

The background of the slide features a light gray circuit board pattern with various traces and circular components. A solid black horizontal band runs across the middle of the image, serving as a backdrop for the text.

Arduino Workshop

Internet of Things



Agenda

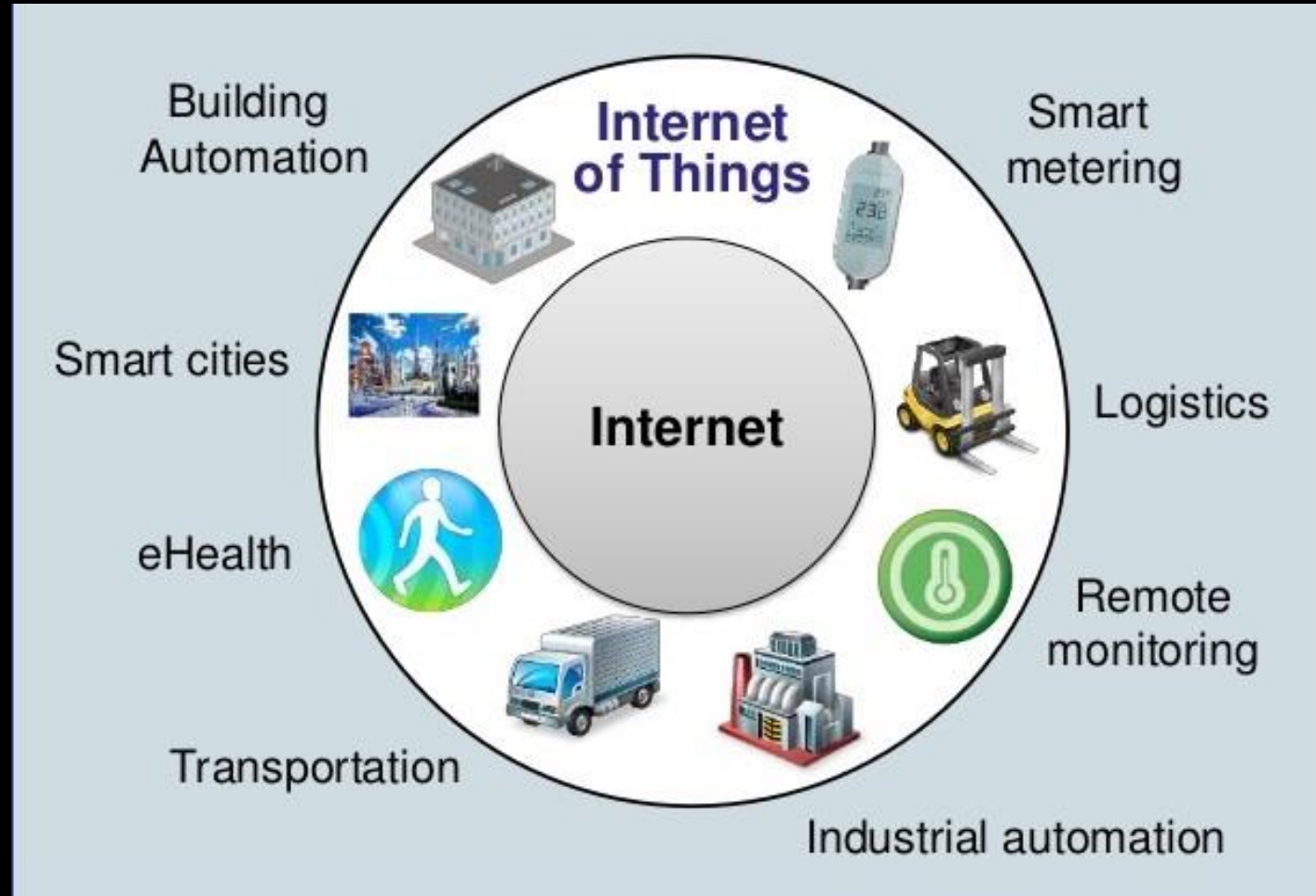
- Part -01 (Arduino basics)
 - Introduction to Internet of Things
 - Arduino – an IoT device
 - Arduino IDE – setup and installation
 - Hands on – programming Arduino
- Part -02 (Arduino Wi-Fi)
 - ESP8266 – Wi-Fi capability for Arduino
 - ThingSpeak – IoT platform
 - Upload sensor data to ThingSpeak

Internet of Things (IoT)

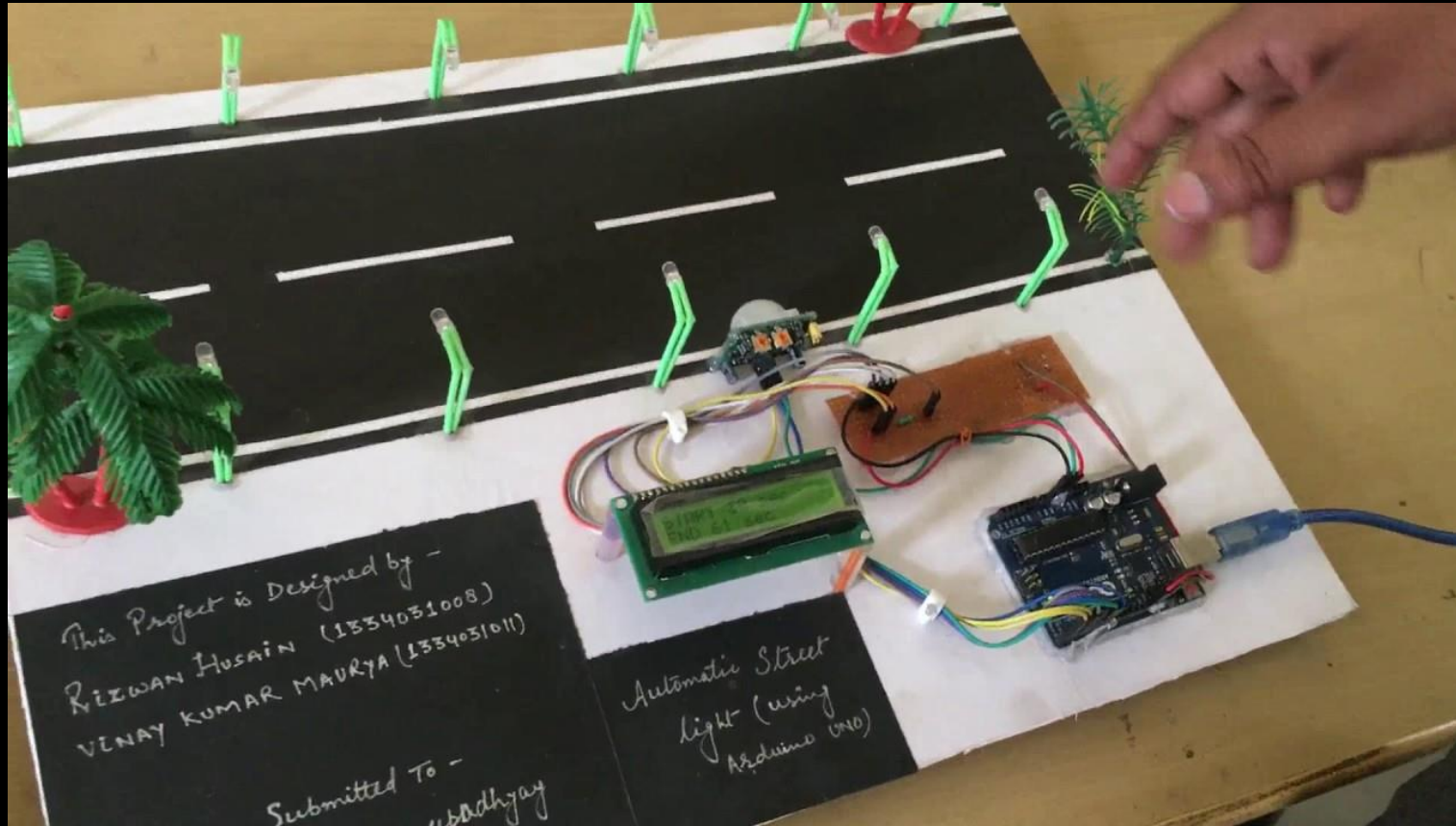
- Network of things (physical devices, vehicles, and other items embedded with electronics, software, sensors, and actuators).
- Network connectivity which enable these objects to collect and exchange data.
- Each thing is uniquely identifiable through its embedded computing system.
- 30 billion objects by 2020.



