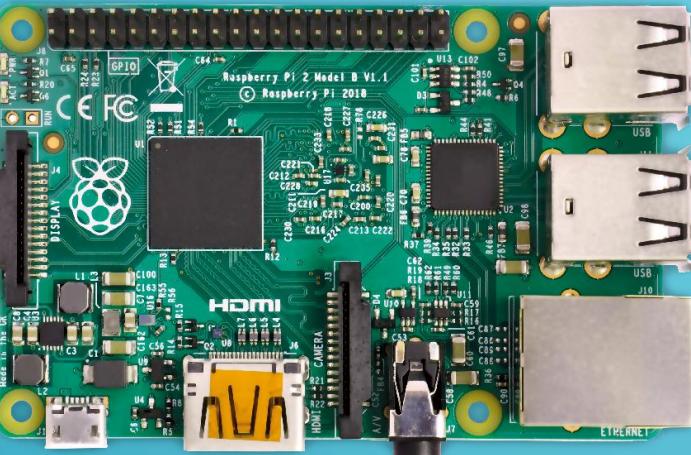


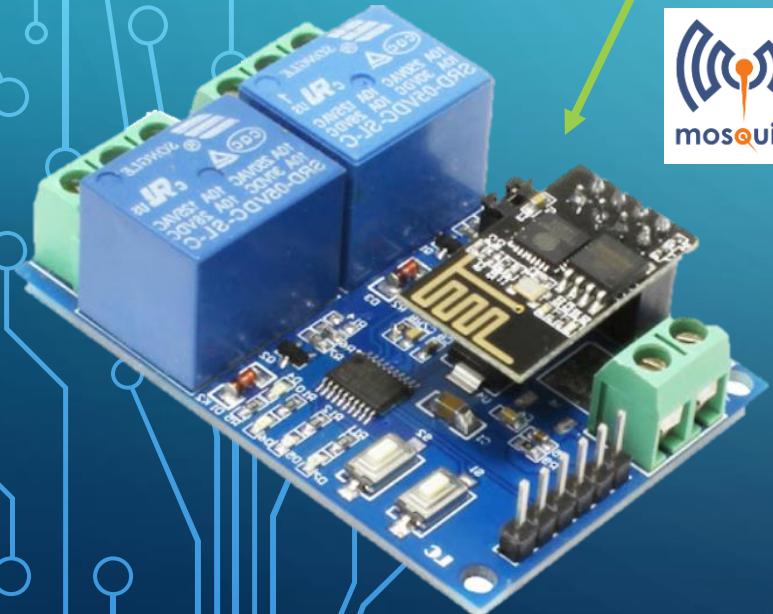
INTRODUCTION TO IOT



NodeRed



Mosquitto

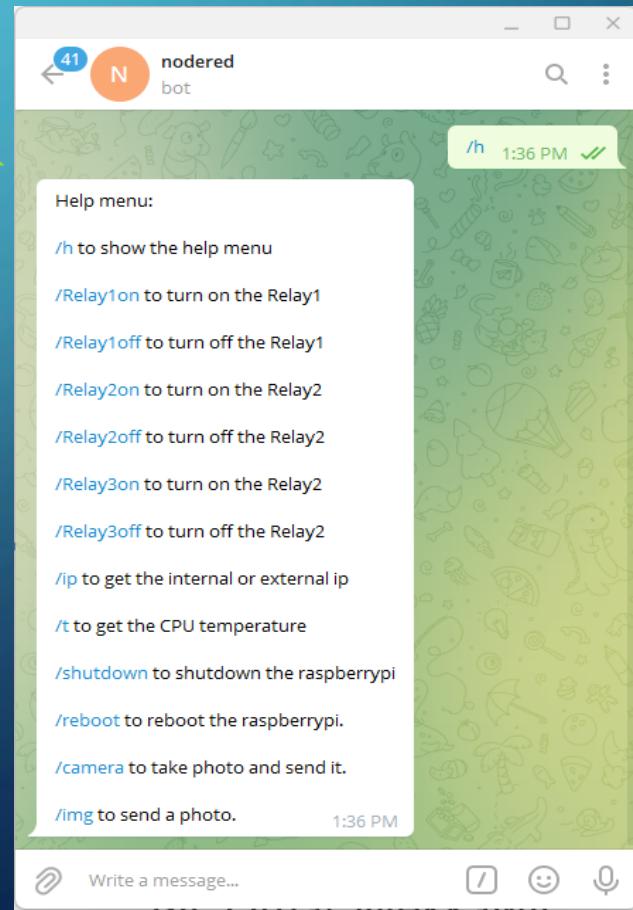


BY: OMAR MEKKAWY



Telegram Bot

Control Your Device Anywhere



CONTACT INFO

My LinkedIn: <https://www.linkedin.com/in/omar-mekkawy/>

Facebook: <https://www.facebook.com/OmarMekkawyOfficial/>

GitHub: <https://github.com/omarKmekkawy/>

My Website: <https://omar-mekkawy.net> – <https://omar-mekkawy.com>

AGENDA

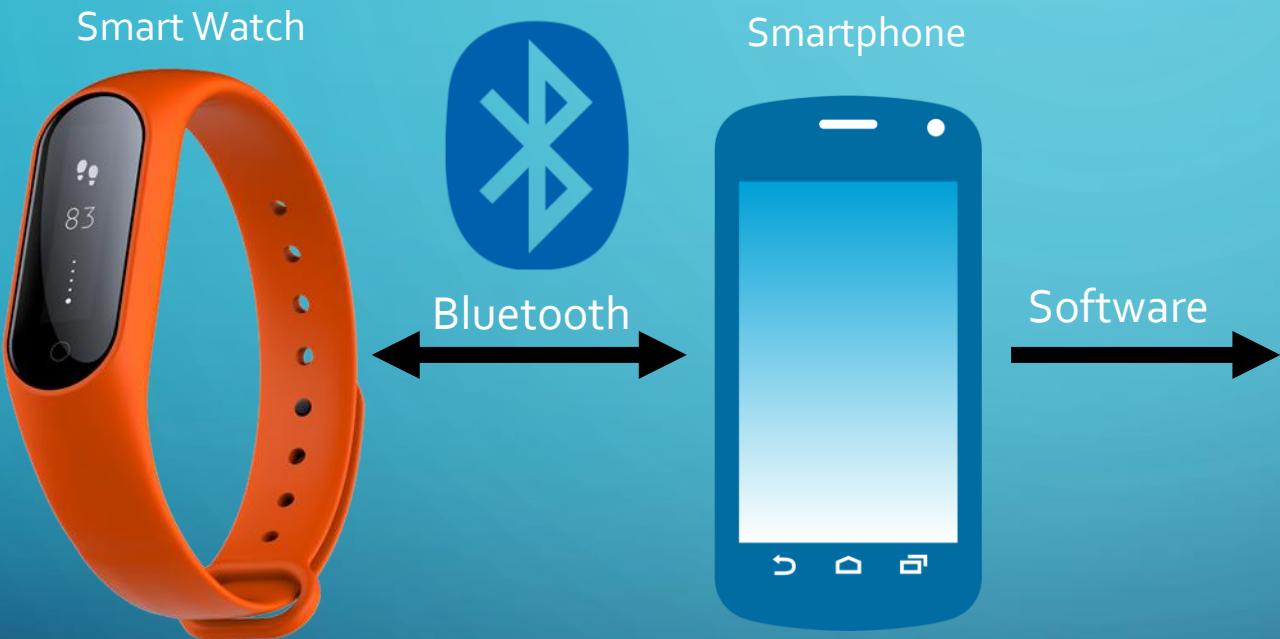
- What is **Internet Of Things (IOT)** ?
- Lifecycle of the IOT
- How IOT works ?
 - Collect The Data.
 - Communicate
 - Wireless(Bluetooth, Zigbee, Z-Wave, Thread, WIFI, Cellular, NFC, and LORAWAN).
 - MQTT.
 - Analyze
 - Act
- Benefits of IOT.
- Some Challenges in IOT.
- Main Application areas for the IOT.
- Examples.
- How to make your own IOT device (**Introduction**).

WHAT IS INTERNET OF THINGS (IOT) ?

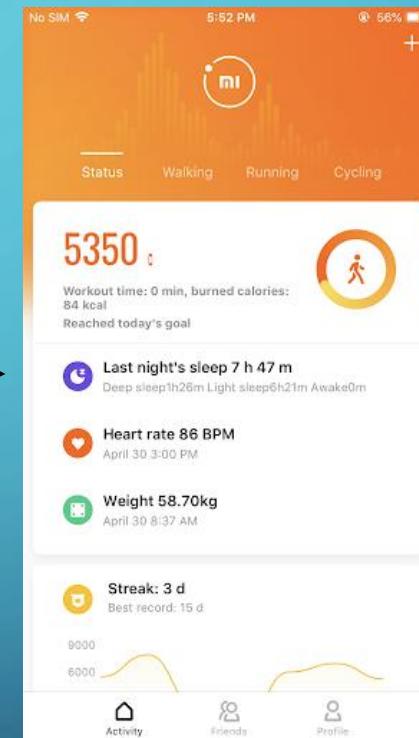
- The Internet Of Things (**IOT**) is the network of physical objects (**things**) which enable these objects to collect and exchange data.
- The **things** can collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors, and communication hardware.
- These devices called “connected” or “smart” devices, sometimes can talk to other related devices machine-to-machine (M2M) communication, and act on the information they get from one another.

WHAT IS INTERNET OF THINGS (IOT) ?

