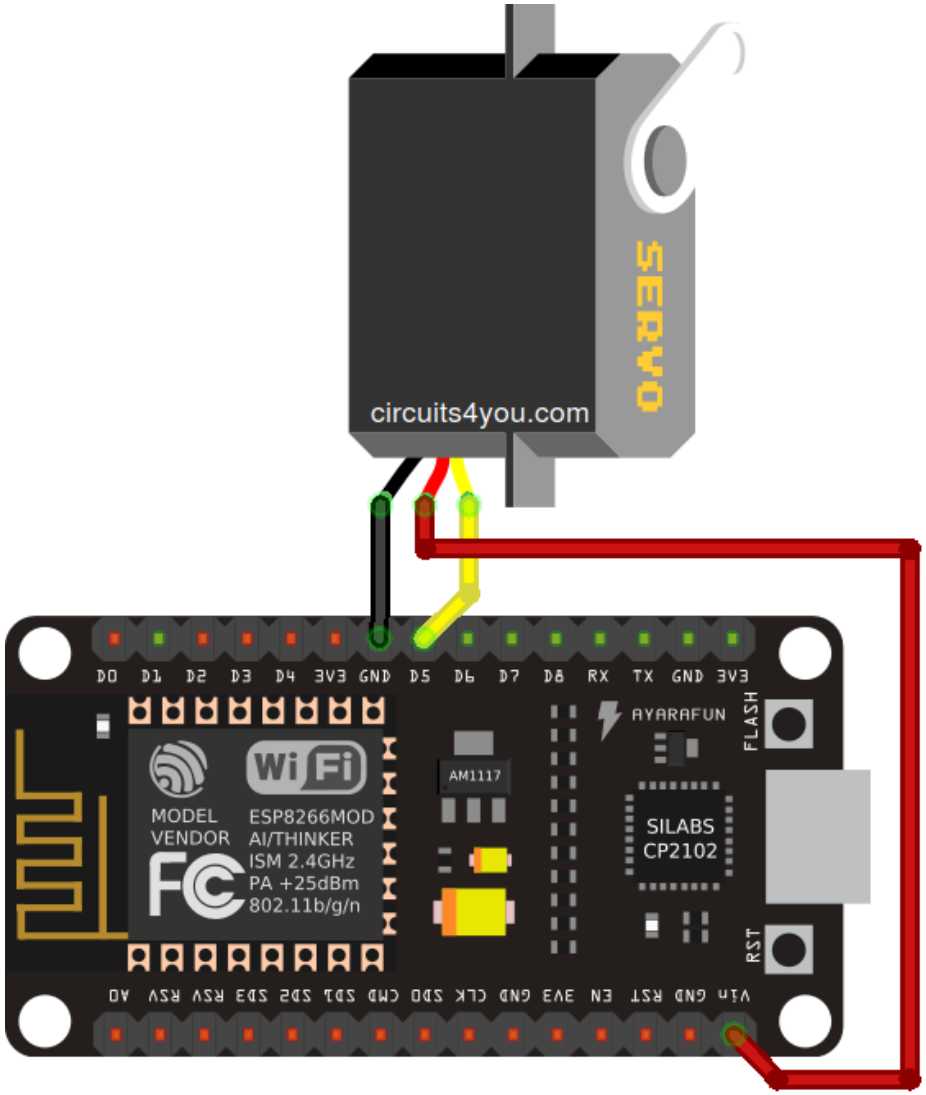
Angular motion - Servo Motors



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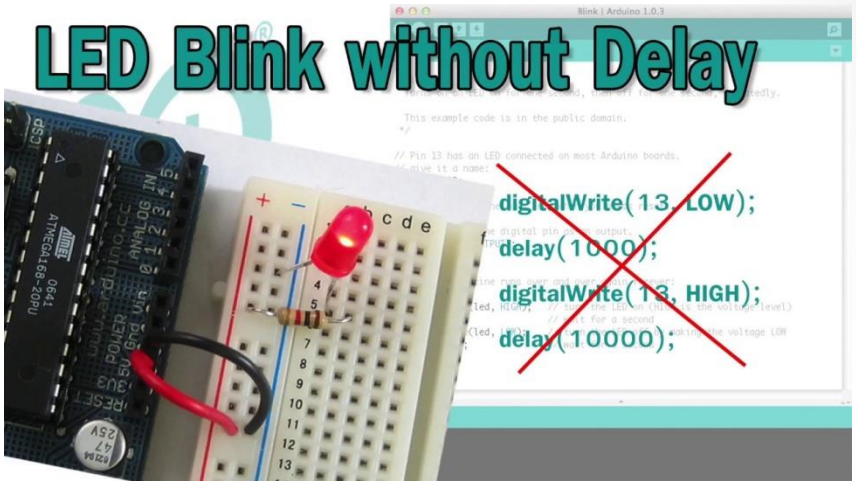
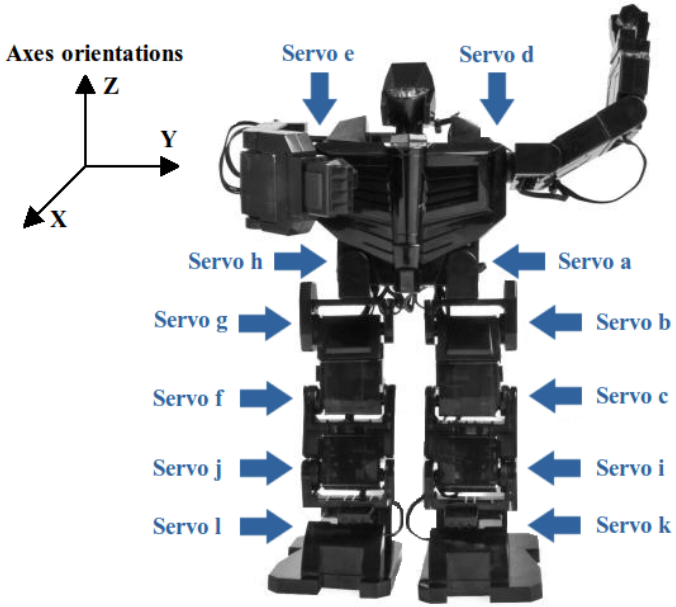
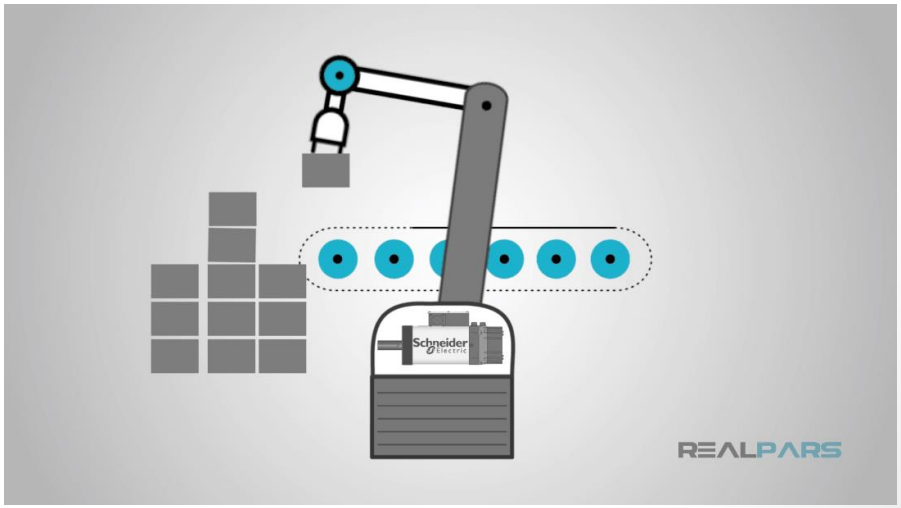
Coding ...