IoT applications



IoT applications

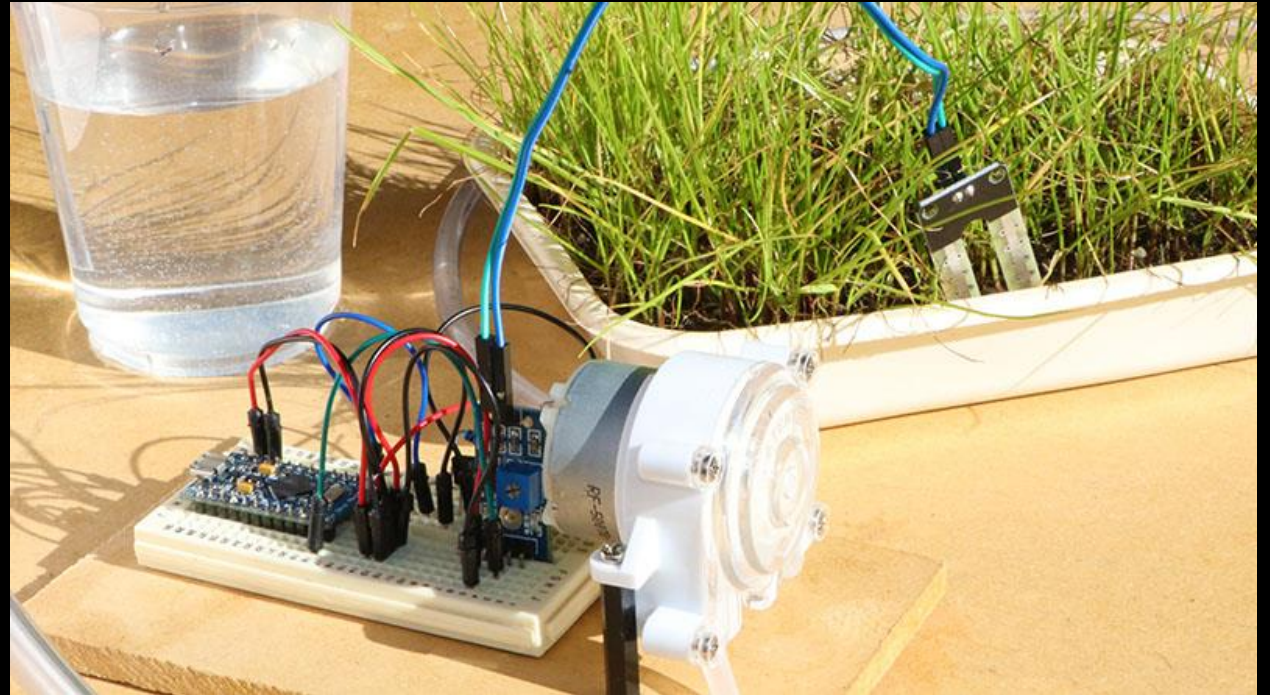


Automatic street lighting system

IoT applications

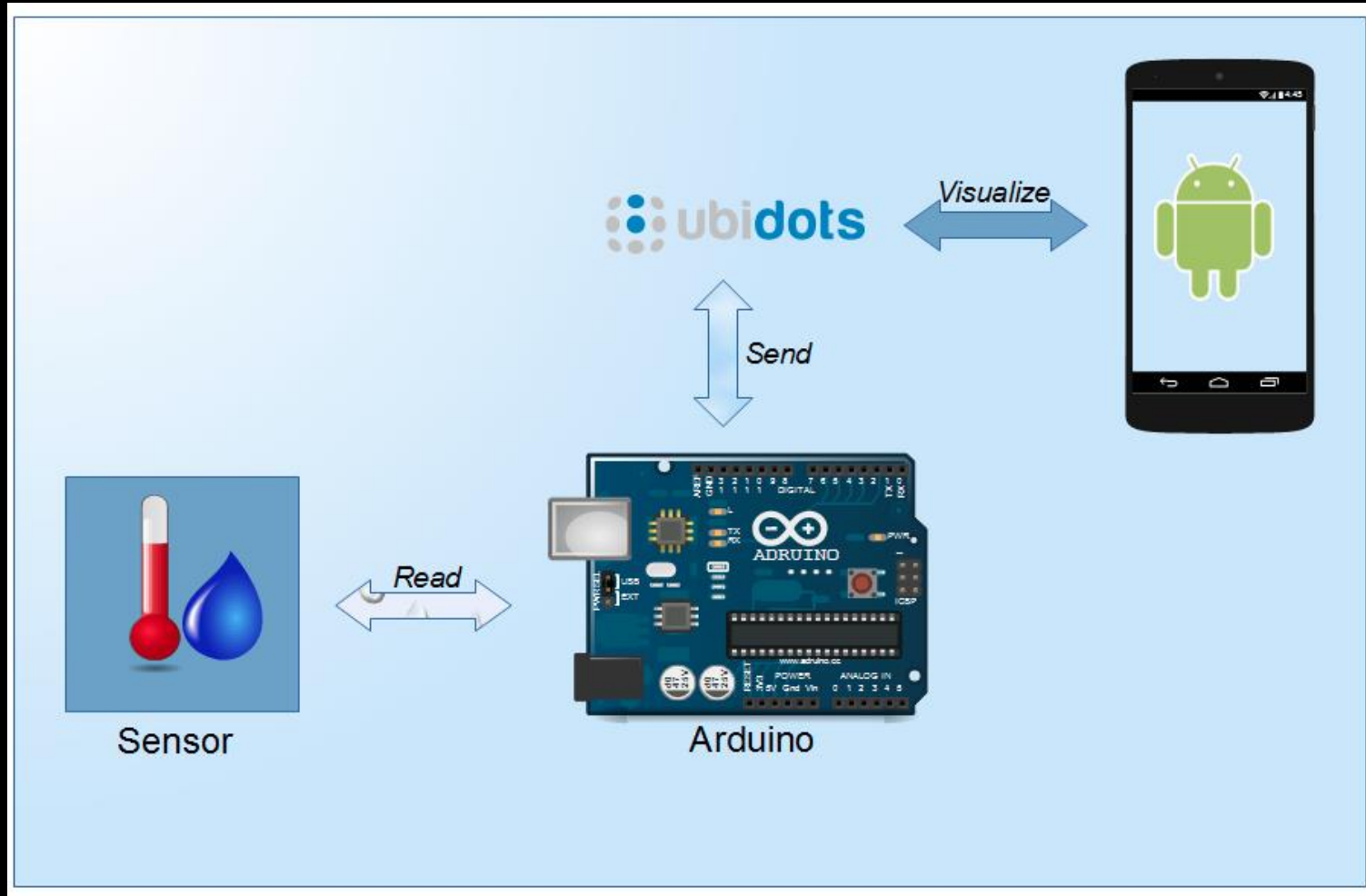


IoT controlled Rover



Arduino based Smart watering of plants

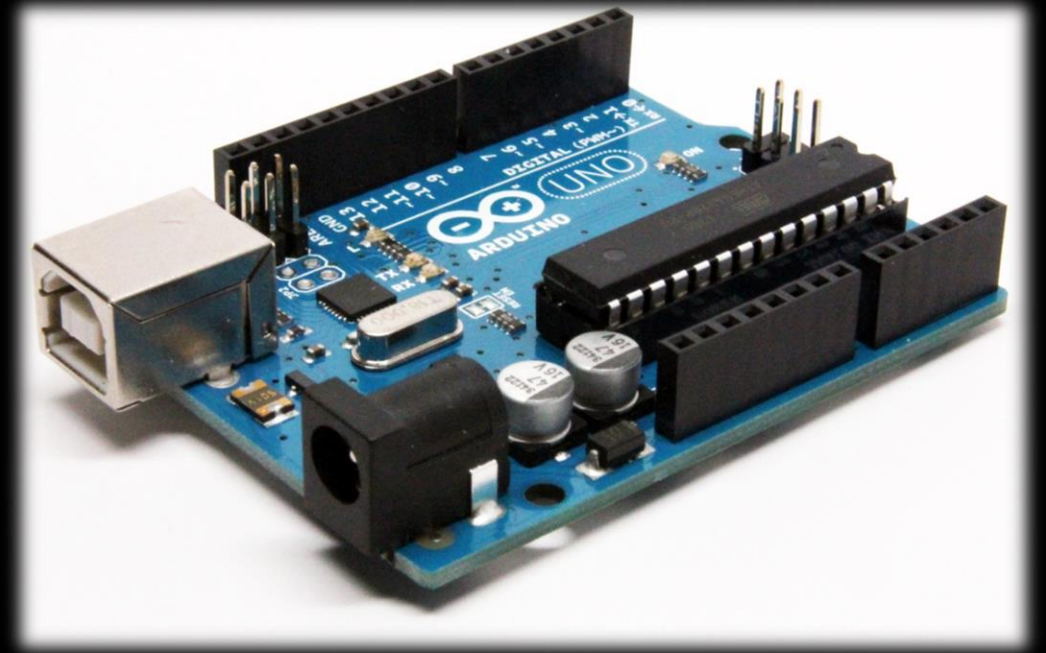
IoT applications



IoT based remote monitoring and sensor data visualization

Arduino

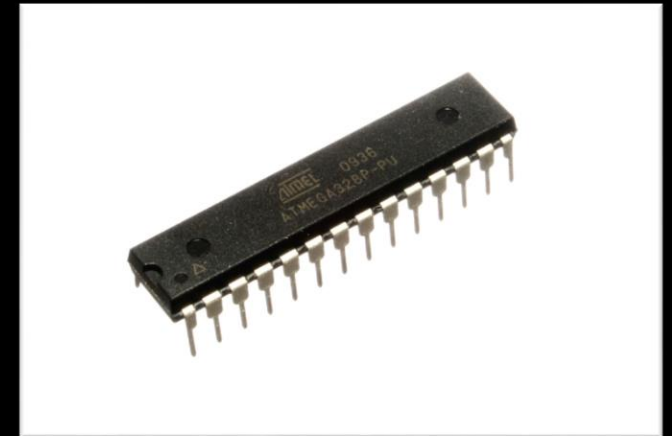
- Open source computer hardware and software.
- Maker hardware, rapid prototyping, robotics, IoT.
- Includes a microcontroller, and pins to connect various peripherals.
- Bare metal target – no operating system.
- Peripherals and communication :
 - Digital I/O
 - Analog I/O
 - PWM
 - Serial
 - I2C
 - SPI
- Programmed using Arduino IDE.



Microcontroller

Atmega328

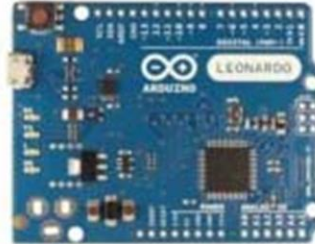
(PCINT14/RESET) PC6	<input type="checkbox"/> 1	28	<input type="checkbox"/> PC5 (ADC5/SCL/PCINT13)
(PCINT16/RXD) PD0	<input type="checkbox"/> 2	27	<input type="checkbox"/> PC4 (ADC4/SDA/PCINT12)