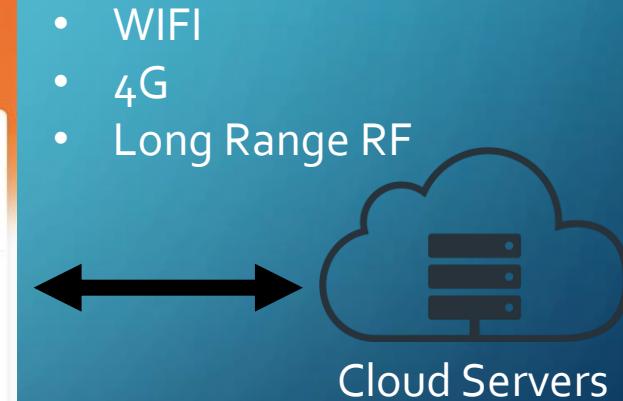
- Example:



- Sensors
 - Heart Rate
 - Gyroscope
 - Touch button
- Display



- Datalogging
- Data Processing
- Communication with cloud servers



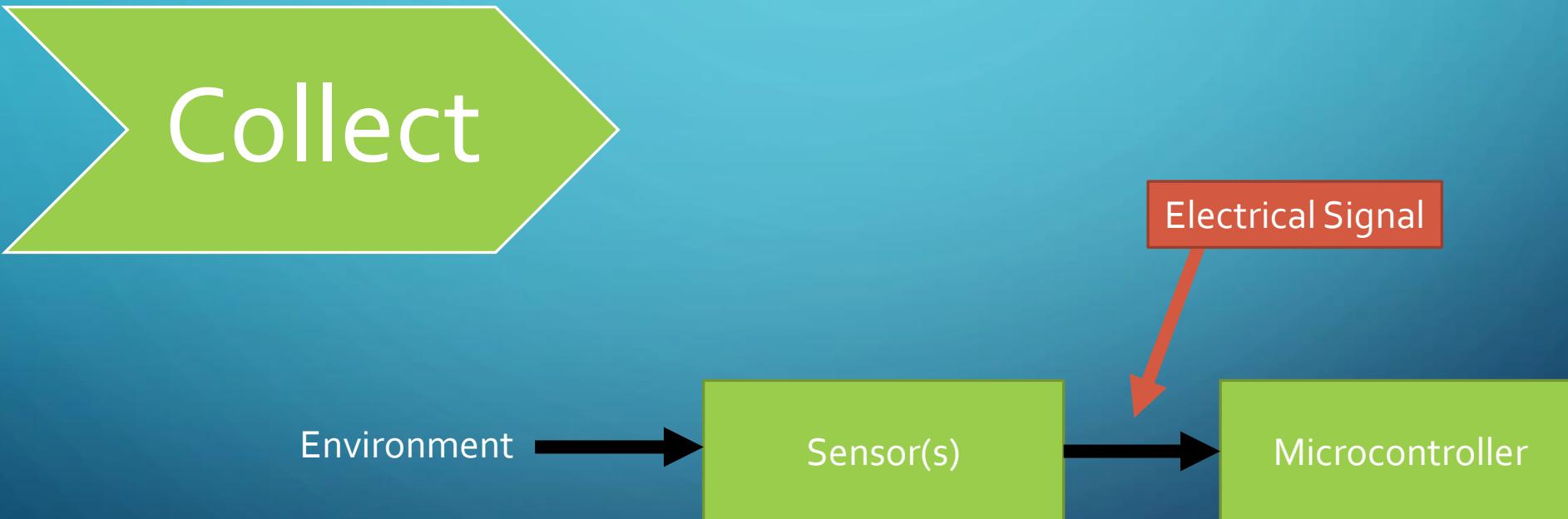
- WIFI
- 4G
- Long Range RF

LIFECYCLE OF THE IOT



COLLECTION

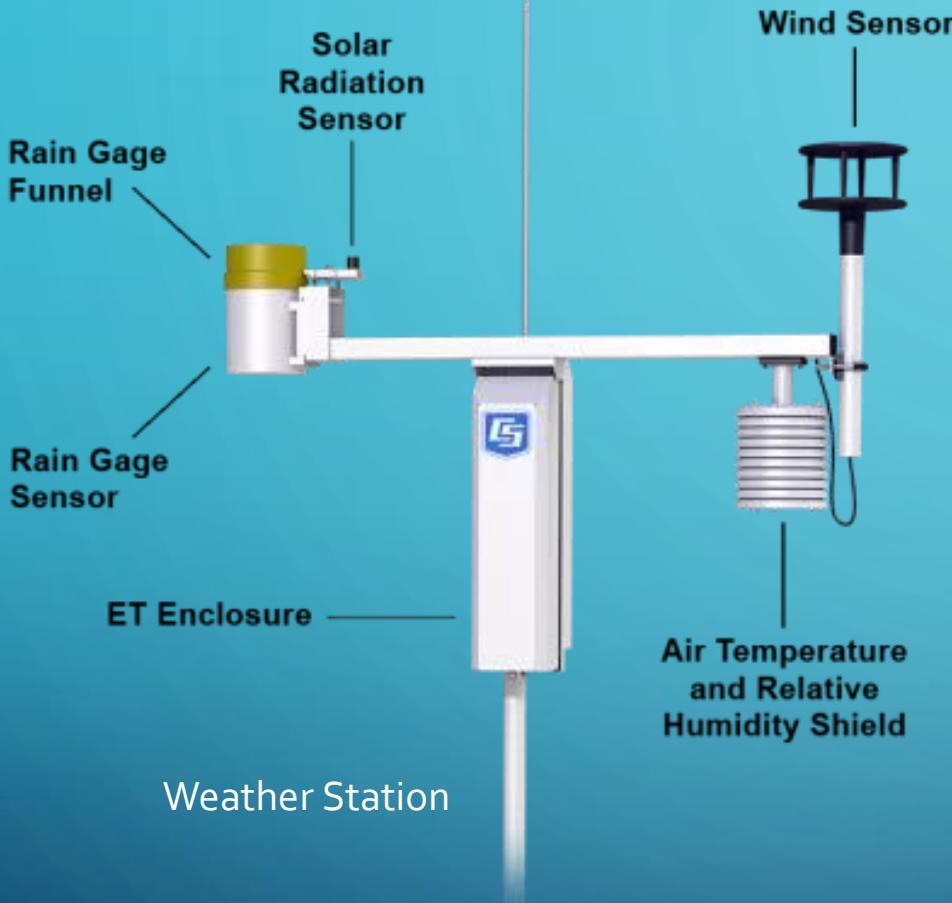
- Devices and sensors are collecting the data from their surrounding environment.



COLLECTION

Continued..

Simple Example



Weather Station

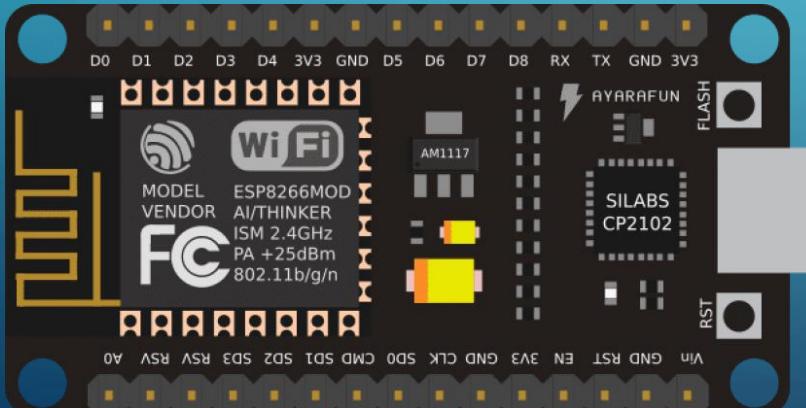
<https://www.campbellsci.ca/blog/et-station-components-to-maintain>



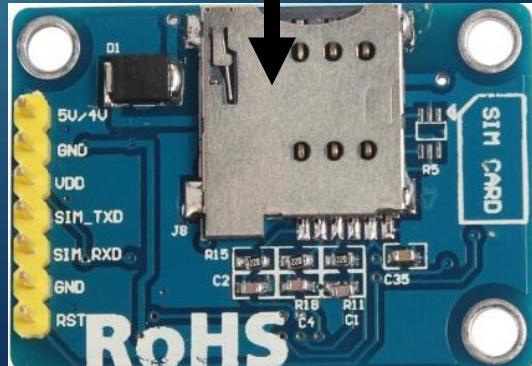
Weather Station

COMMUNICATION

Continued..



ESP8266 WIFI module



SIM800L GSM Modem

SIM Card



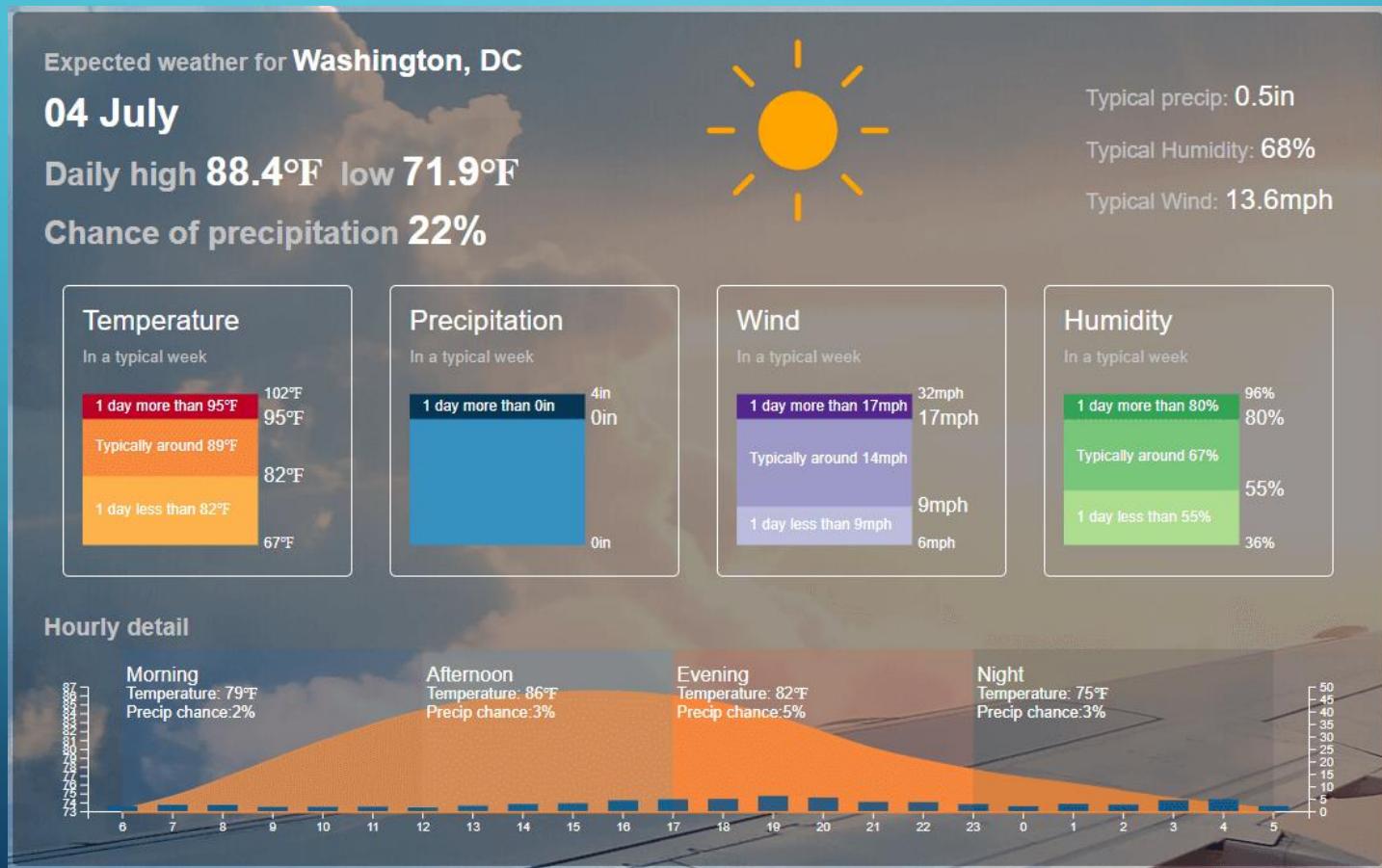
→ Communicate

ANALYZE

Continued..