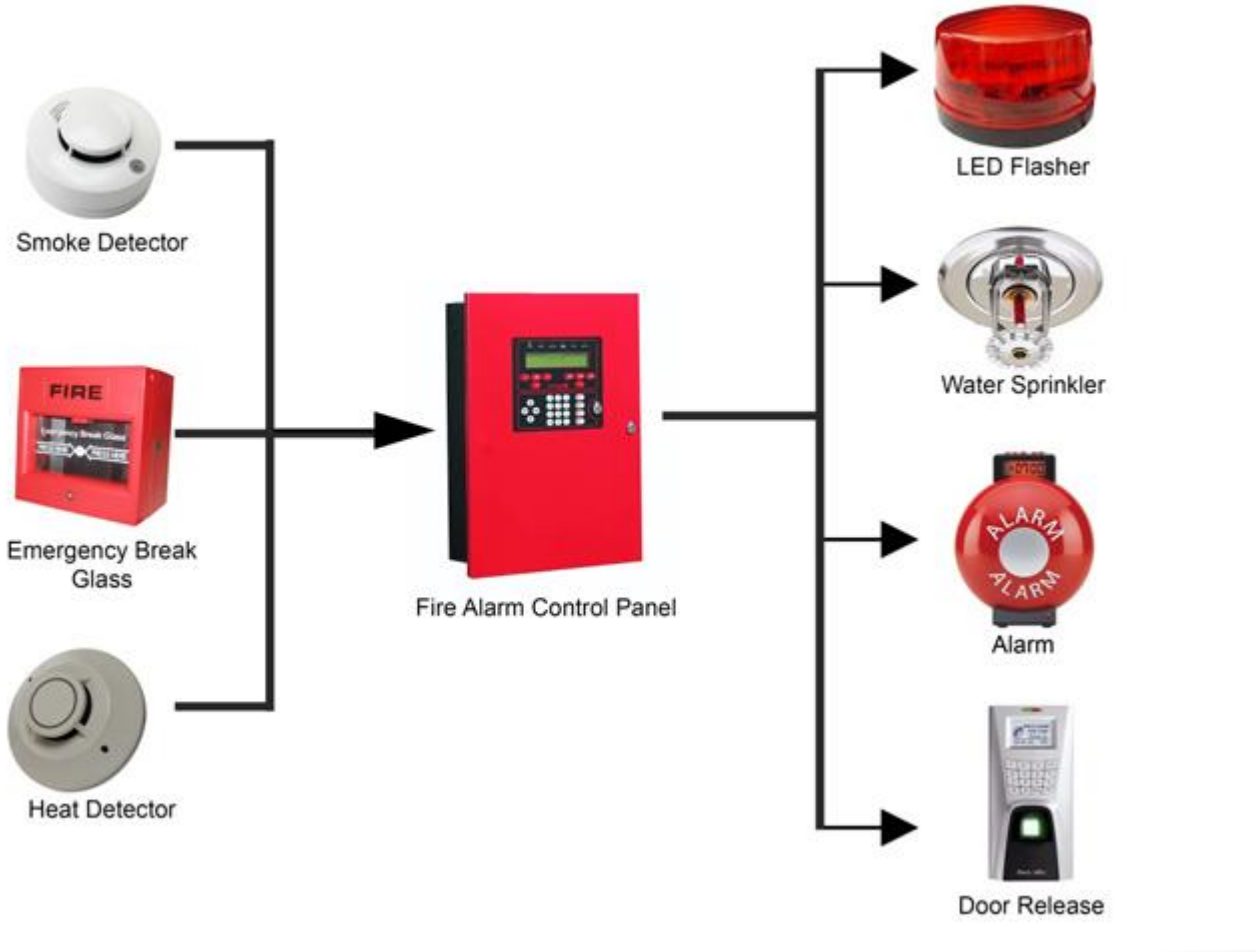

```
uint32_t prevmillis; //As global variable.


if(millis() - prevmillis > 1000){ //At main loop.
      digitalWrite( ledPin , !digitalRead(ledPin) );

      prevmillis = millis();
}
```

السر وراء الاستجابة الفورية : شرح لهذه الطريقة


Axes orientations
Z
Y
X
Servo e
Servo d
Servo h
Servo a
Servo g
Servo b
Servo f
Servo c
Servo j
Servo i
Servo l
Servo k


Schneider
REALPARS

Systems analysis



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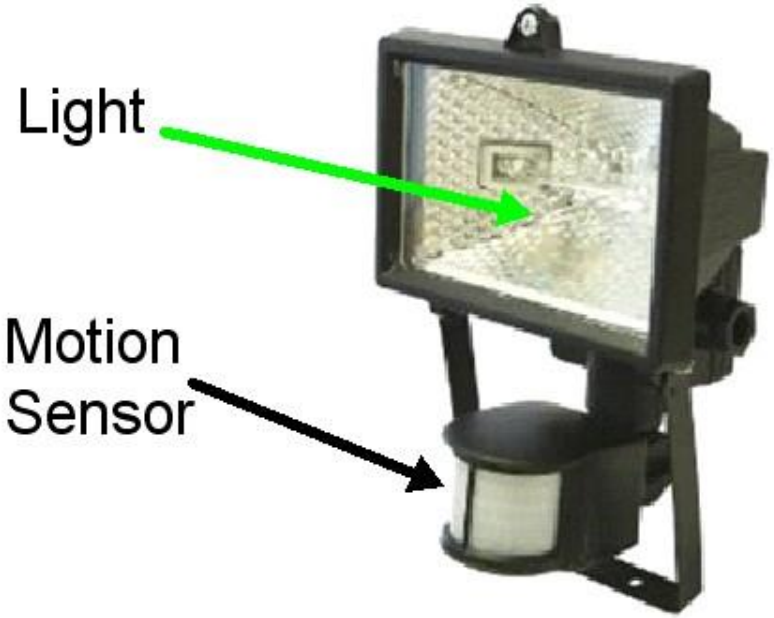
Systems analysis



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Systems analysis

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Systems analysis

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SONOFF

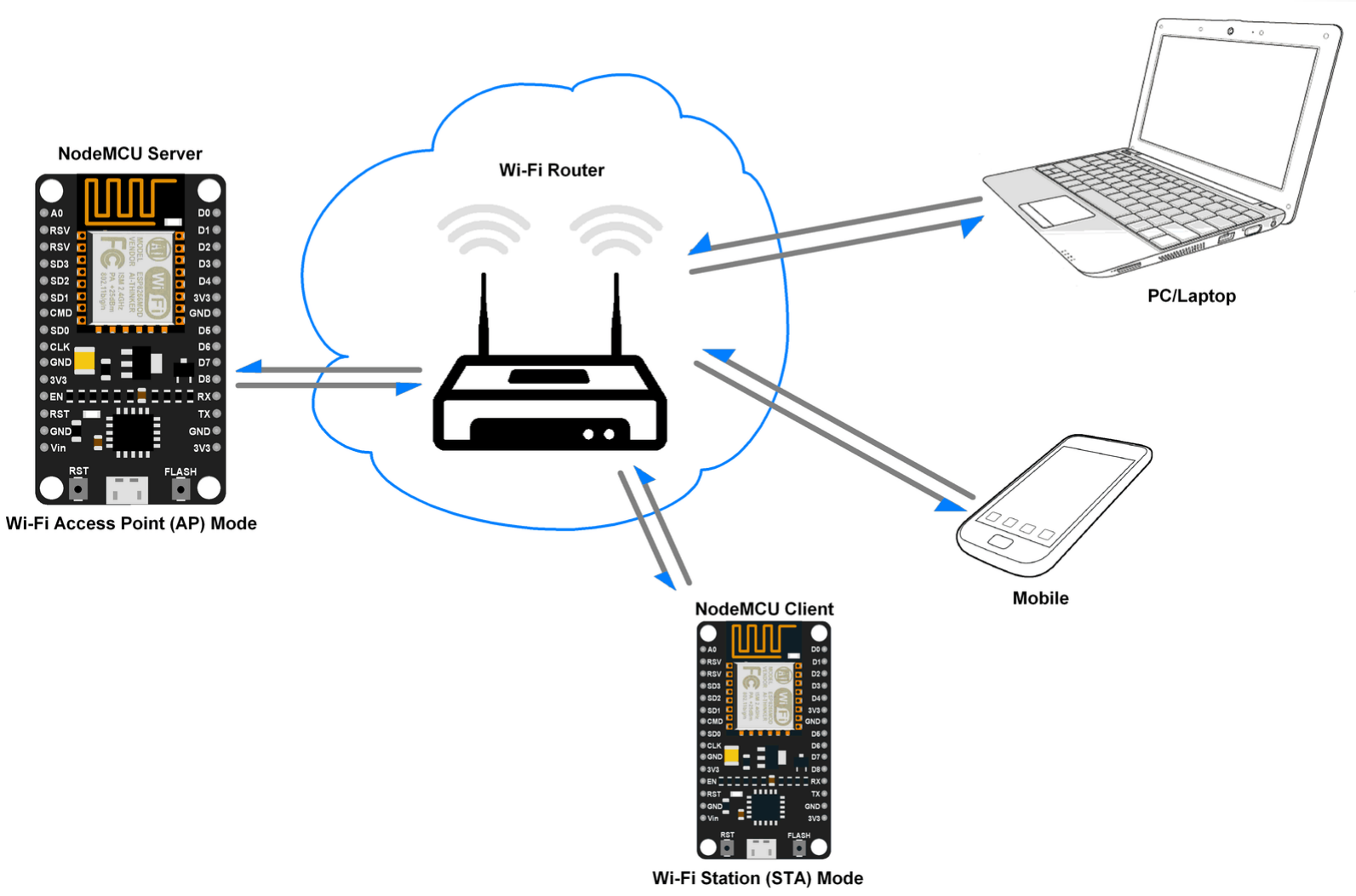
- Easy Configurable AC Switch
- ESP8266 Core