(PCINT17/TXD) PD1	<input type="checkbox"/> 3	26	<input type="checkbox"/> PC3 (ADC3/PCINT11)
(PCINT18/INT0) PD2	<input type="checkbox"/> 4	25	<input type="checkbox"/> PC2 (ADC2/PCINT10)
(PCINT19/OC2B/INT1) PD3	<input type="checkbox"/> 5	24	<input type="checkbox"/> PC1 (ADC1/PCINT9)
(PCINT20/XCK/T0) PD4	<input type="checkbox"/> 6	23	<input type="checkbox"/> PC0 (ADC0/PCINT8)
VCC	<input type="checkbox"/> 7	22	<input type="checkbox"/> GND
GND	<input type="checkbox"/> 8	21	<input type="checkbox"/> AREF
PCINT6/XTAL1/TOSC1) PB6	<input type="checkbox"/> 9	20	<input type="checkbox"/> AVCC
PCINT7/XTAL2/TOSC2) PB7	<input type="checkbox"/> 10	19	<input type="checkbox"/> PB5 (SCK/PCINT5)
(PCINT21/OC0B/T1) PD5	<input type="checkbox"/> 11	18	<input type="checkbox"/> PB4 (MISO/PCINT4)
(PCINT22/OC0A/AIN0) PD6	<input type="checkbox"/> 12	17	<input type="checkbox"/> PB3 (MOSI/OC2A/PCINT3)
(PCINT23/AIN1) PD7	<input type="checkbox"/> 13	16	<input type="checkbox"/> PB2 (\overline{SS} /OC1B/PCINT2)
(PCINT0/CLKO/ICP1) PB0	<input type="checkbox"/> 14	15	<input type="checkbox"/> PB1 (OC1A/PCINT1)