- Creating information from the collected data.

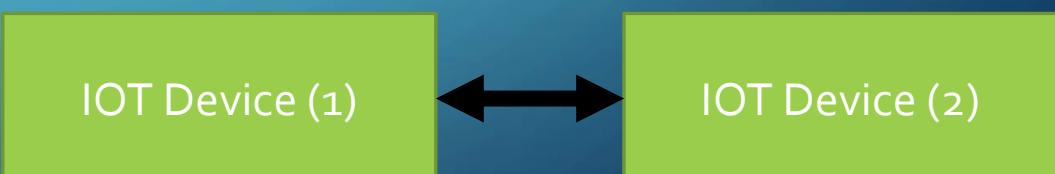
Analyze



ACT

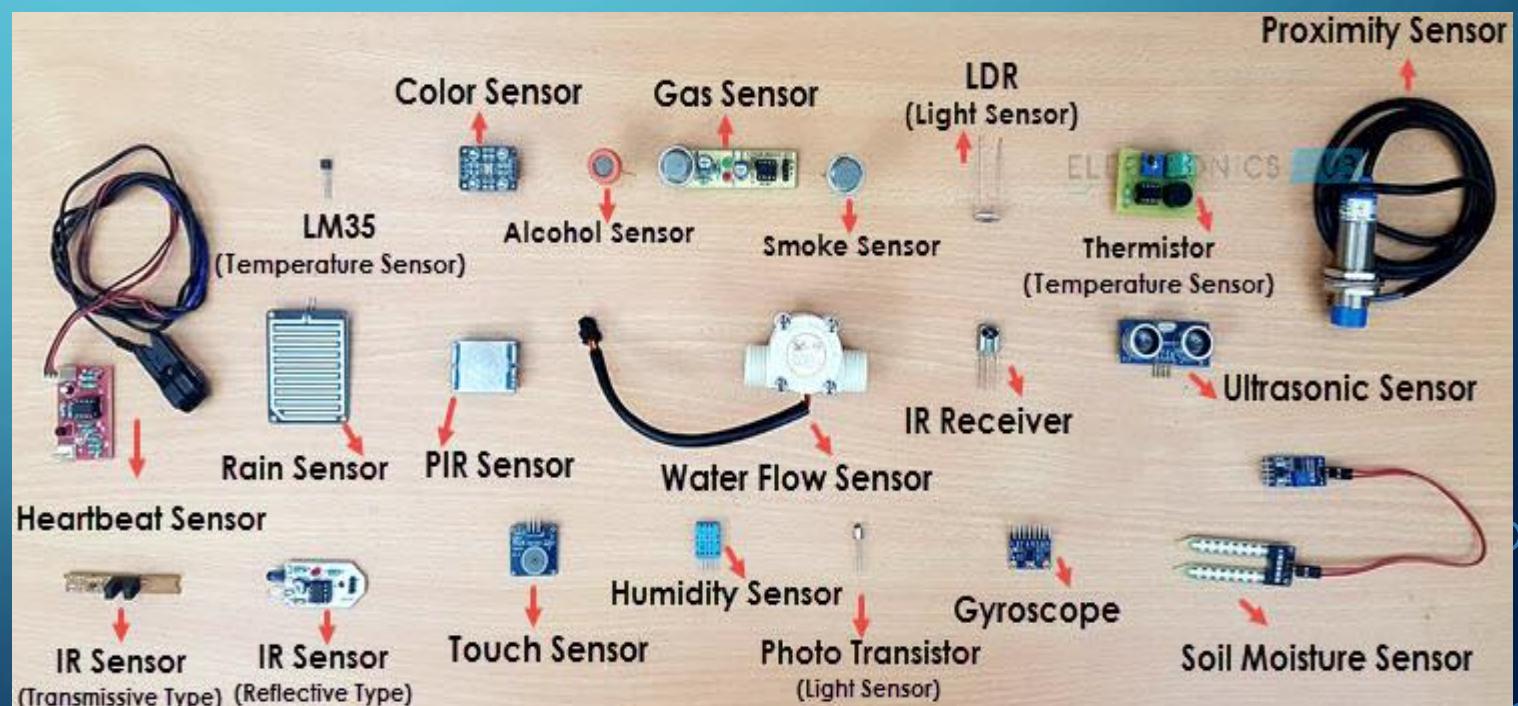
Continued..

- Taking action based on the information and data
 - Communicate with another machine (M₂M).
 - Send a notification (SMS, email, etc.).
 - Talk to another system (Emergency System).



HOW IOT WORKS

- Collect The Data
 - Devices can collect the data using embedded sensors (It's a science).
- Sensor: is a device that produces an output signal for the purpose of sensing of a physical phenomenon.
- Examples of the sensors:
 - Pressure Sensors.
 - Temperature Sensors.
 - Vibration Sensors.
 - Humidity Sensors.
 - Proximity Sensors.



HOW IOT WORKS

- Communicate

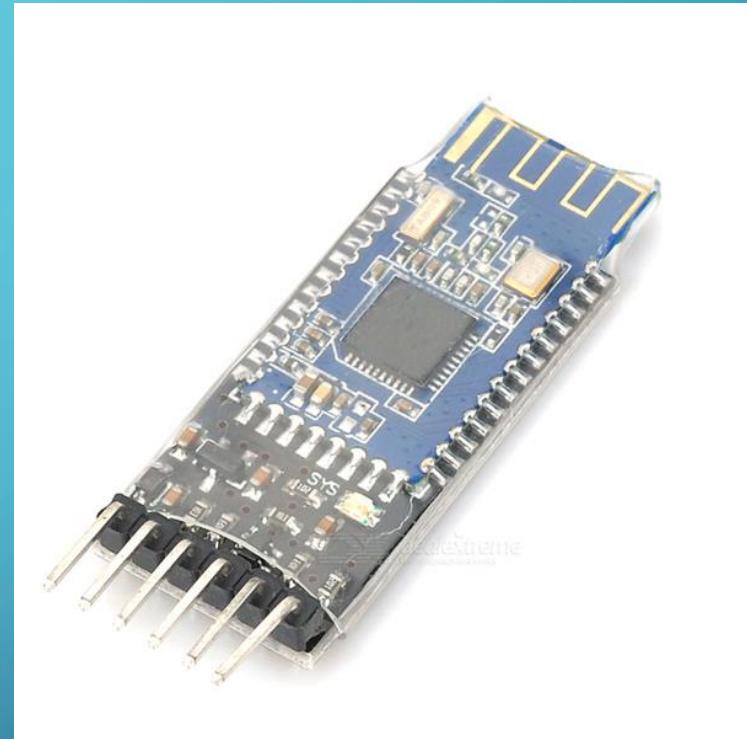
- Choosing the communication method is too important because it affect many things:
 - Power consumption of IOT device (IOT devices work on a battery!).
 - Data rate (how much data transmitted per second).
 - Transmission range.
 - Frequency band.
 - Cost.
 - Security and encryption.
 - Network topology.
 - Regulations.

HOW IOT WORKS

- Communicate
 - Bluetooth
 - Standard: Bluetooth 4.2
 - Frequency: 2.4GHz (ISM Band).
 - Range: 50-150m.
 - Data rates: 1Mbps
 - There is BLE 5.0 and 5.2 also.
 - Cost: Low.
 - Battery life: Weeks.



Industrial **S**cientific **M**edical



HOW IOT WORKS

- Communicate
 - Zigbee
 - Standard: Zigbee 3.0 based on IEEE802.15.4
 - Frequency: 2.4GHz (ISM Band).
 - Range: 10-100m.
 - Data rates: 250Kbps
 - There is BLE 5.2 and 5.0 also.
 - Cost: Low.
 - Battery life: Months to years.



HOW IOT WORKS

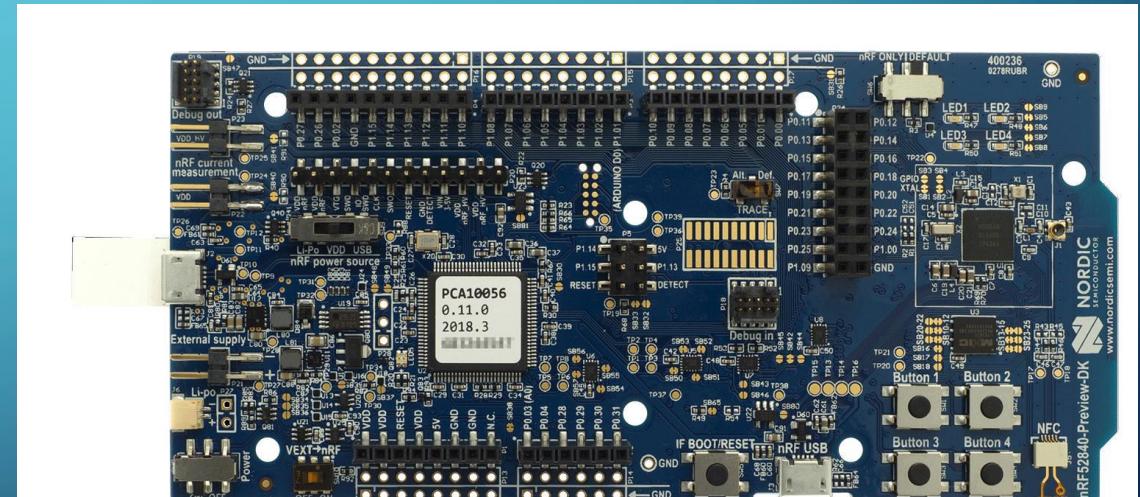
- Communicate
 - Z-wave
 - Standard: Z-wave Alliance ZAD12837 / ITU-T G.9959
 - Frequency: 900MHz (ISM Band).
 - Range: 30m.
 - Data rates: 3.6/40/100 Kbps
 - Cost: Low.
 - Battery life: Months to years.



HOW IOT WORKS

- Communicate
 - Thread
 - Standard: Thread, based on IEEE8.2.15.4 and 6LowPAN
 - Frequency: 2.4GHz (ISM Band).
 - Range: N/A.
 - Data rates: N/A.

THREAD



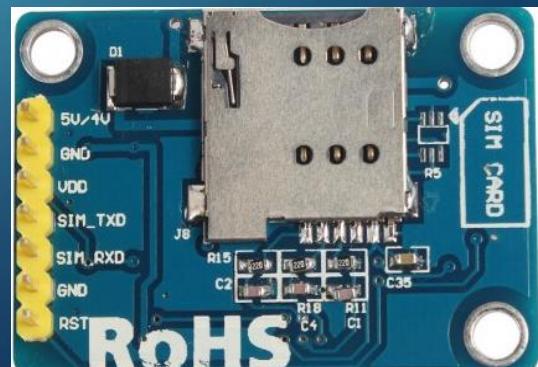
HOW IOT WORKS

- Communicate
 - WIFI
 - Standard: 802.11n (Most commonly used).
 - Frequency: 2.4GHz and 5GHz bands.
 - Range: 50m.
 - Data rates: 600 Mbps maximum, usually 150-200Mbps.
 - Cost: High.
 - Battery life: Hours.