SONOFF

- 4 Channels

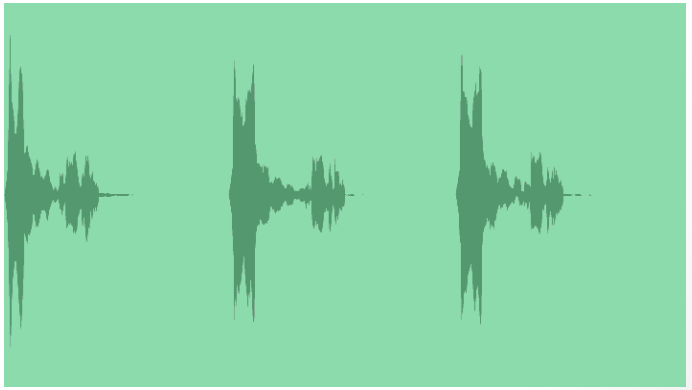
Arduino ESP8266

LAN

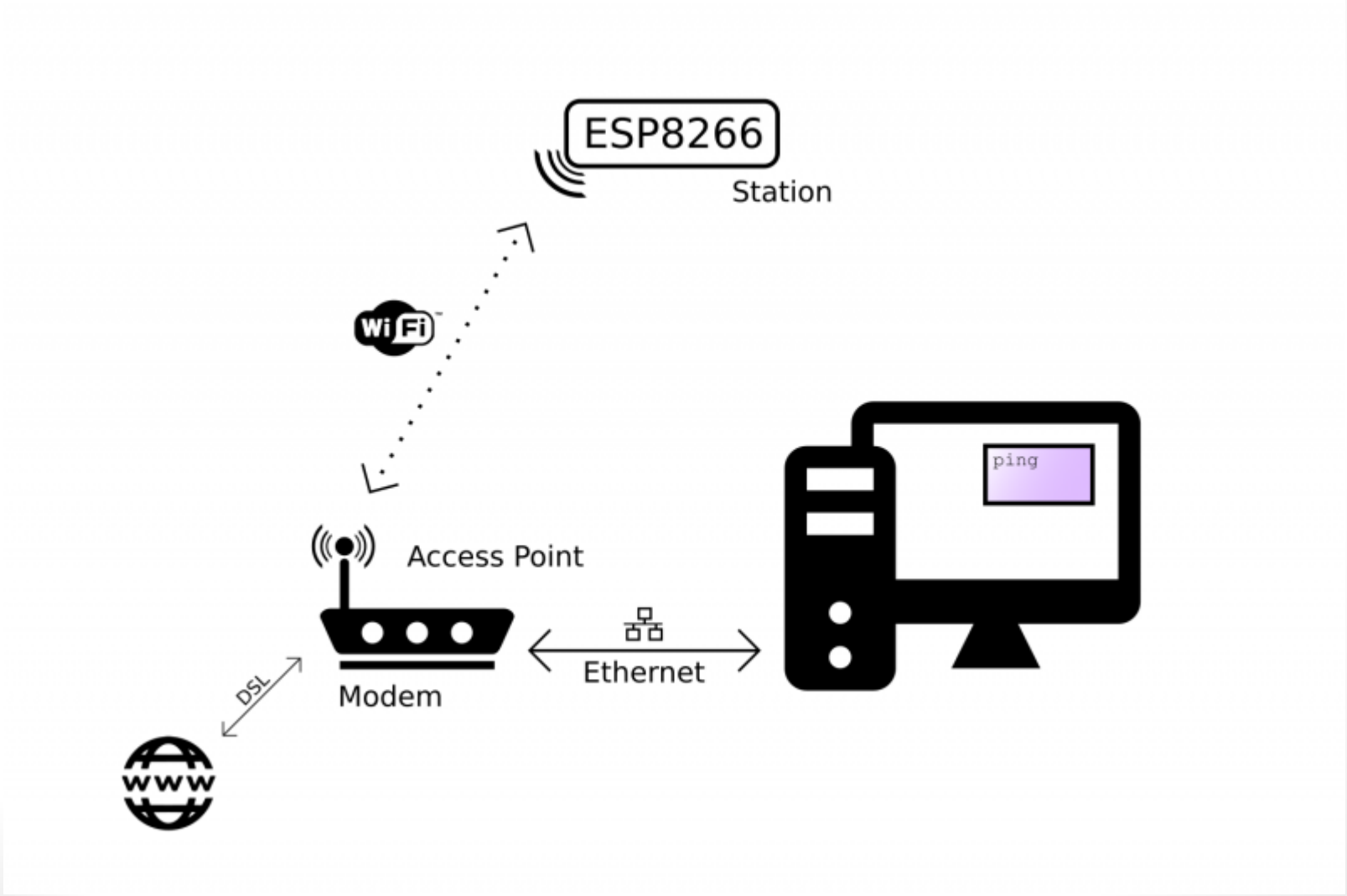

NodeMCU Server
Wi-Fi Router
PC/Laptop
Mobile
NodeMCU Client
Wi-Fi Access Point (AP) Mode
Wi-Fi Station (STA) Mode

Beginning with ESP8266

- **Connect :**
  - ESP8266WIFI.h
  - WiFi.begin(SSID,password)
  - WiFi.waitForConnectResult()
  - Obtain and Print IP Address
  - Ping
    - Ping ESP’s local IP
    - Ping google.com



Beginning with ESP8266



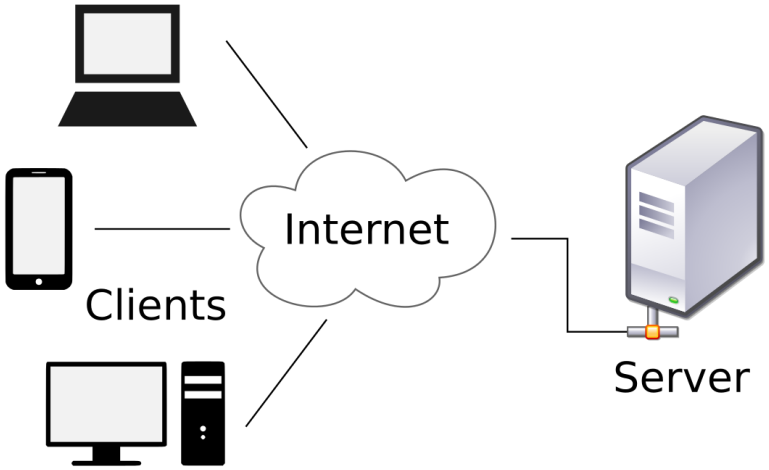
Web Server

- Open Second project “WebServer“
- Modify Credentials
- Go to :
  - http://wha.tev.er.ip/OFF
  - http://wha.tev.er.ip/ON
    - Ex : http://192.168.1.15/ON

Web Server

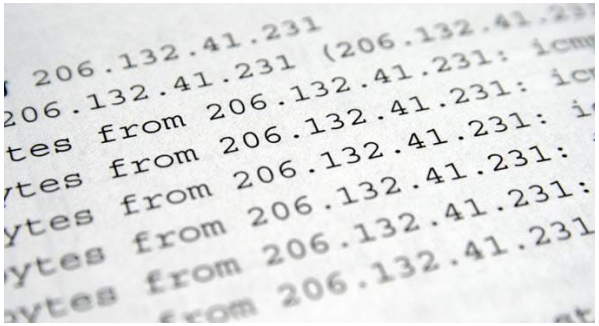
Server : A **server** is a computer that provides data to other computers. It may serve data to systems on a local area network (LAN) or a wide area network (WAN) over the Internet.