Arduino variants



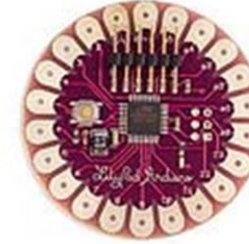
Arduino Uno



Arduino Leonardo



Arduino Mega 2560



Arduino LilyPad



Arduino Mega ADK



Arduino Fio



Arduino Ethernet



Arduino Pro



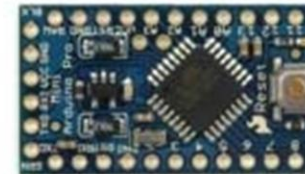
Arduino BT



Arduino Nano

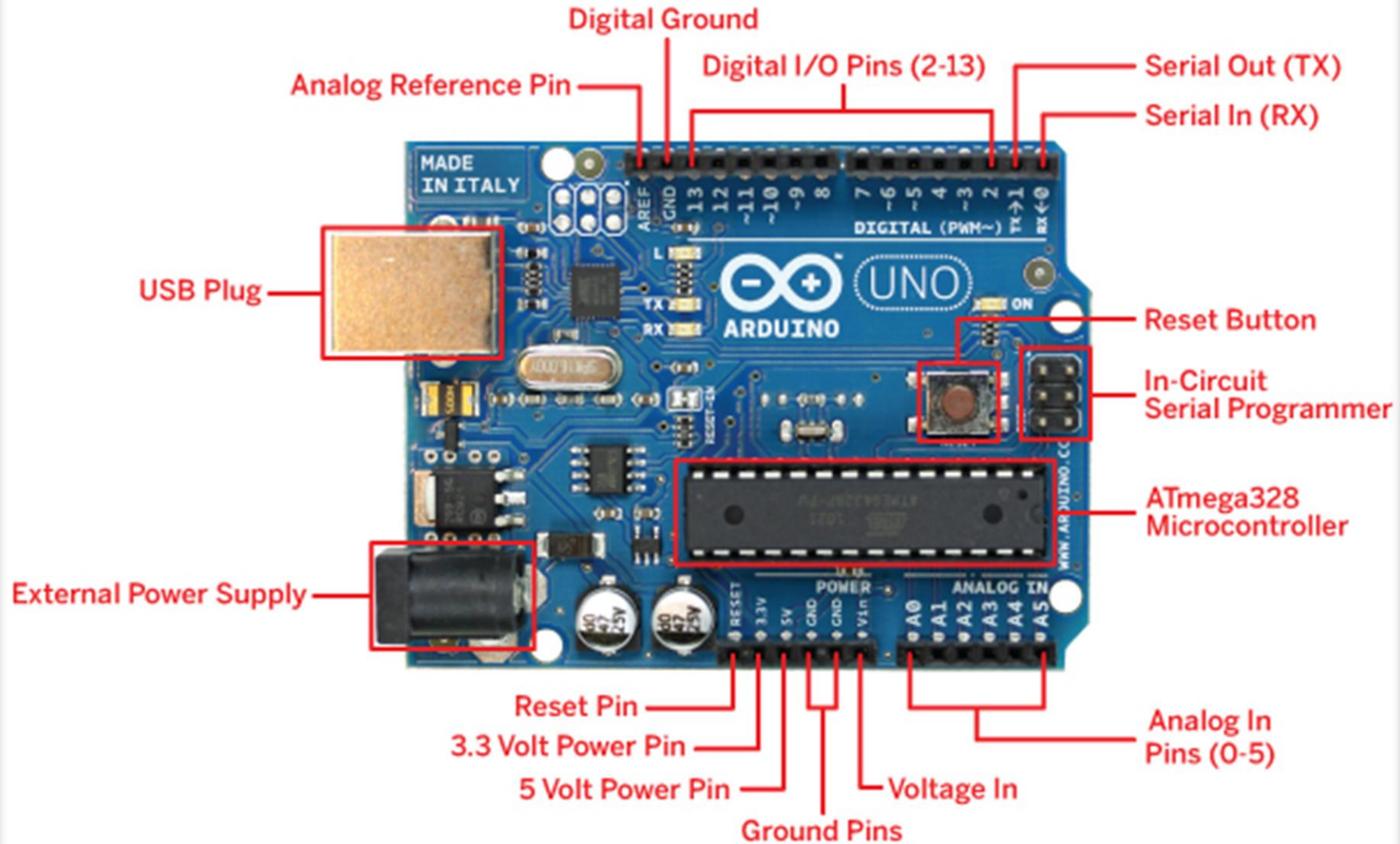


Arduino Mini

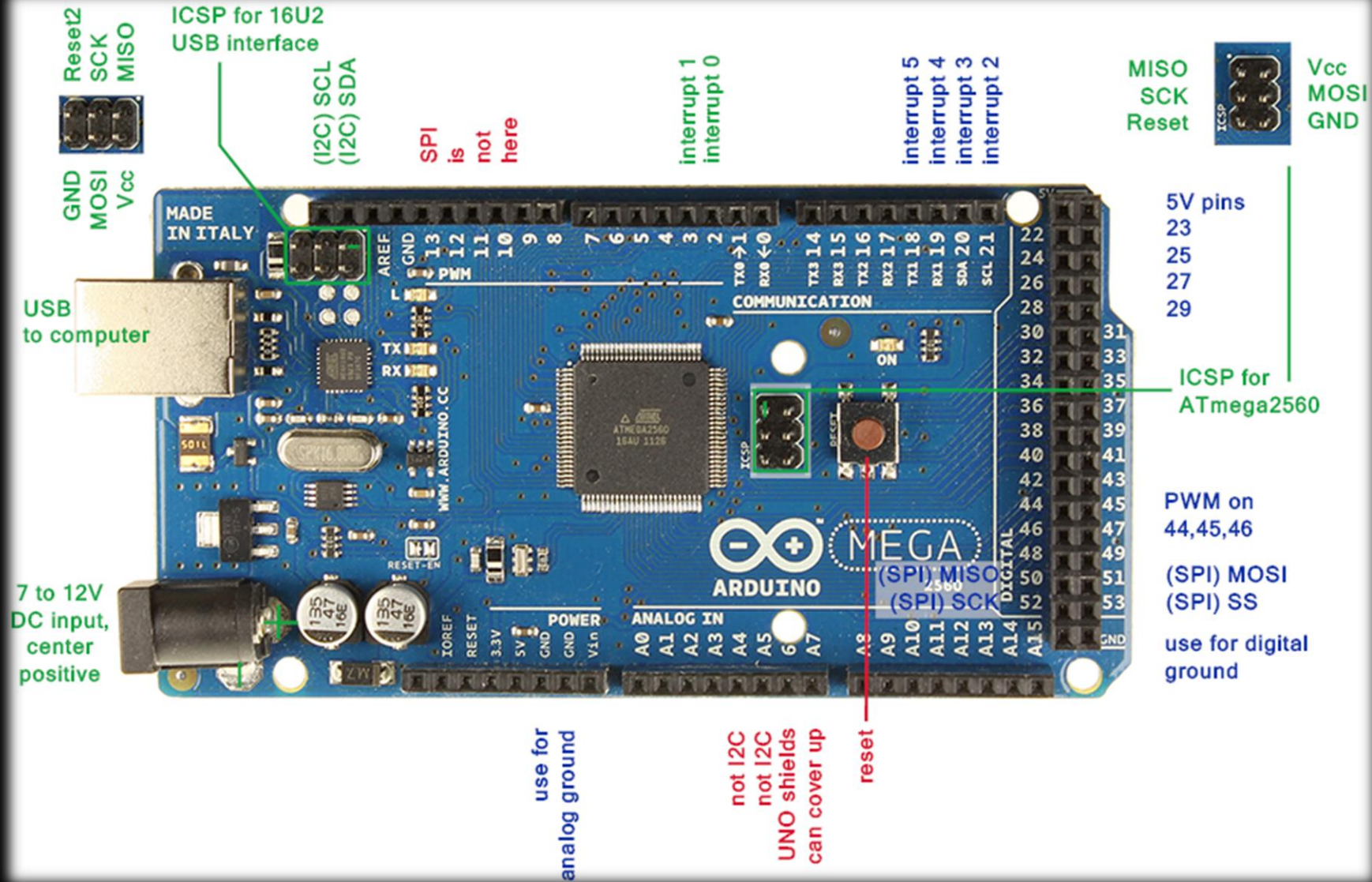


Arduino Pro Mini

Arduino Uno

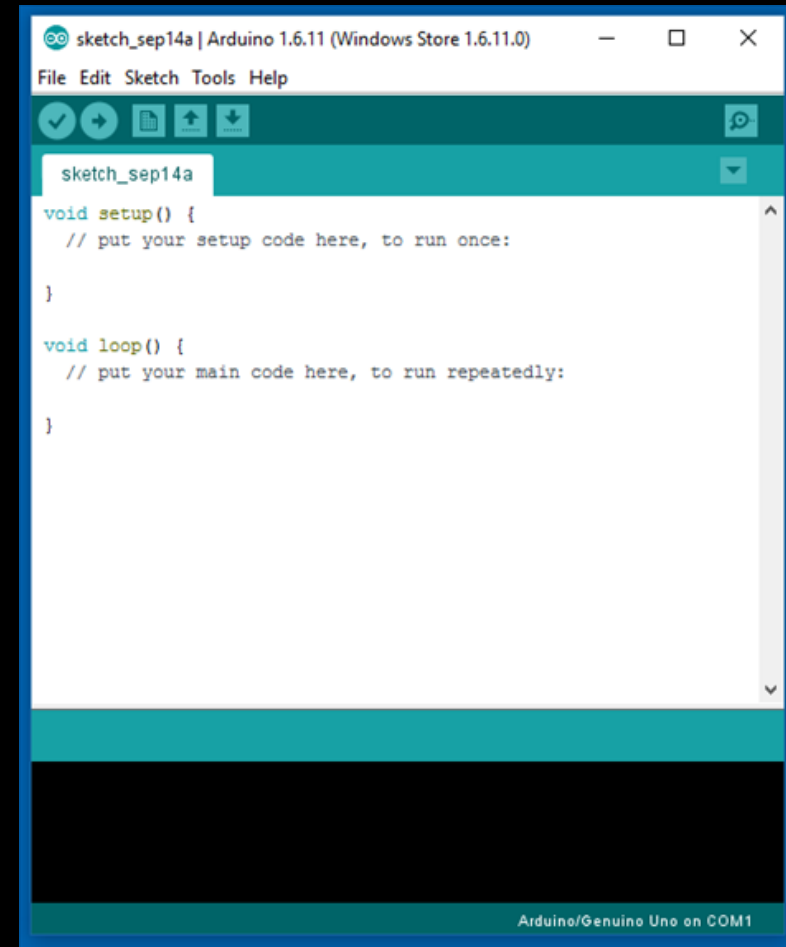