HOW IOT WORKS

- Communicate
 - Cellular
 - Standard: GSM/GPRS/EDGE (2G), UMTS/HSPA (3G), LTE (4G)
 - Frequency: 900/1800/1900/2100 MHz.
 - Range: 35Km max for GSM, 200Km for HSPA.
 - Data rates:
 - 35-170Kbps (GPRS)
 - 120-384Kbps (EDGE)
 - 384kbps-2Mbps (UMTS)
 - 600kbps-10Mbps (HSPA)
 - 3-10Mbps (LTE)
 - Cost: Very high.
 - Battery life: hours.



HOW IOT WORKS

- Communicate
 - NFC
 - Standard: ISO/IEC 18000-3
 - Frequency: 13.56 MHz (ISM).
 - Range: 10cm.
 - Data rates: 100-420 kbps
 - Cost: Low.



HOW IOT WORKS

- Communicate
 - LoRaWAN
 - Standard: LoRaWAN
 - Frequency: Various.
 - Range: 2-5km (urban environment), 15km (suburban environment).
 - Data rates: 0.3-50kbps
 - Cost: High.
 - Battery life: Years.



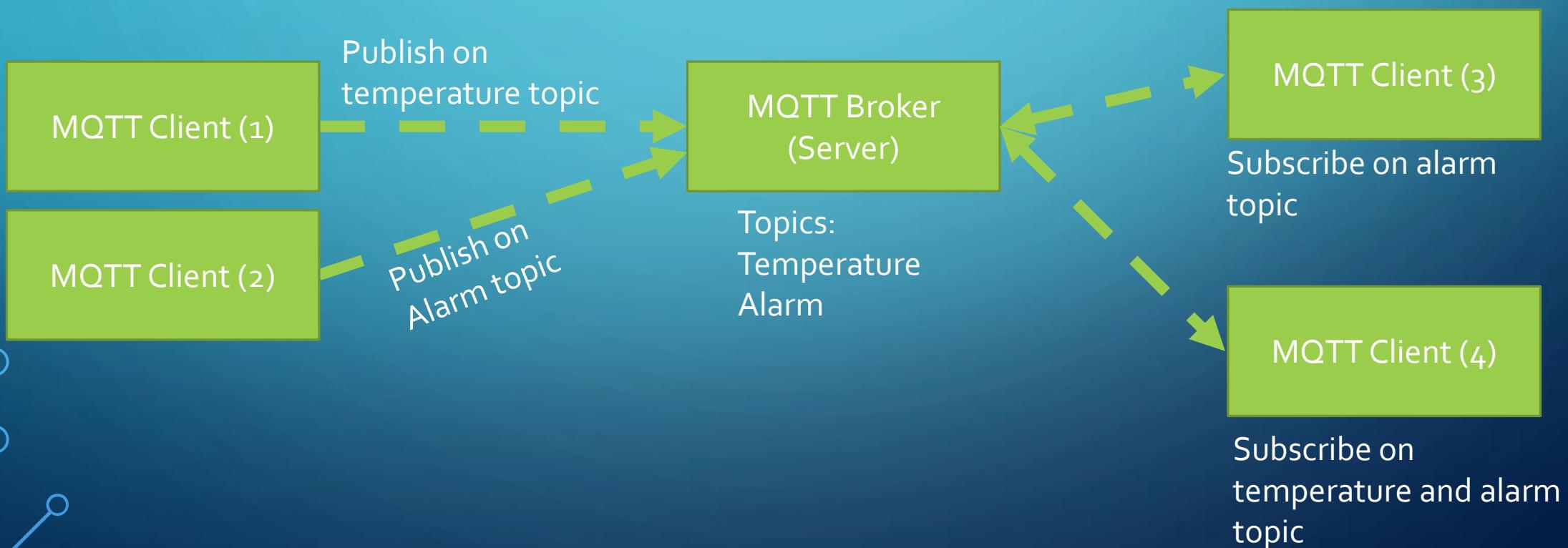
HOW IOT WORKS

- Communicate

- MQTT: standard messaging protocol for the Internet of Things (IoT).
- It is designed as an extremely lightweight publish/subscribe messaging transport that is ideal for connecting remote devices with a small code footprint and minimal network bandwidth.
- MQTT today is used in a wide variety of industries, such as automotive, manufacturing, telecommunications, oil and gas, etc.

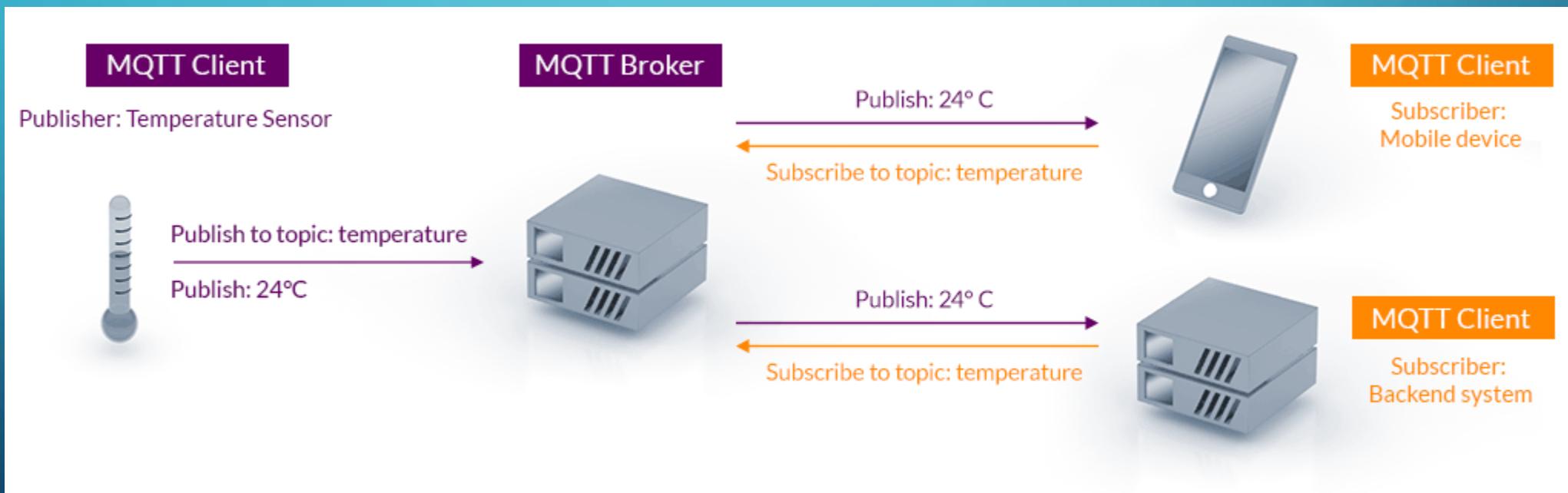
HOW IOT WORKS

- Communicate
 - MQTT



HOW IOT WORKS

- Communicate
 - MQTT



<https://mqtt.org/>

HOW IOT WORKS

- Analyze
 - Machine learning and Artificial intelligence.
 - Big Data.
 - Handling the storage.

BENEFITS OF IOT

- **Improved productivity of staff and reduced human work**
 - Tasks can be done automatically, so human resources may be transferred to more complex tasks that require personal skills. This way, the number of workers can be minimized, which results in reduced costs of business operation.
- **Efficient operation management**
 - Automated control over multiple operation areas, including, inventory management, shipping tracking, fuel and spare parts management.

BENEFITS OF IOT

- **Better use of resources and assets**
 - The automated scheduling and monitoring implemented with the help of interconnected sensors enable higher efficiency of resource use, such as:
 - improved power management.
 - water consumption
 - For example, simple motion detectors may save significant sums of money in electricity and water bills, thus making both small and large businesses more productive and eco-friendly.

BENEFITS OF IOT

- **Cost-effective operation**

- Automatically scheduled and controlled maintenance, supply of raw materials, and other manufacturing requirements, the equipment may have a higher production rate resulting in bigger profits.

- **Improved work safety**

- Smart devices also reduce the probability of a human error during various stages of business operation, which also contributes to a higher level of safety. In addition, a network of IoT devices such as surveillance cameras, motion sensors, and other monitoring devices can be utilized to ensure the security of an enterprise and prevent thefts and even corporate espionage.

BENEFITS OF IOT

- **Better marketing and business development**
 - Smart devices that are situated at homes, especially voice assistants and other appliances that can directly communicate with end-users on a regular basis, provide invaluable source information for business analysis. IoT helps enterprises by gathering large volumes of user-specific data employed for developing business strategies, targeted advertising.

SOME OF CHALLENGES IN IOT

- Battery lifetime limitation due to low weight and less power consumption.
- Wireless communication
 - All devices don't use the same communication method).
- Security.
- Privacy.
- Lack of standardization (lots of devices imported from China) which has different standards of quality control and security.
- Data collection and processing: data plays an important role (how to process the collected data).
- Compatibility between different wireless devices.