Client : A **client** is a piece of computer hardware or software that accesses a service made available by a server. The server is often (but not always) on another computer system, in which case the client accesses the service by way of a network.

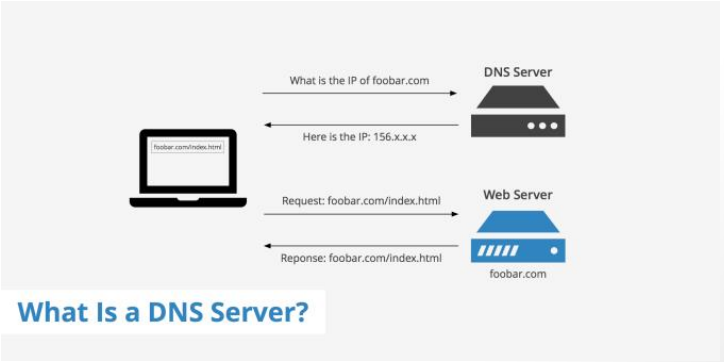


Web Server

IP Address : An Internet Protocol **address** (**IP address**) is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication.

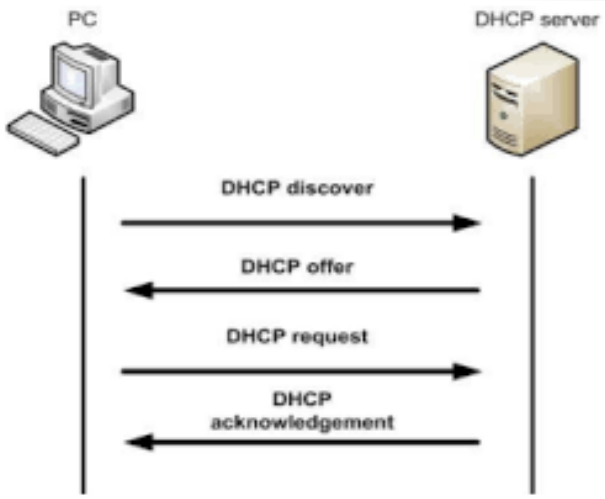


DNS : Domain Name **Servers** (**DNS**) are the Internet's equivalent of a phone book. They maintain a directory of domain names and translate them to Internet Protocol (IP) addresses.

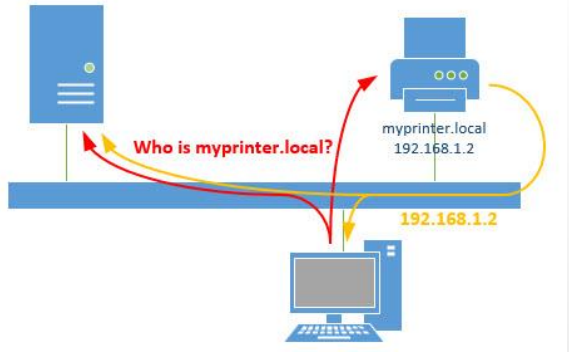


Web Server

DHCP : The **Dynamic Host Configuration Protocol** (**DHCP**) is a network management protocol used on UDP/IP networks whereby a DHCP server dynamically assigns an IP address and other network configuration parameters to each device on a network so they can communicate with other IP networks.



mDNS : **multicast DNS** (**mDNS**) protocol resolves hostnames to IP addresses within small networks that do not include a local name server.



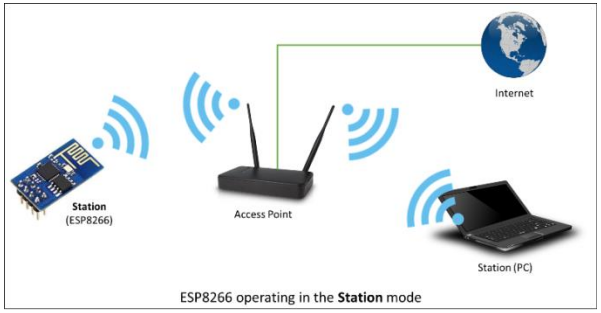
Web Server

LAN : A **local area network** (**LAN**) is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

Station :
In IEEE 802.11 (Wi-Fi) terminology, a **station** (abbreviated as **STA**) is a device that has the capability to use the 802.11 protocol. For example, a station may be a laptop, a desktop PC, PDA, access point or Wi-Fi phone. An STA may be fixed, mobile or portable.

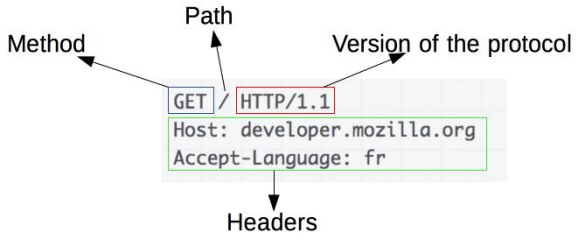
Web Server

Access Point : **access point** (**AP**), is a networking hardware device that allows other Wi-Fi devices to connect to a wired network. An AP is differentiated from a hotspot, which is the physical location where Wi-Fi access to a WLAN is available.



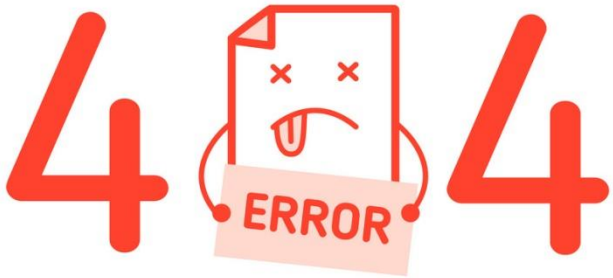
ESP8266 operating in the **Station** mode

HTTP : **Hypertext Transfer Protocol** (**HTTP**) is an application protocol for distributed, collaborative, hypermedia information systems.



Connecting over LAN

- Create a Web server
  - **simple server's code "Hello World":**
    - **HTTP responses**



HTTP Status Codes

Level 200 (Success)	Level 400	Level 500
200 : OK	400 : Bad Request	500 : Internal Server Error
201 : Created	401 : Unauthorized	503 : Service Unavailable
203 : Non-Authoritative Information	403 : Forbidden	501 : Not Implemented
204 : No Content	404 : Not Found	504 : Gateway Timeout
	409 : Conflict	599 : Network timeout
		502 : Bad Gateway