Arduino Mega 2560



Arduino IDE installation

- <https://www.arduino.cc/en/Main/Software>
- Virtual COM port
- Tools -> Board
- Tools -> Port
- Tools -> Serial Monitor
- Tools -> Serial Plotter



Arduino Sketch

void setup()

{

// put your setup code here, to run once:

}

void loop()

{

// put your main code here, to run repeatedly:

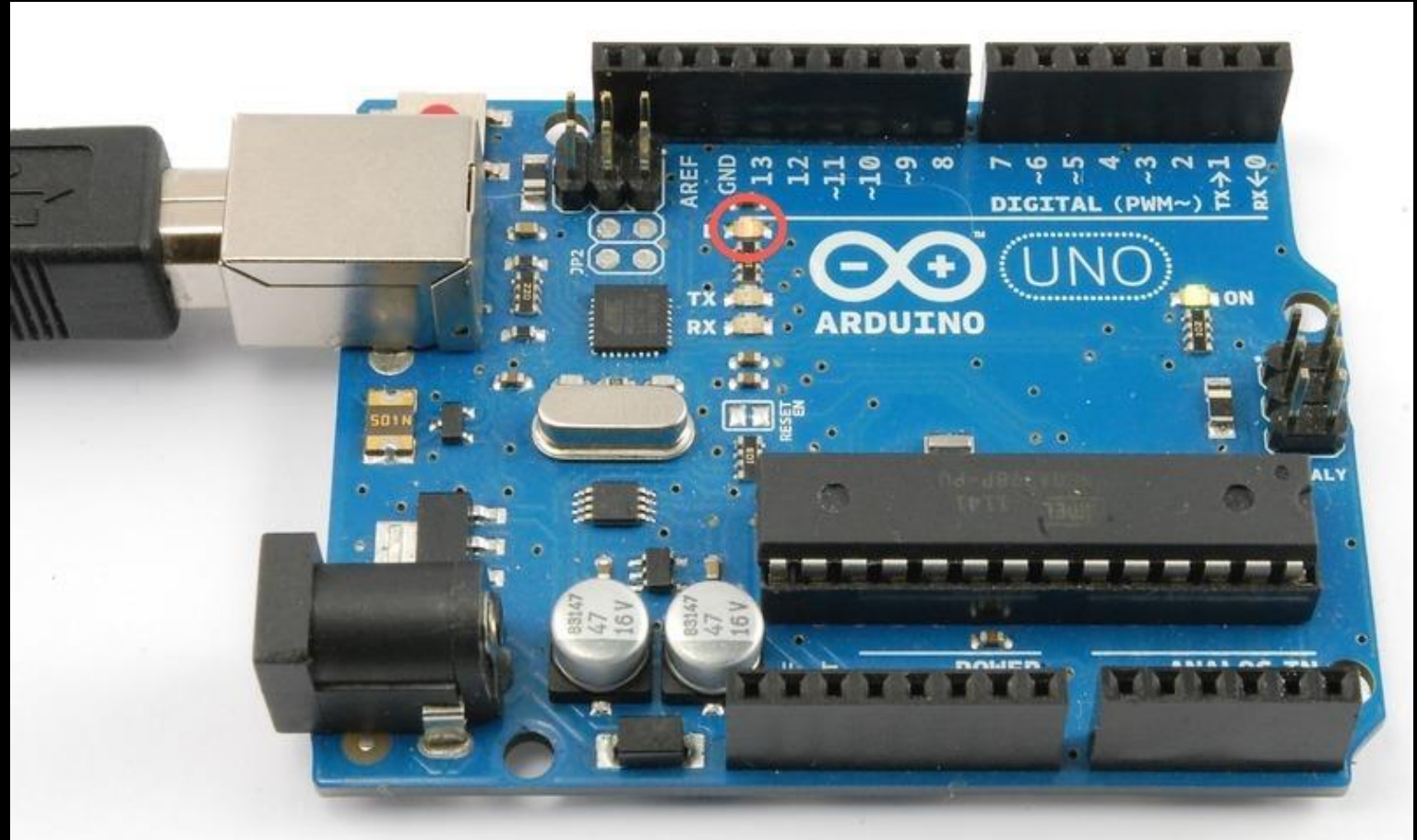
}

Part – 01 (Arduino Basics)