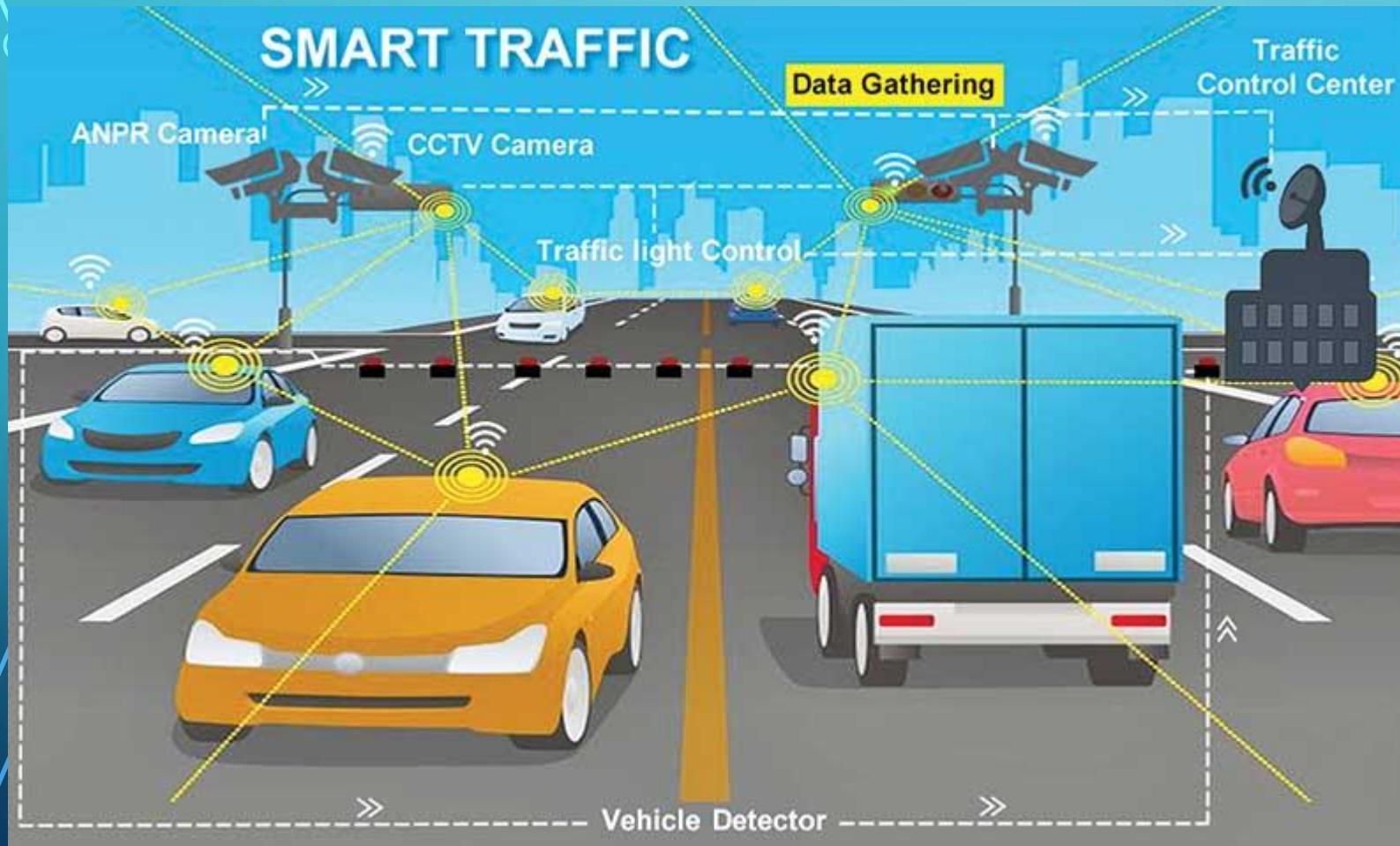
MAIN APPLICATION AREAS FOR THE IOT

- Home automation.
- Smart City.
- Smart manufacturing (Smart Factory).
- Wearables.
- Healthcare.
- Automotive.

EXAMPLES

- Traffic Jam Problem.

Lets think together!



EXAMPLES

- Green House.



<https://helbanna.com/iot-in-the-smart-greenhouse/>

Lets think together !

EXAMPLES

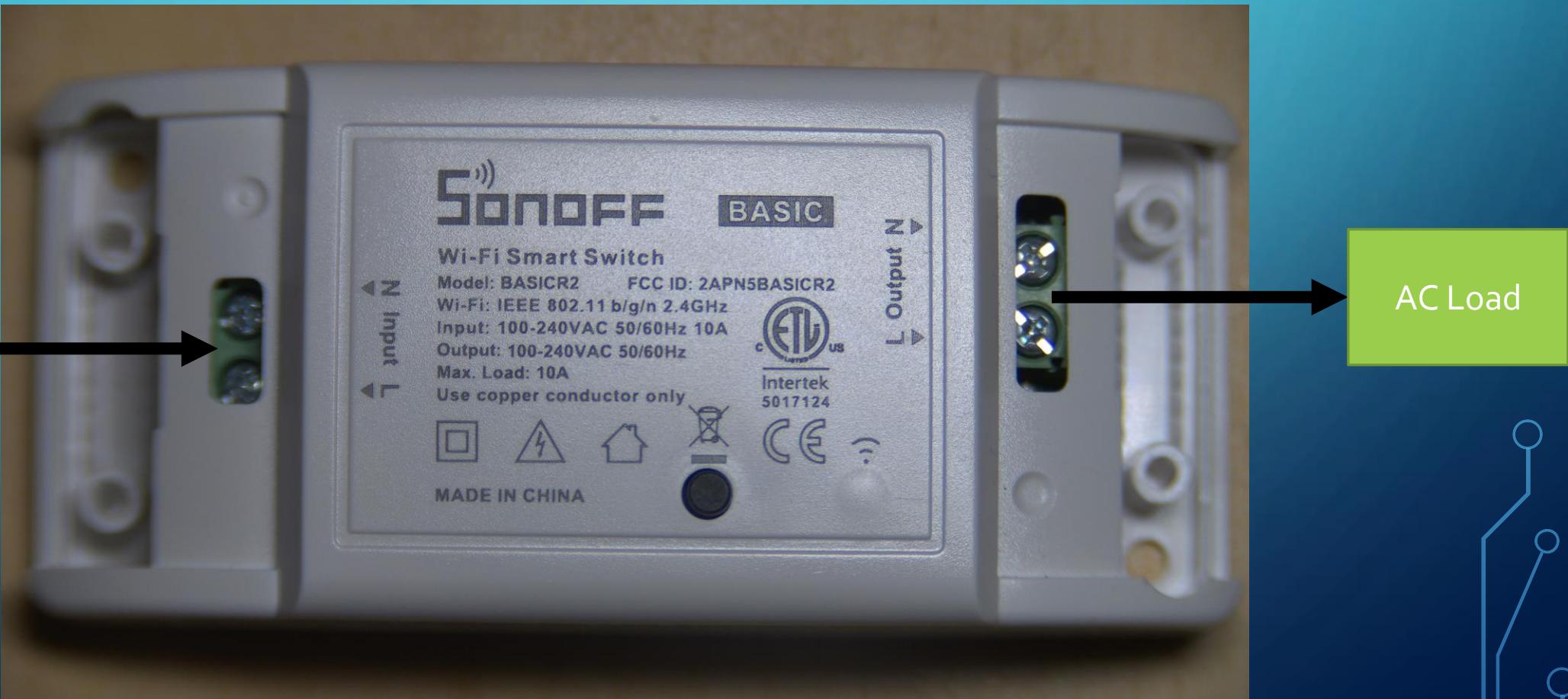
- Street Light.

Lets think together !



EXAMPLES

- SONOFF Relay
 - A WIFI controlled smart switch for home appliances.



EXAMPLES

- SONOFF Relay

- A WIFI controlled smart switch for home appliances.
- Could be controlled using smart phone app ([eWLink](#)) [This app connected to Chinese IOT servers].
- The app supports controlling your device when you [leave from, come to] place.
- Also supports timer and lots of features.