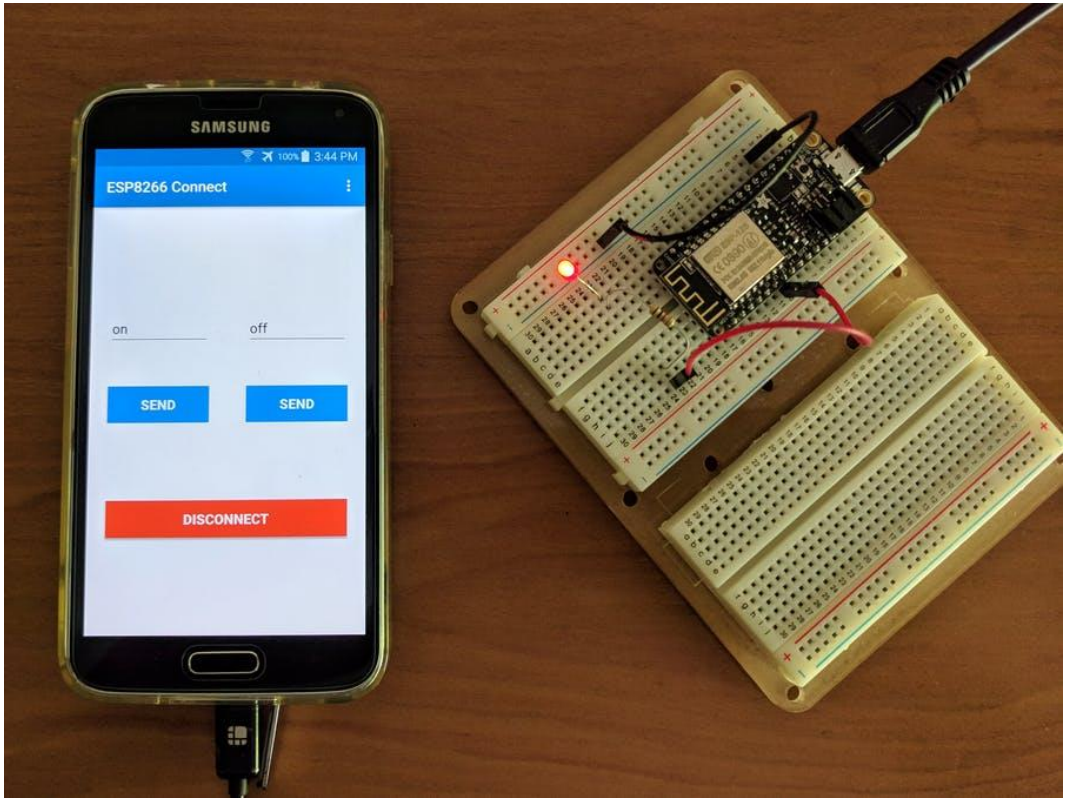
Connecting over LAN

- Create a Web server
  - **simple server's code "Hello World":**
    - **HTTP responses**
    - **HTML code**

```
1  <!DOCTYPE HTML>
2  <html>
3      <head>
4      </head>
5      <body>
6          <h1 style="color:#ff0000">
7          "Hello World!"
8          </h1>
9      </body>
10 </html>
11
12
13
```

Connecting over LAN

- Create a Web server
  - **Android Appilication**
    - **Google search : App inventor**



As Access Point

- Open Third Project “AccessPoint”
- Upload and Monitor to ESP8266
- Connect to its network.
- Go to :
  - http://wha.tev.er.ip/OFF
  - http://wha.tev.er.ip/ON
    - Ex : http://192.168.4.1/ON

Coding …

- Functions
  - Bundles a set of commands in one packet.

- Take money
- Open door
- Close door
- Go 100m forward
- Go inside shop
- Buy 1 Milk
- Come back home

- Get Milk :

Take money
Open door
Close door
Go 100m forward
Go inside shop
Buy 1 Milk
Come back home

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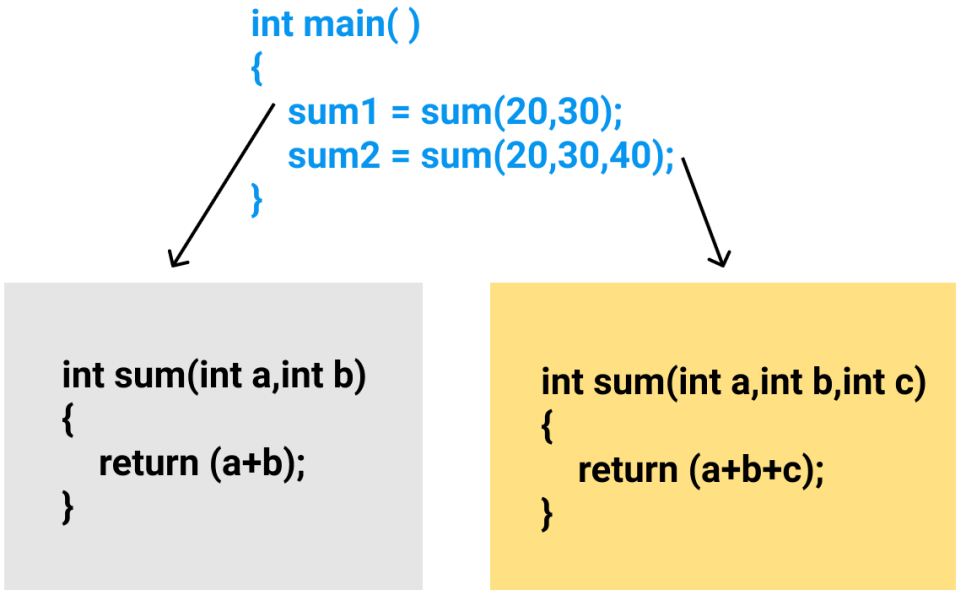
Coding …

- Functions
  - Bundles a set of commands in one packet.



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Programming concepts

- **O**bject **O**riented **P**rogramming **OOP**

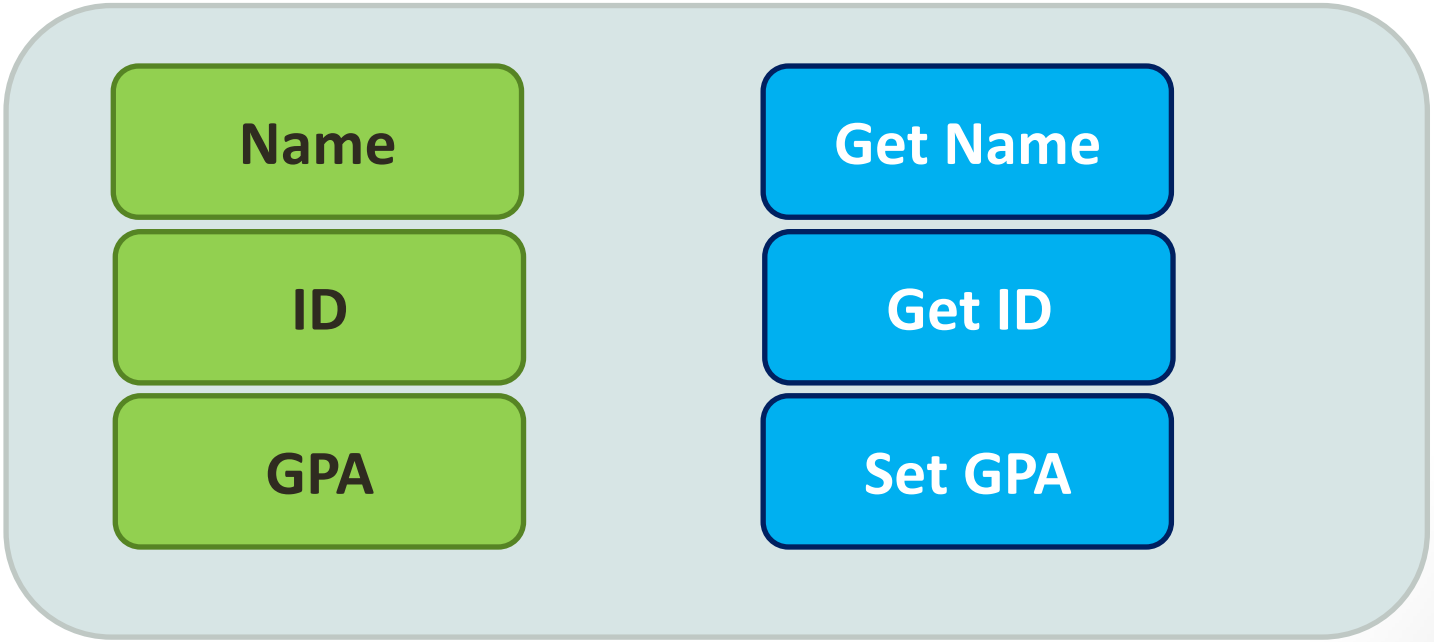
- What's the role of ' **.** ' in :
  - `Serial.print()`
  - `Blynk.run()` **??**