1. Onboard LED blink
2. External LED blink
3. RGB LED
4. Potentiometer to control LED brightness
5. Alarm sound using Piezo buzzer
6. Read LDR Light sensor
7. Read LM35 Temperature sensor

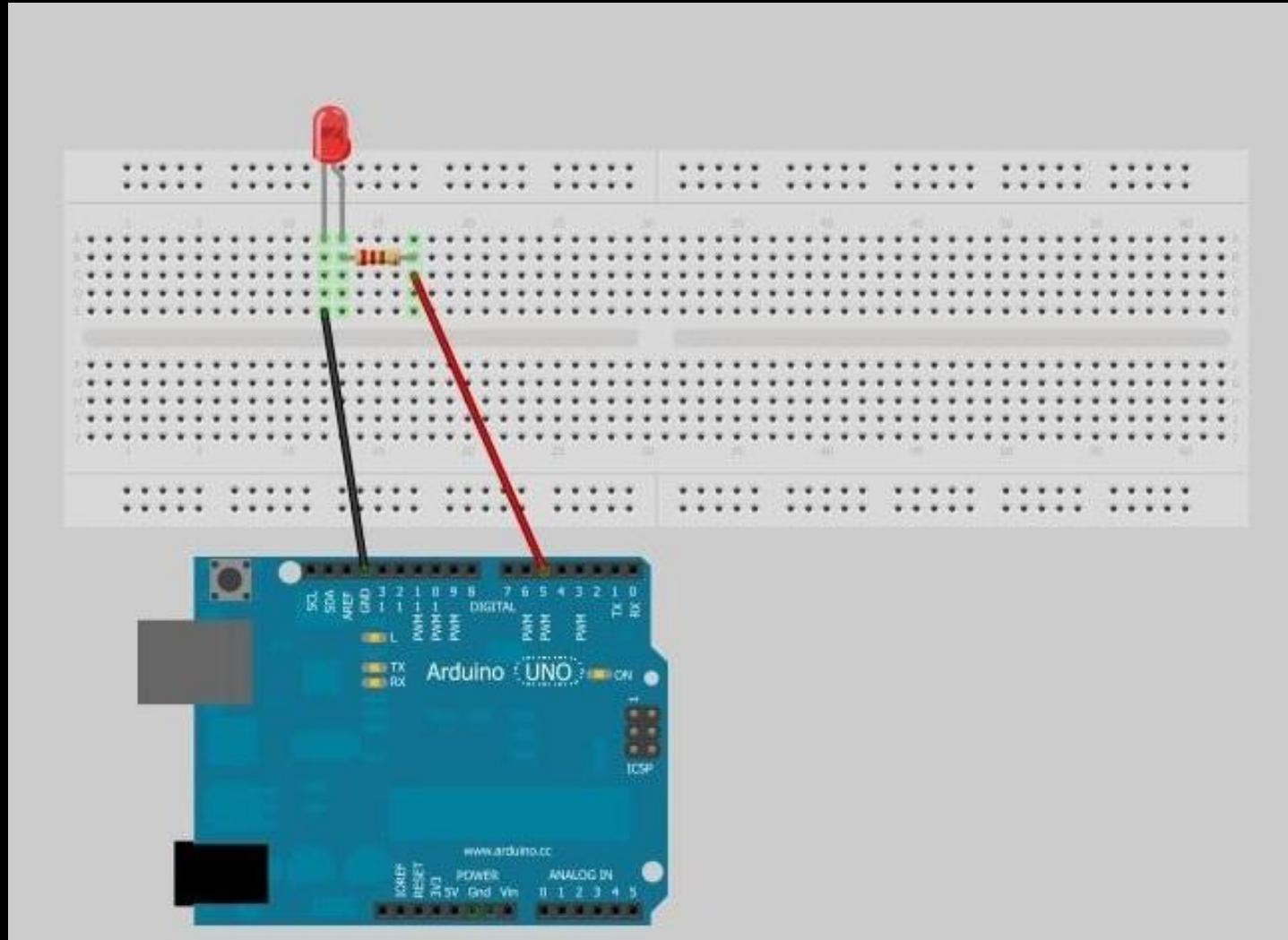
Task 1 : Onboard LED Blink

- pinMode()
- digitalWrite()

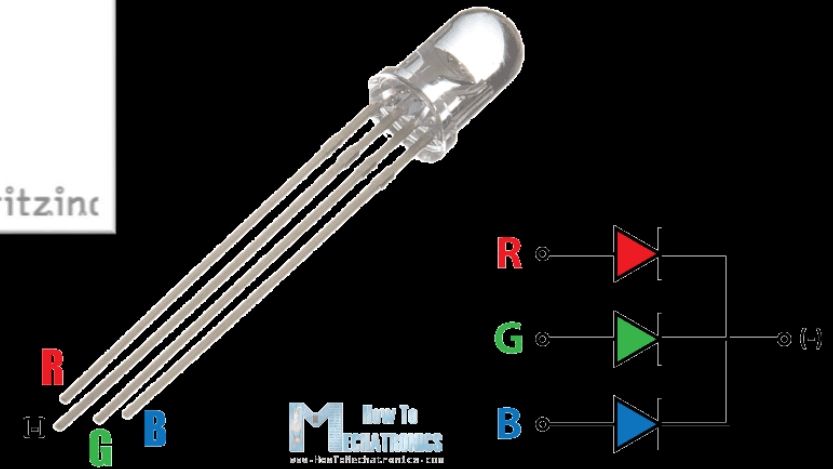
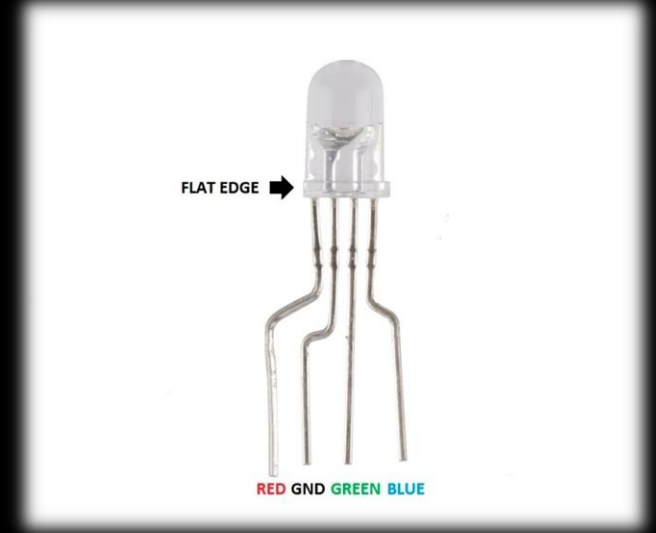
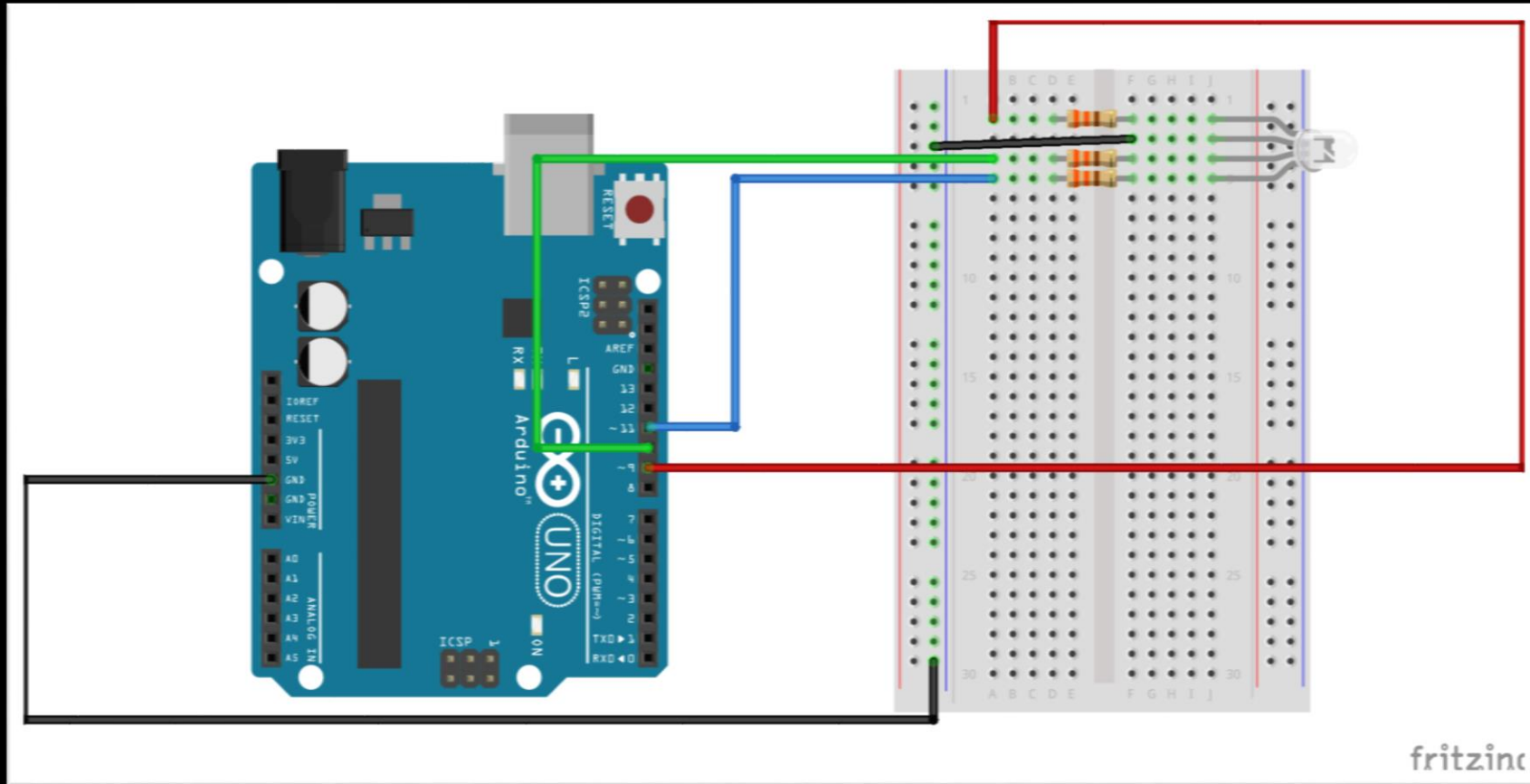