EXAMPLES

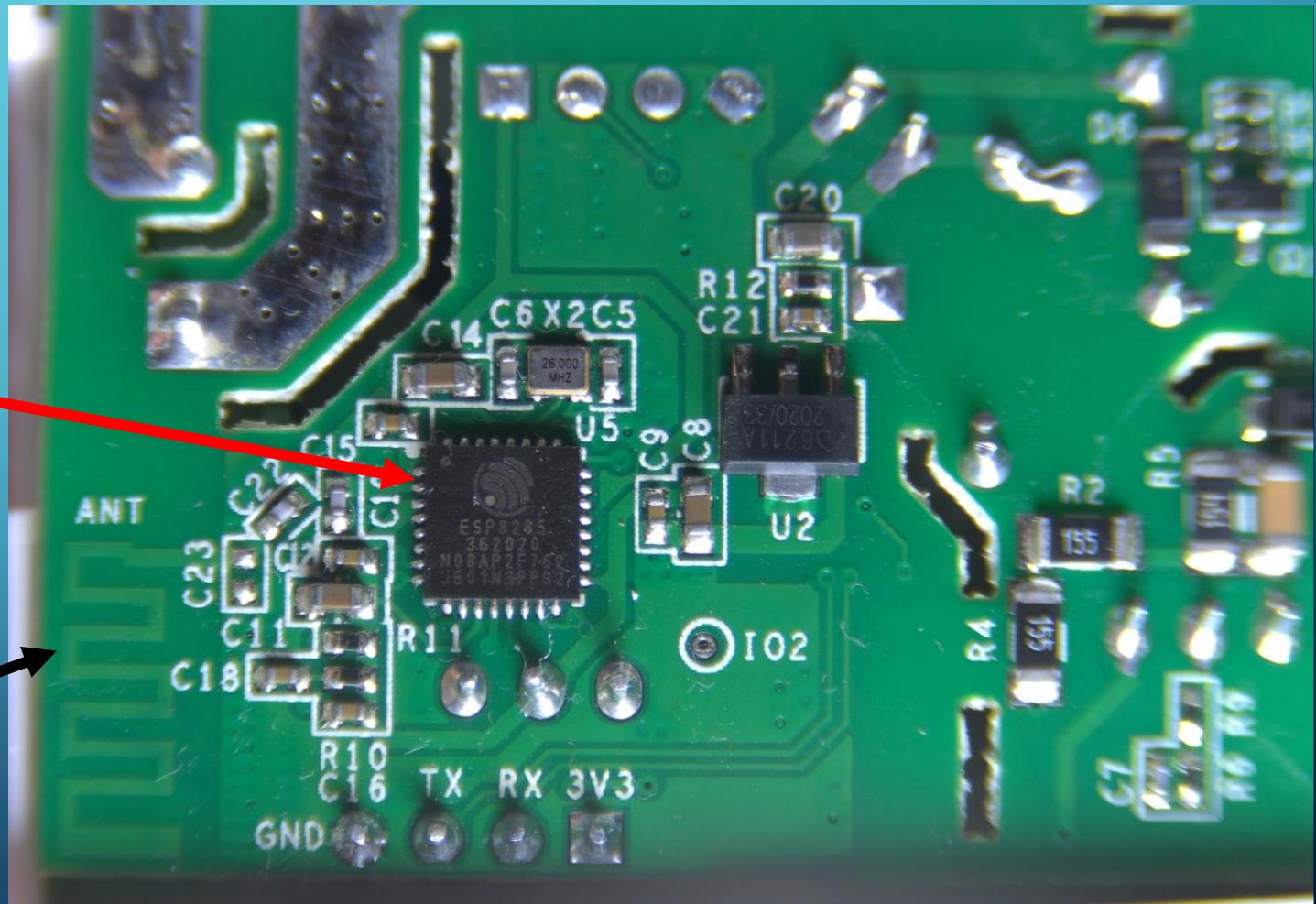
- SONOFF Relay
 - Images from inside



ESP8285 Microcontroller

WIFI PCB
Antenna

Bottom View

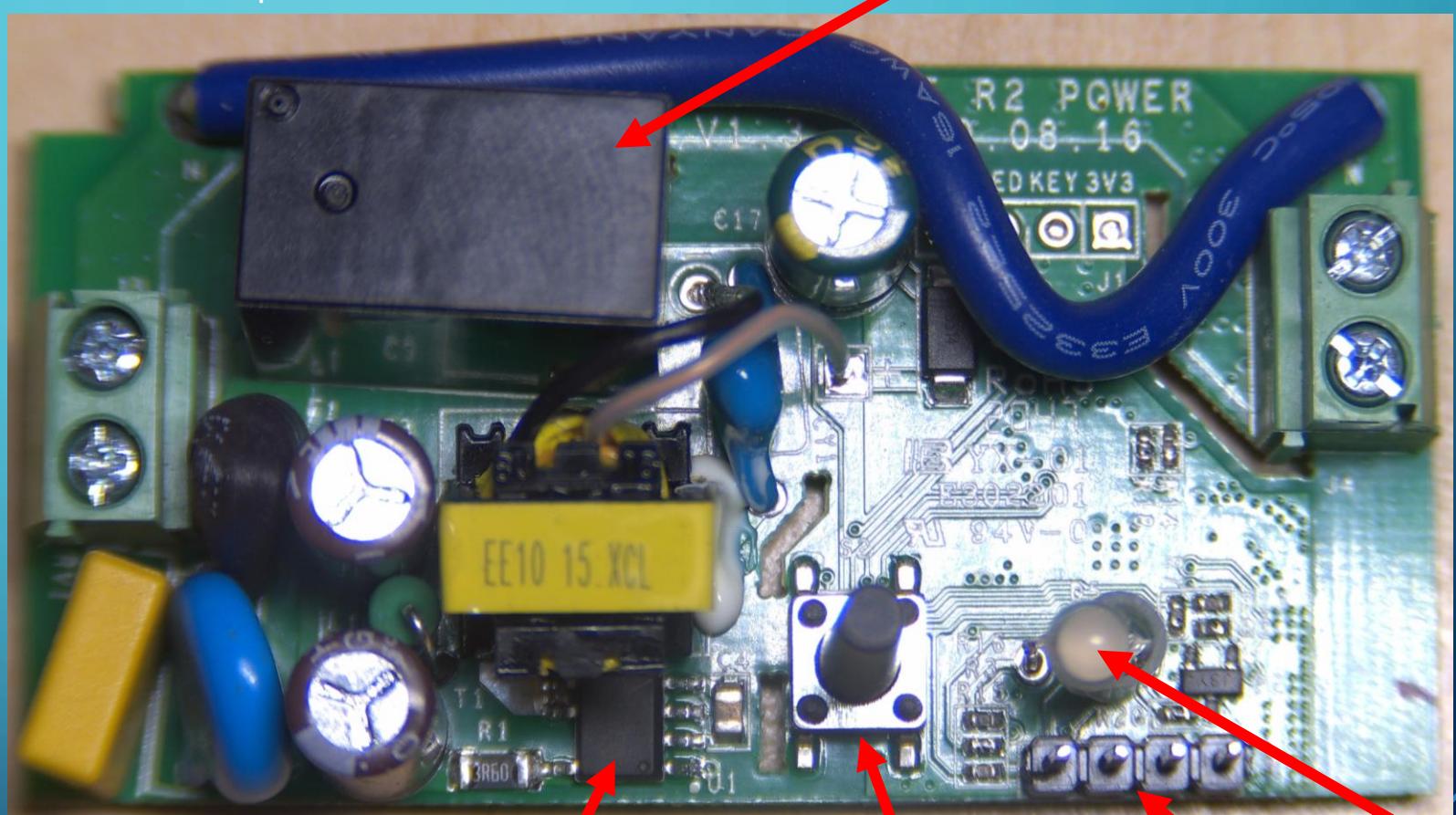


ESP8285 Microcontroller

- SONOFF Relay
 - Images from inside

EXAMPLES

Top View



Relay [Electrically controlled Switch]

Power Supply Circuit

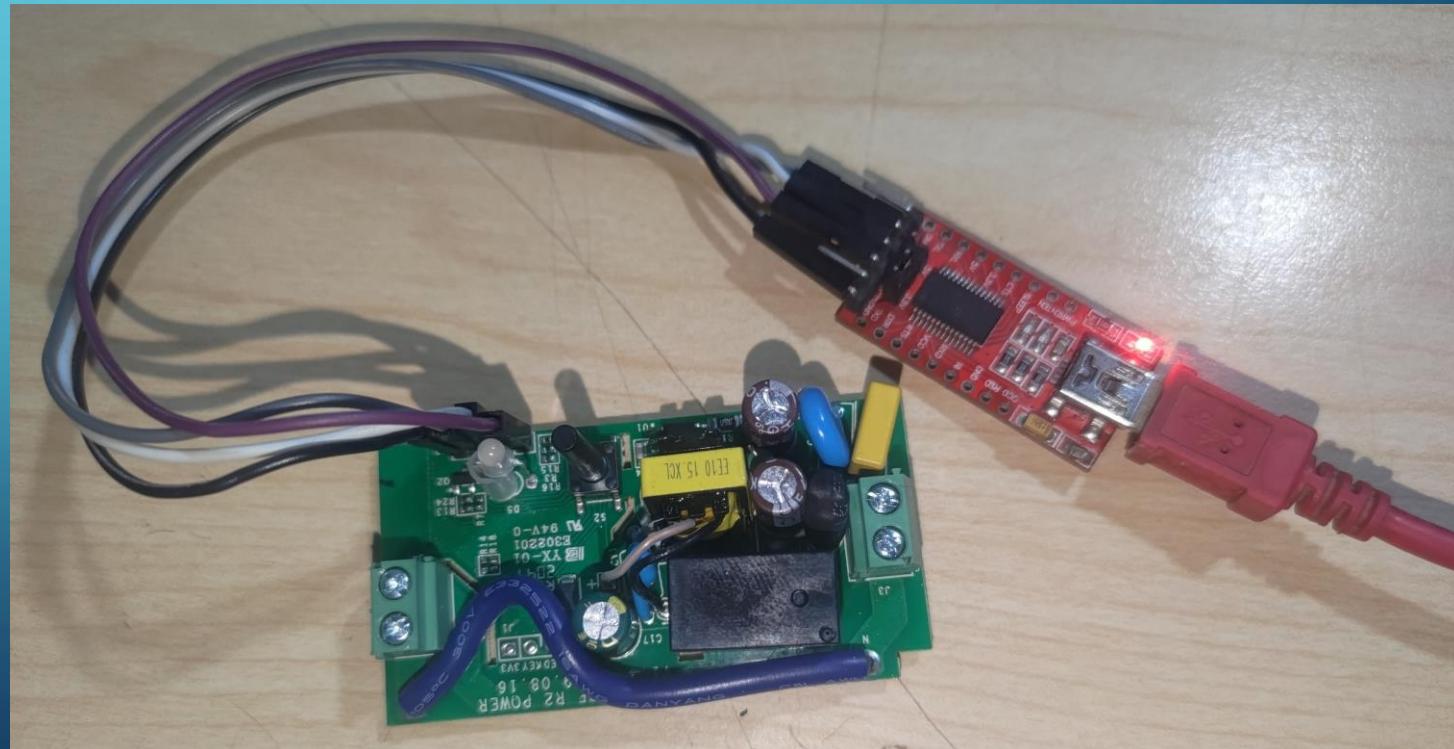
Push Button Switch

Status LED

Flashing Socket

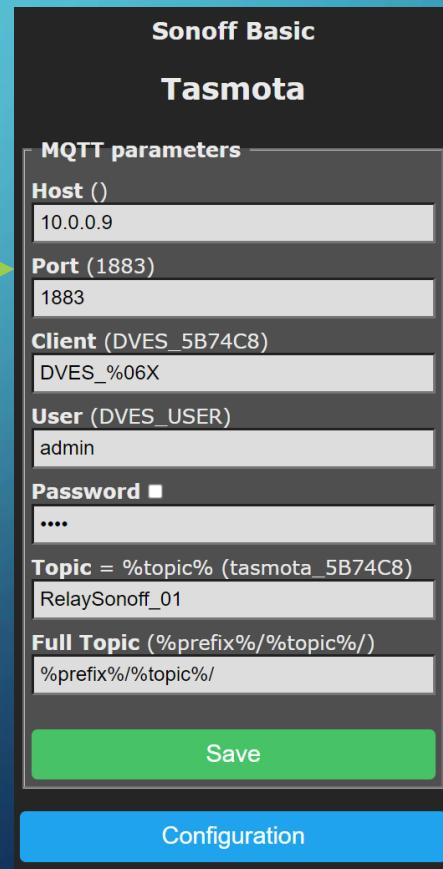
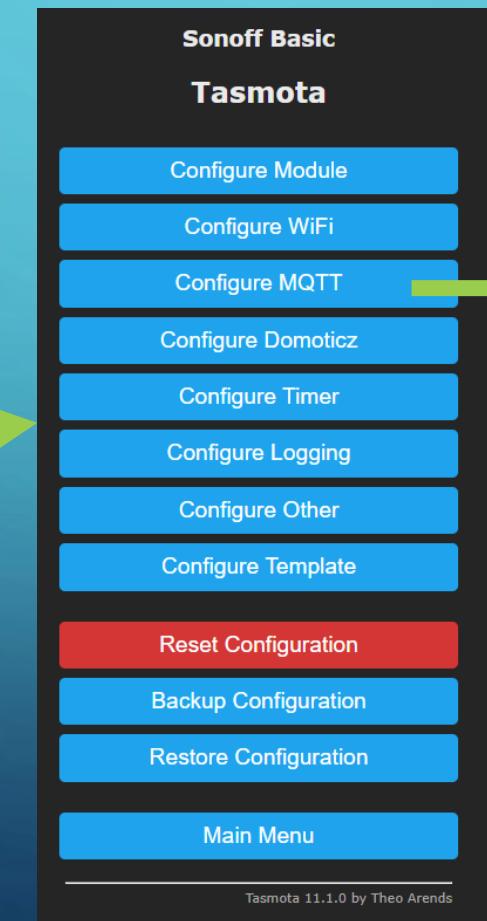
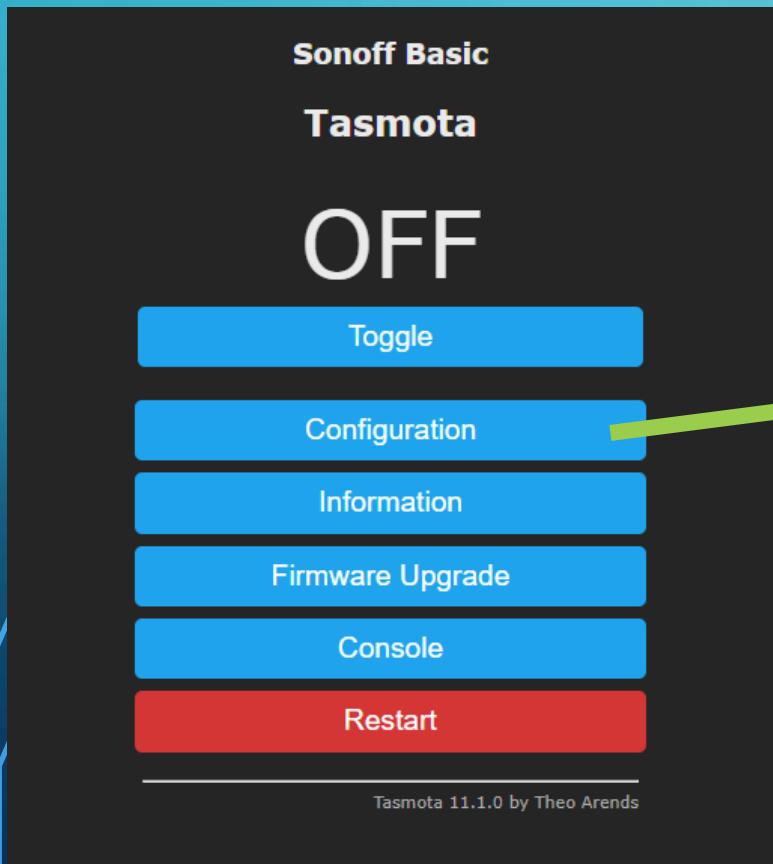
EXAMPLES