- What's the purpose of OOP ?
- Basic need :

ما هي البرمجة كائنية التوجه ؟ فيديو

OOP

- **Student Class :**

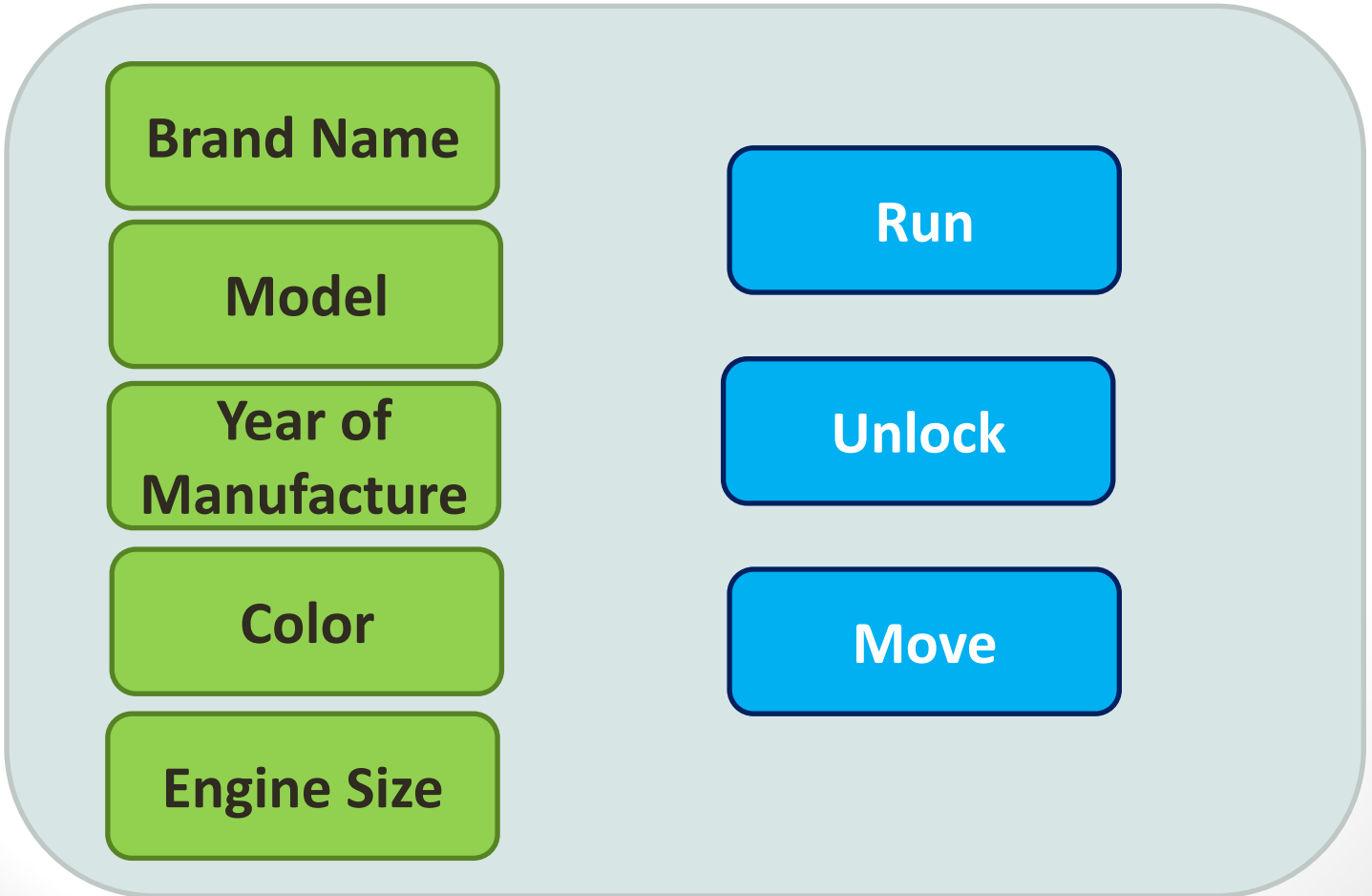


OOP

- **Circle Class :**

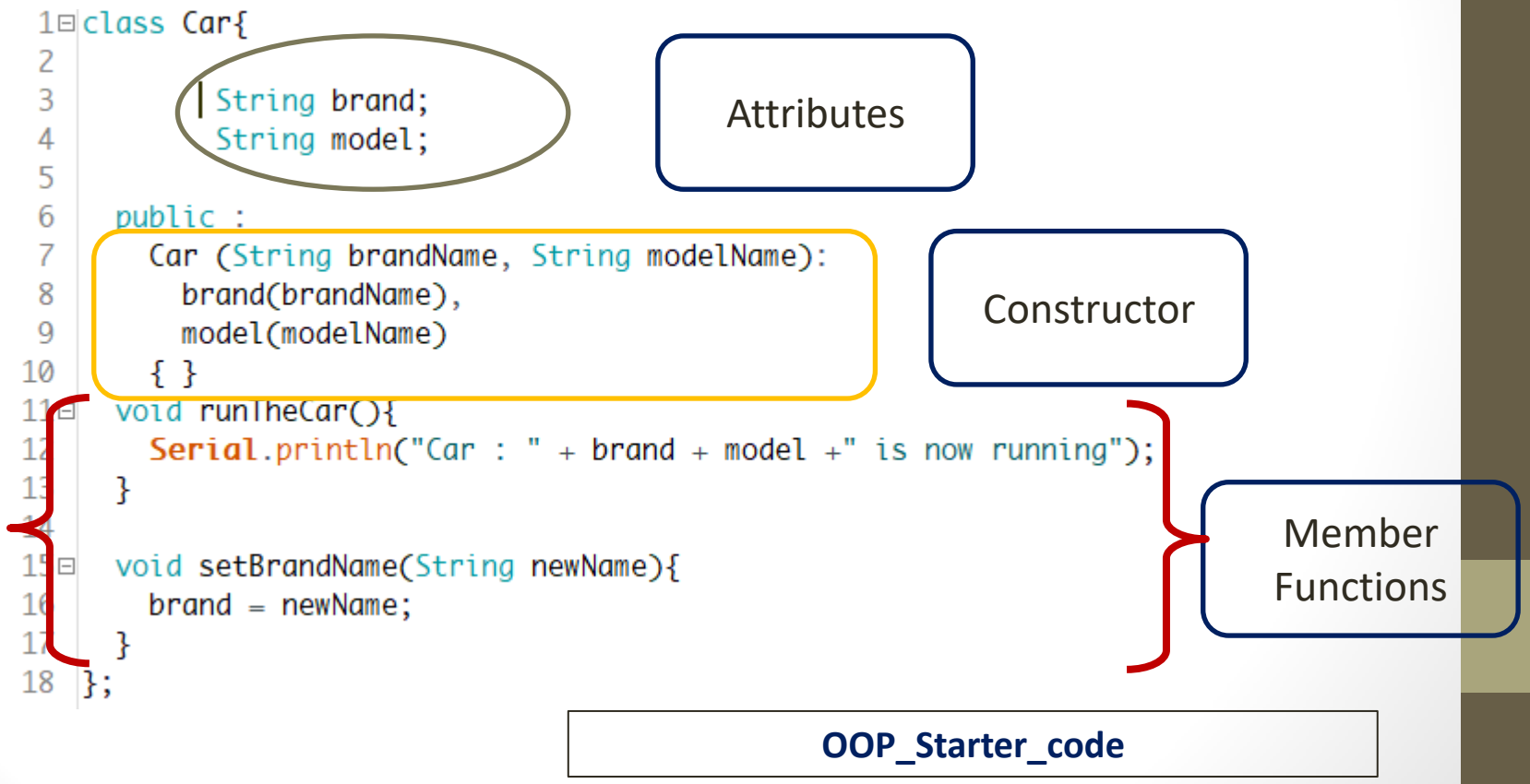
OOP

- **Car Class :**



Class Example

- **Car Class Declaration:**



OOP_Starter_code

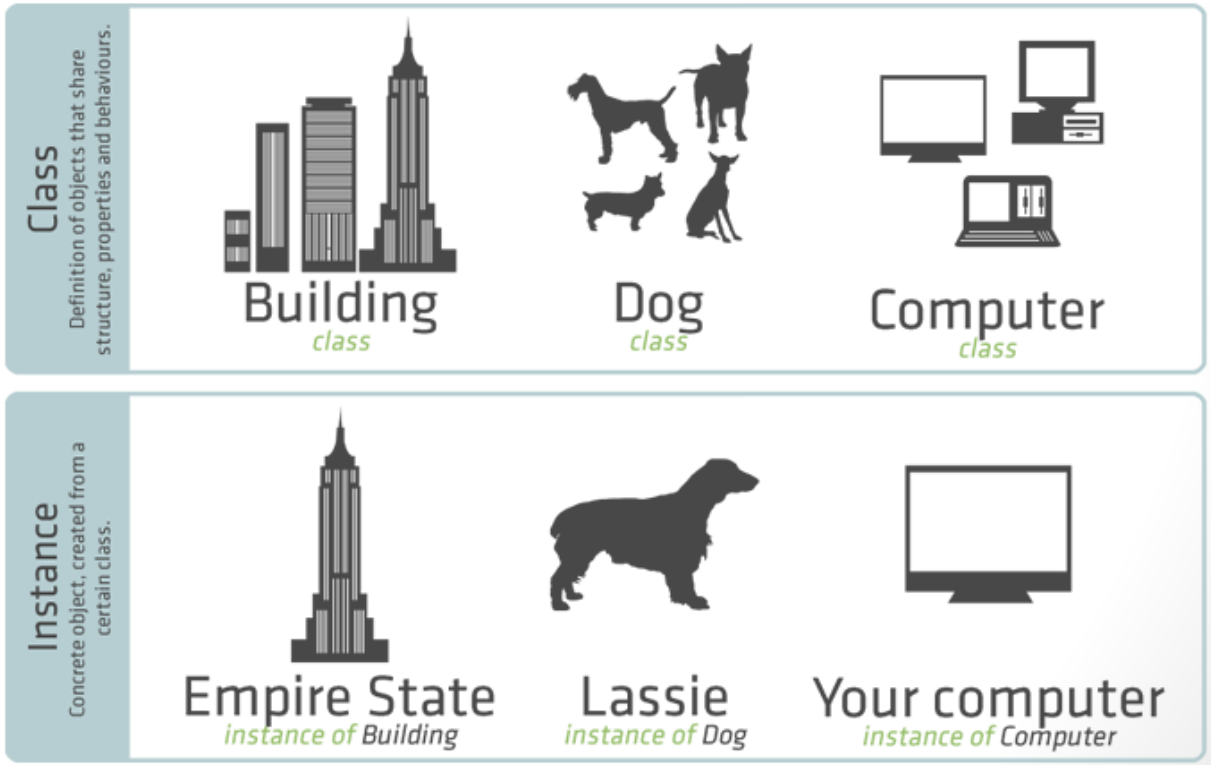
- Car declarations code

```
48
49 void setup(){
50   Serial.begin(115200);
51   Serial.println("Hello");
52