Task 2 : External LED Blink

- pinMode()
- digitalWrite()

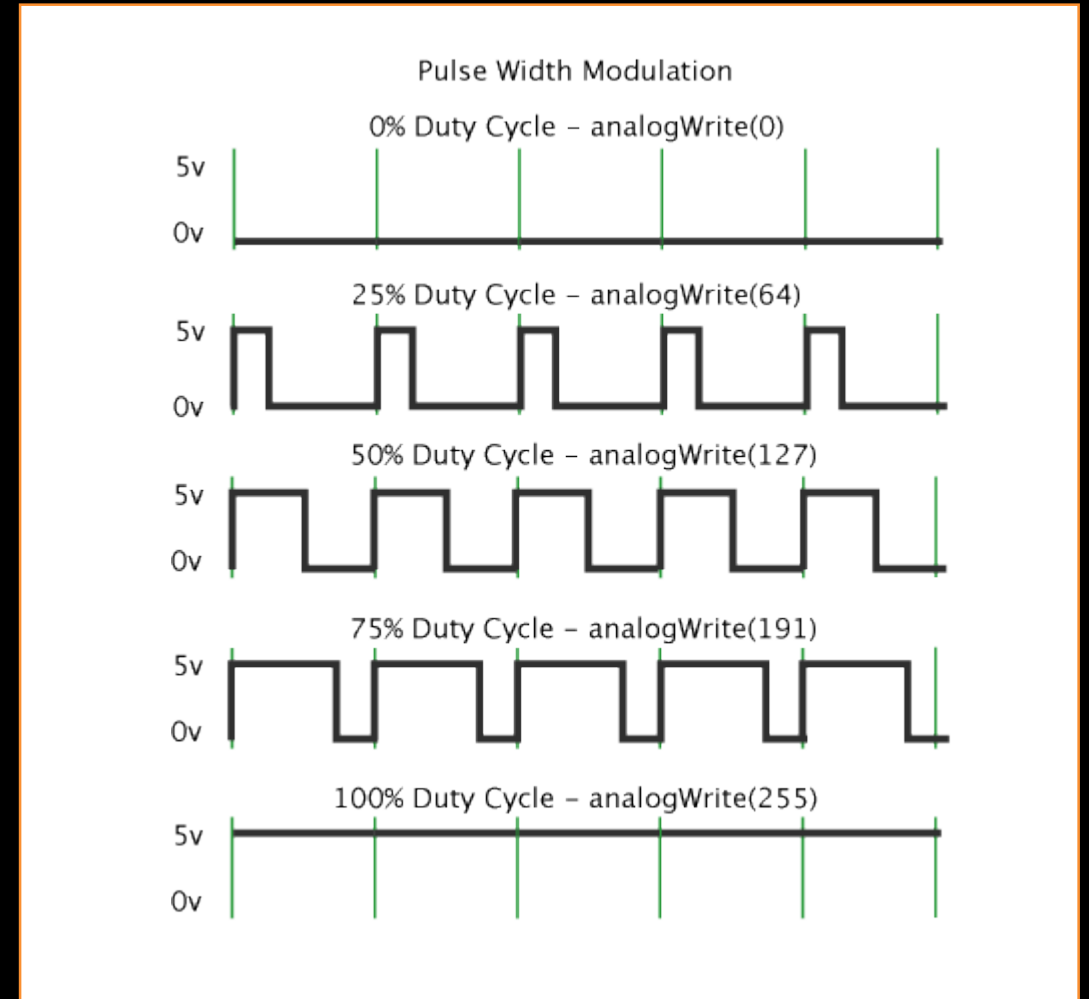


Task 3 : RGB LED

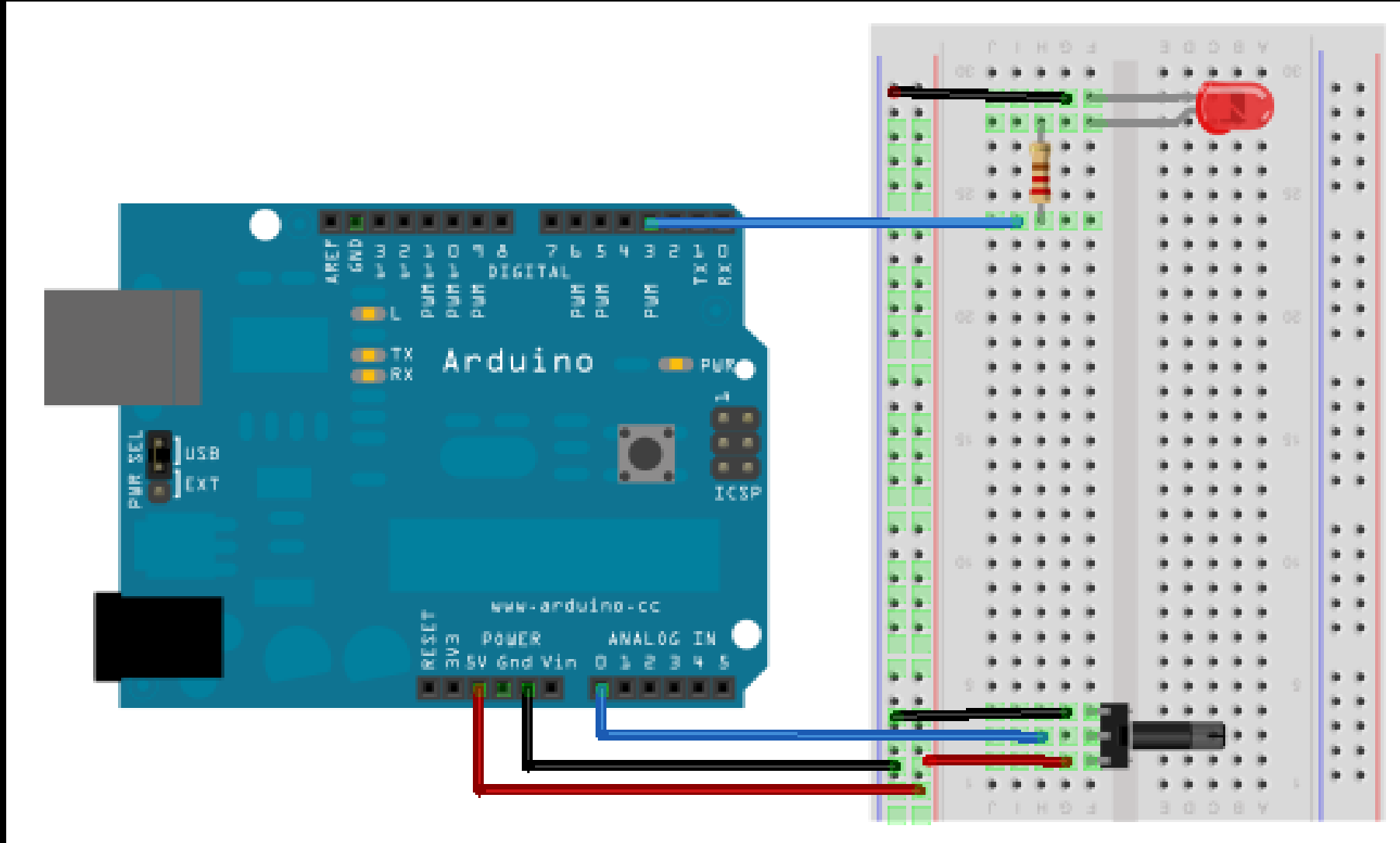


Task 4 :Potentiometer to control LED brightness