- SONOFF Relay
 - Community Support
 - Tasmota Firmware [Configurable, Easy to use, supports many devices]



EXAMPLES

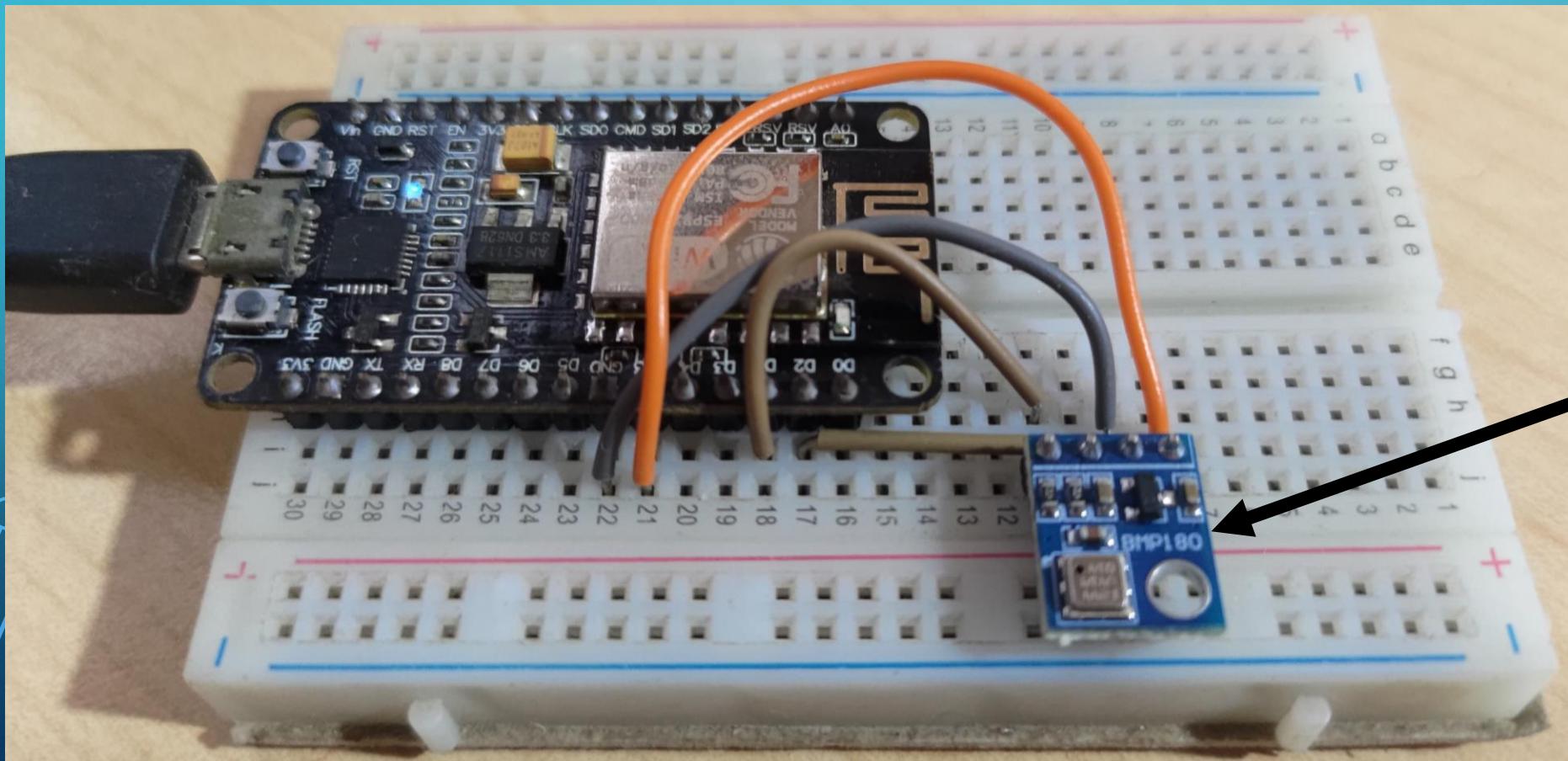
- SONOFF Relay
 - Community Support
 - Tasmota Firmware [Configurable, Easy to use, supports many devices]



10.0.0.243

EXAMPLES

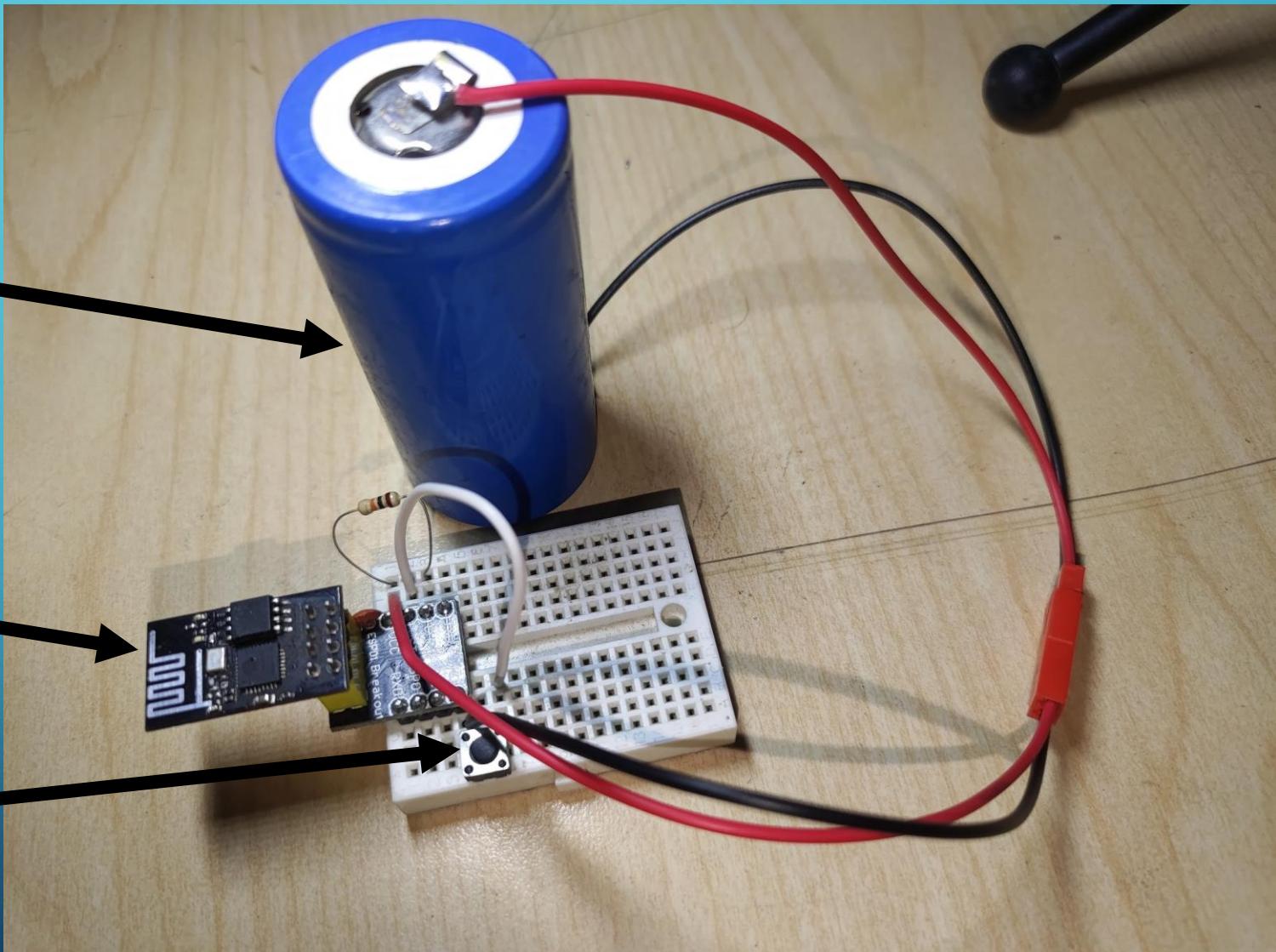
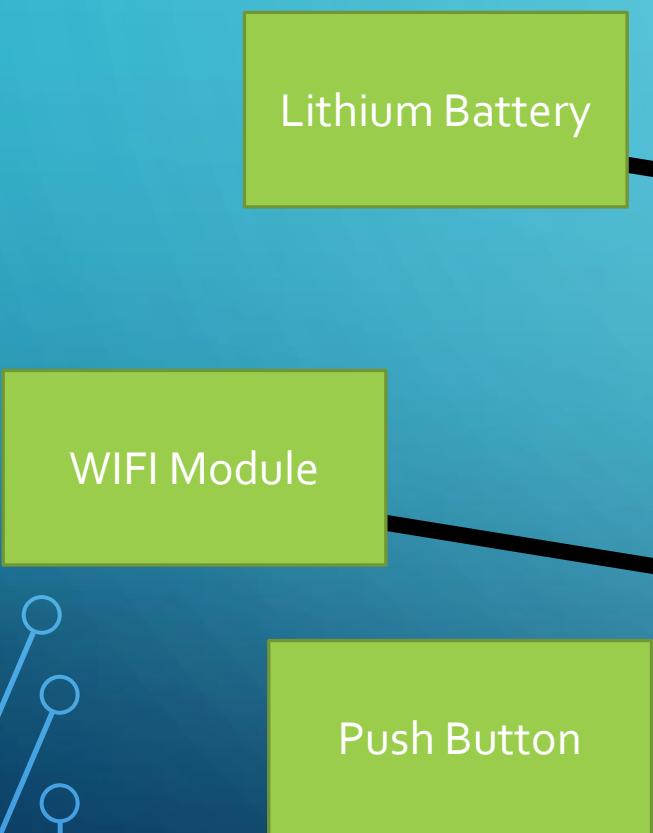
- Temperature Monitoring