53   Car myCar("Hyundai","Accent","1997","White",1500);
54
55   myCar.runTheCar();
56
57   delay(2000);
58   Car myFriendsCar("Ford","Fusion","2015","Silver",1600);
59   myFriendsCar.runTheCar();
60
61   delay(2000);
62   myFriendsCar.setBrandName("Toyota");
63   myFriendsCar.runTheCar();
64
65   delay(2000);
66   Car thirdCar("BMW","350i");
67   thirdCar.runTheCar();
68 }
69
```

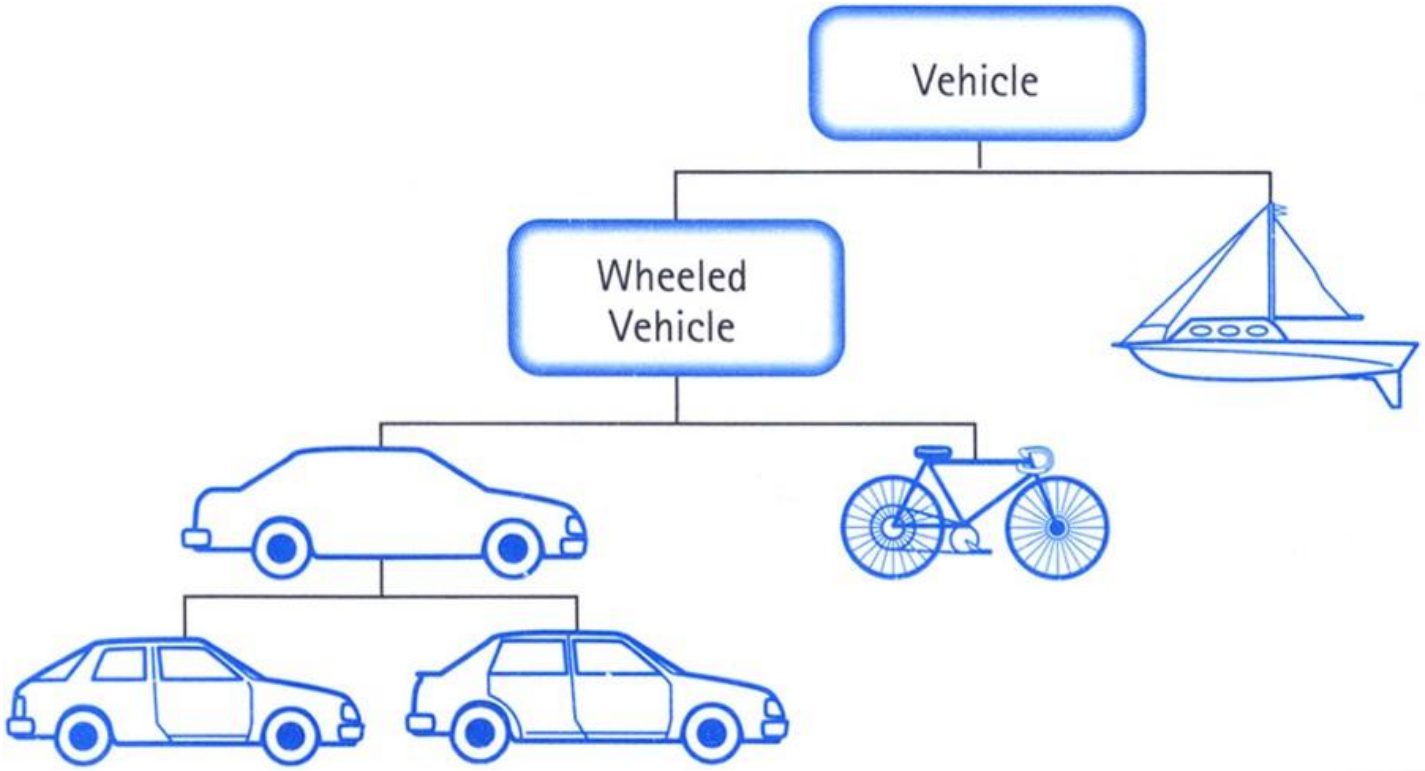
Complete code : https://pastebin.com/8jEXK6KF