BMP180
Temperature and
Pressure Sensor

EXAMPLES

- WIFI Button



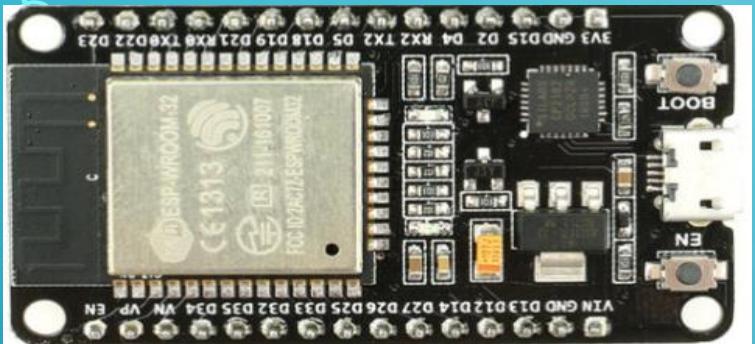
HOW TO MAKE YOUR OWN IOT DEVICE

- Embedded software development:
 - Arduino (Simplest way!)
 - Standardized APIs.
 - Community support.
 - Already made IOT libraries.
 - Easy to use for prototyping and POC (**P**roof **O**f **C**oncept).
 - Supports many development kits.
 - Based on C++.
 - Embedded software development using C language
 - You might have to write the code for everything including:
 - Reading the sensor's data.
 - Processing the data.
 - Handling the communication and the security.
 - Taking the actions.
 - Consumes time and effort.



HOW TO MAKE YOUR OWN IOT DEVICE

- Supported kits by Arduino:

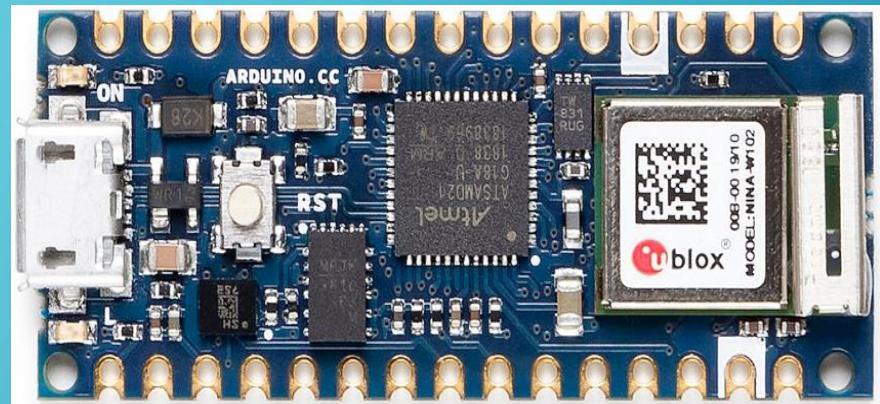


ESP32



ESP8266

Our Example



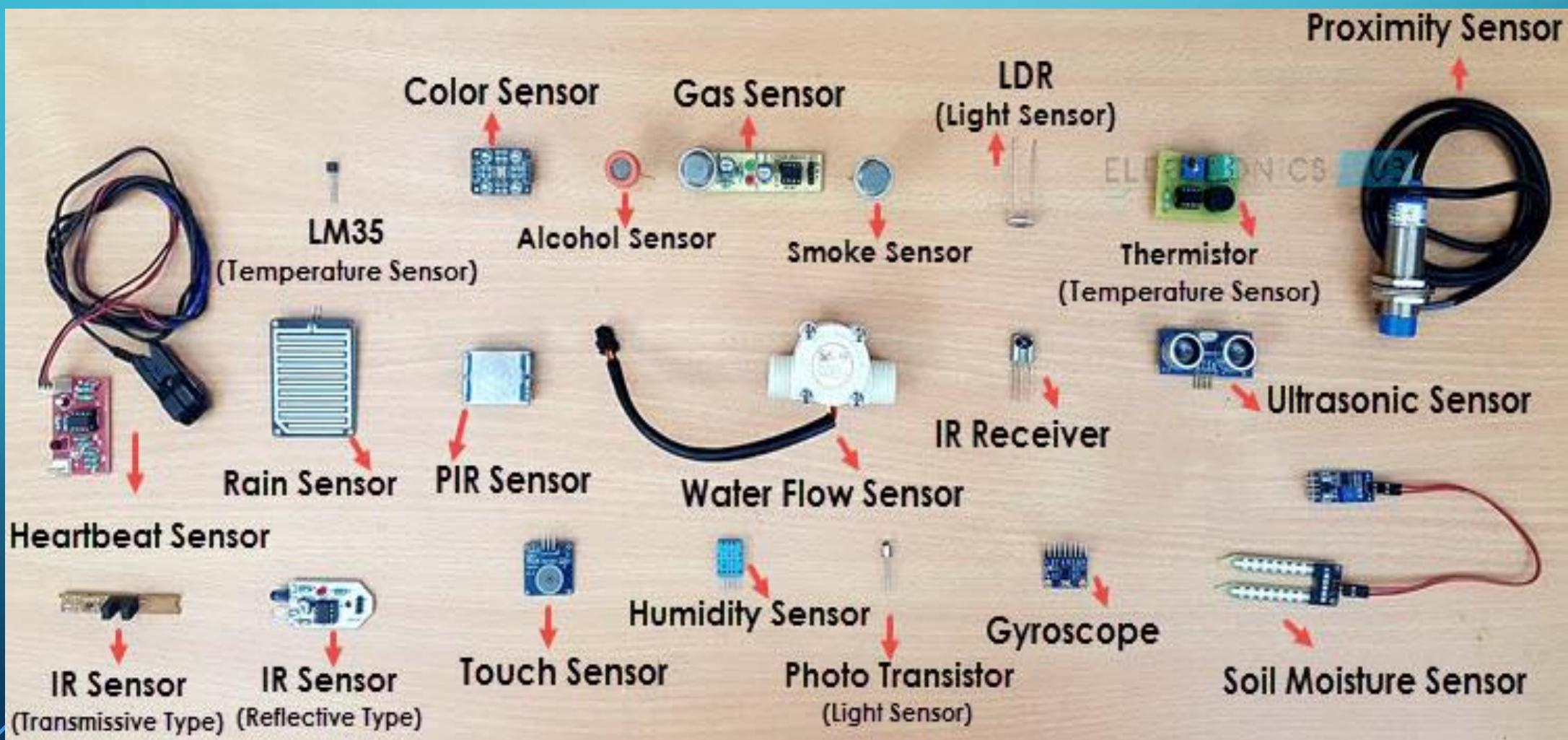
Arduino Nano 33 IoT



Arduino MKR1000 WIFI

HOW TO MAKE YOUR OWN IOT DEVICE

- Learning how to use different sensors by practicing.



HOW TO MAKE YOUR OWN IOT DEVICE

- Learning how to communicate to IOT cloud servers.



HOW TO MAKE YOUR OWN IOT DEVICE

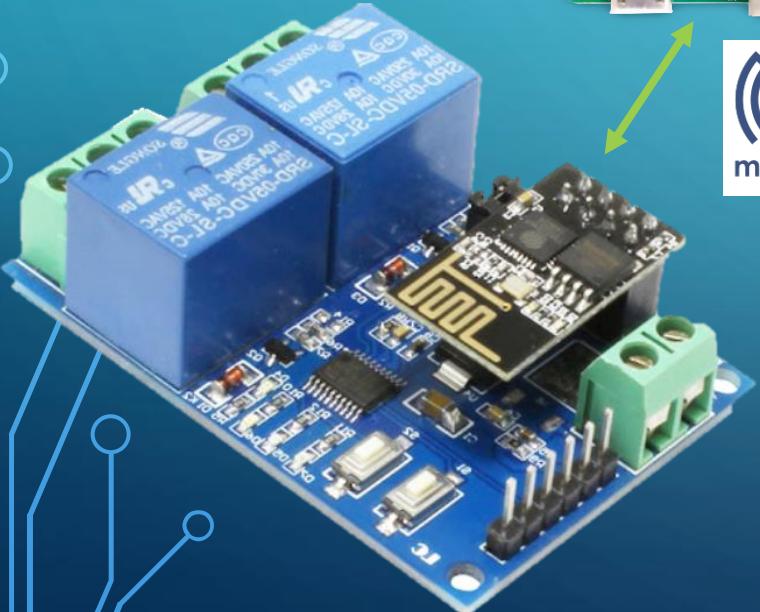
- Learning how to make your own IOT home server (Advanced).



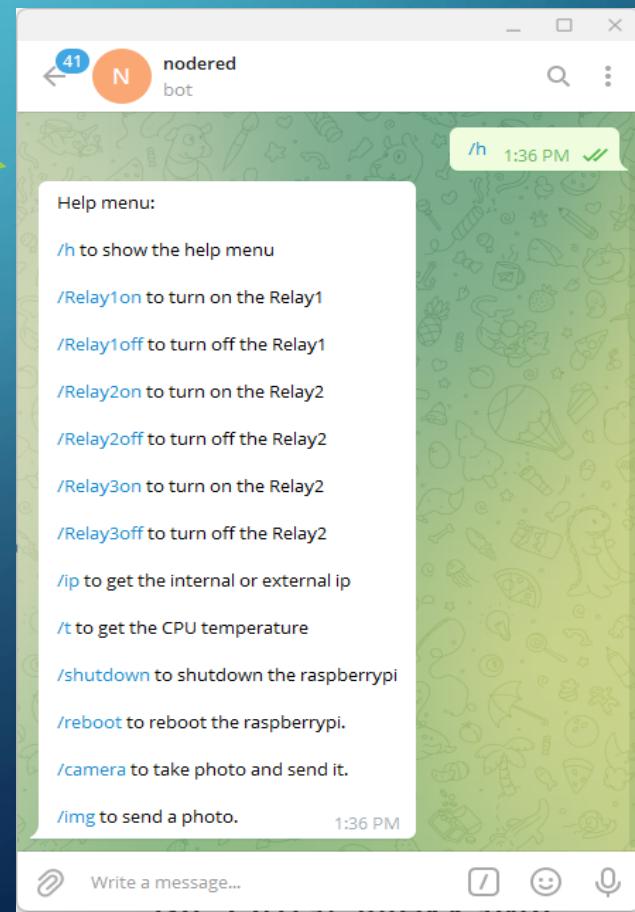
NodeRed



Mosquitto



Telegram Bot



Thank you