Coding Essentials

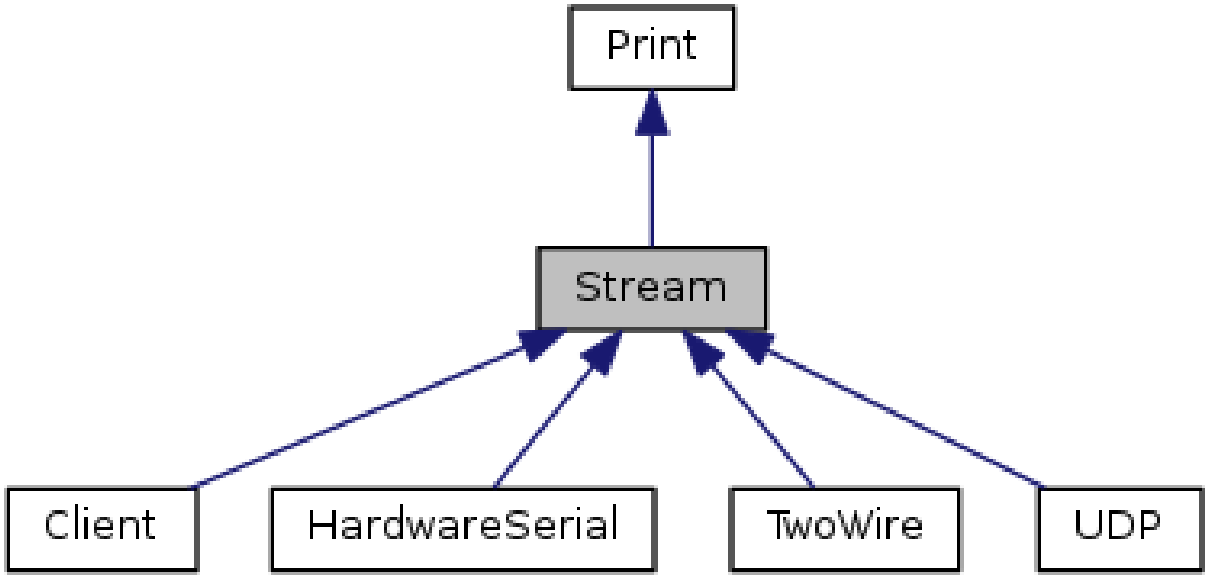
- OOP (Object Oriented Programming)
- Class
- **Instance :**



Inheritance



Stream Class



http://docs.ros.org/kinetic/api/arduino_daq/html/classStream.html

Coding

- **Arduino String class:**

Reference > Language > Variables > Data types > Stringobject

String()

[Data Types]

Functions

LANGUAGE charAt()
LANGUAGE compareTo()
LANGUAGE concat()
LANGUAGE c_str()
LANGUAGE endsWith()
LANGUAGE equals()
LANGUAGE equalsIgnoreCase()
LANGUAGE getBytes()
LANGUAGE indexOf()
LANGUAGE lastIndexOf()
LANGUAGE length()
LANGUAGE remove()
LANGUAGE replace()
LANGUAGE reserve()

LANGUAGE setCharAt()
LANGUAGE startsWith()
LANGUAGE substring()
LANGUAGE toCharArray()
LANGUAGE toInt()
LANGUAGE toFloat()
LANGUAGE toLowerCase()
LANGUAGE toUpperCase()
LANGUAGE trim()

Code : https://pastebin.com/FUBtSNLj

Coding Essentials

- “Programs must be written for people to read, and only incidentally for machines to execute.”
  — **Harold Abelson,** Structure and Interpretation of Computer Programs

Coding Essentials

- “Programs must be written for people to read, and only incidentally for machines to execute.”
  — **Harold Abelson,** Structure and Interpretation of Computer Programs

- “The most disastrous thing that you can ever learn is your first programming language.”

— **Alan Kay**

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- "Every great developer you know got there by solving problems they were unqualified to solve until they actually did it." -

— **Patrick McKenzie**

MQTT

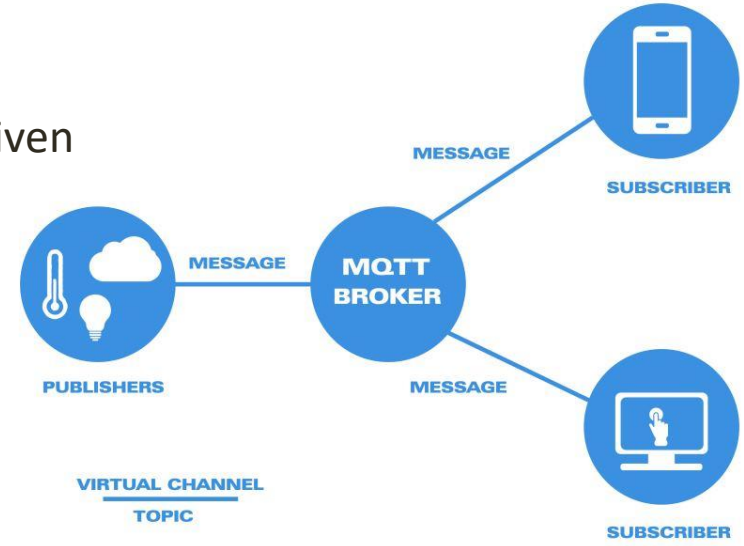

PRODUCER
Publish (topic, data)
BROKER
Publish (topic, data)
Subscribe (topic)
CONSUMER

MQTT

- MQTT protocol
  - Lightweight protocol.

MQTT is the machine-to-machine protocol of the future. It is ideal for the “Internet of Things” world of connected devices. Its minimal design makes it perfect for built-in systems, mobile phones and other memory and bandwidth sensitive applications.

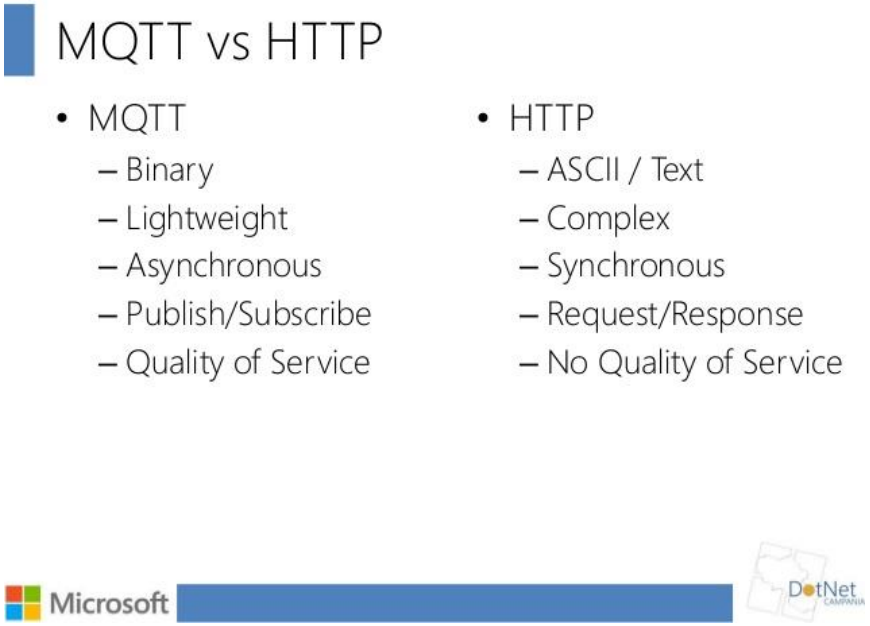
Publish/Subscribe is event-driven



Read more : [MQTT (MQ Telemetry Transport)]

MQTT

- MQTT vs HTTP
- Why MQTT ?



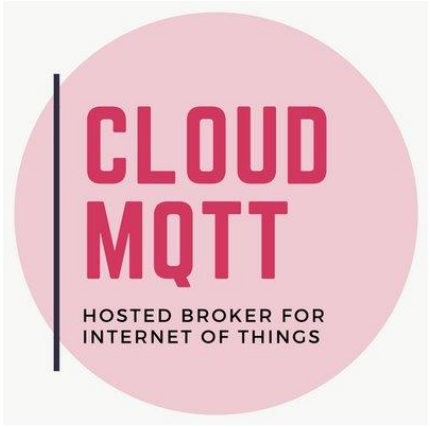
MQTT

- MQTT vs HTTP
  - MQTT is data centric
  - HTTP is document-centric

"The real advantage of MQTT over HTTP occurs when we reuse the single connection for sending multiple messages. source"

MQTT

- CloutMqtt



- MQTTLens for google Chrome

- MQTT Snooper for Android

MQTT

- MQTT is used by Facebook messenger for its low latency.

"Facebook currently uses MQTT for their messenger app, not only because the protocol conserves battery power during mobile phone-to-phone messaging, but also because, in spite of inconsistent internet connections across the globe, the protocol enables messages to be delivered efficiently in milliseconds."

Our Society

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