- Pulse Width Modulation
- `analogWrite(pin, value)`
- 0(0%) – 255 (100%)

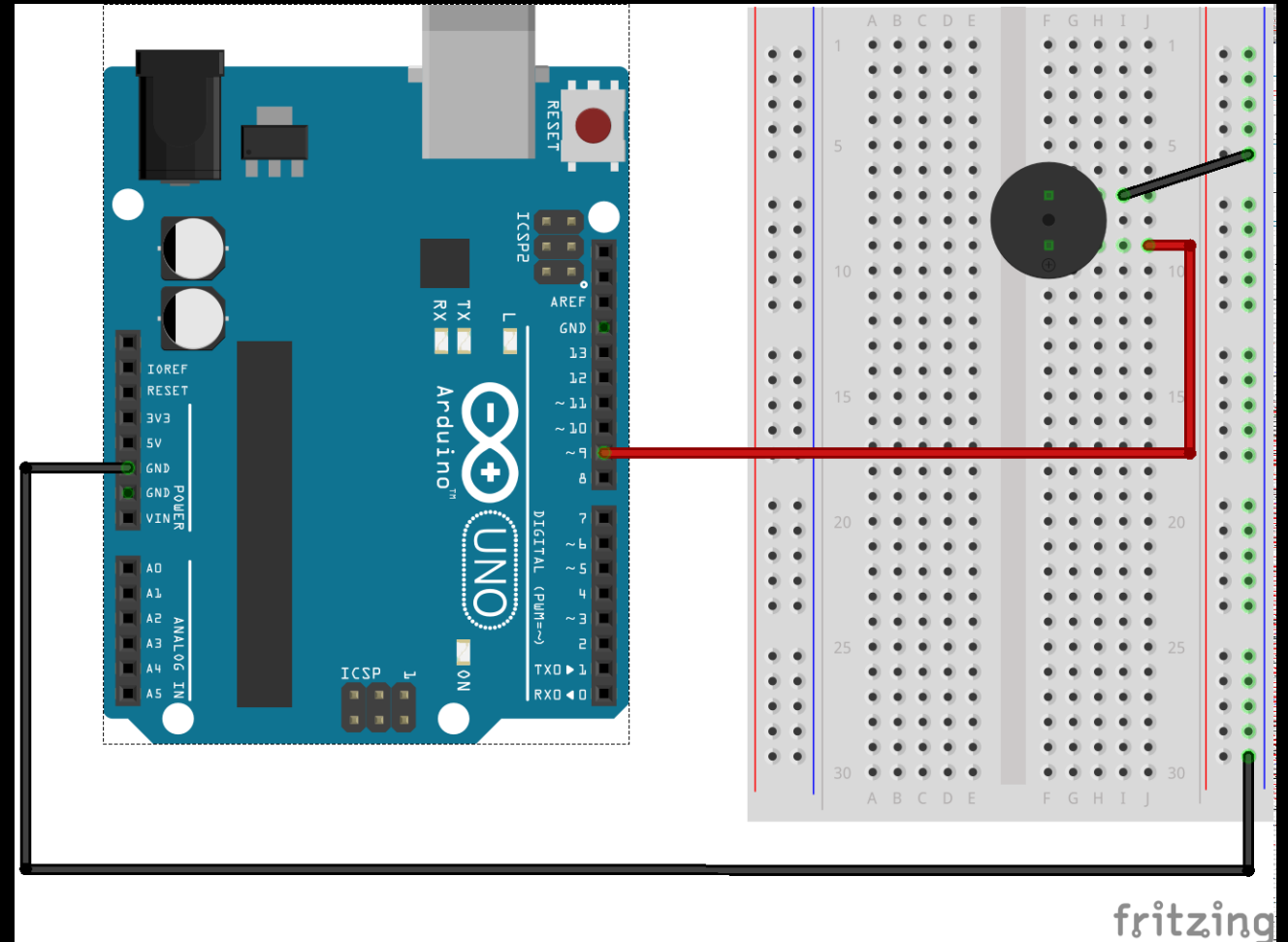


Task 4 :Potentiometer to control LED brightness



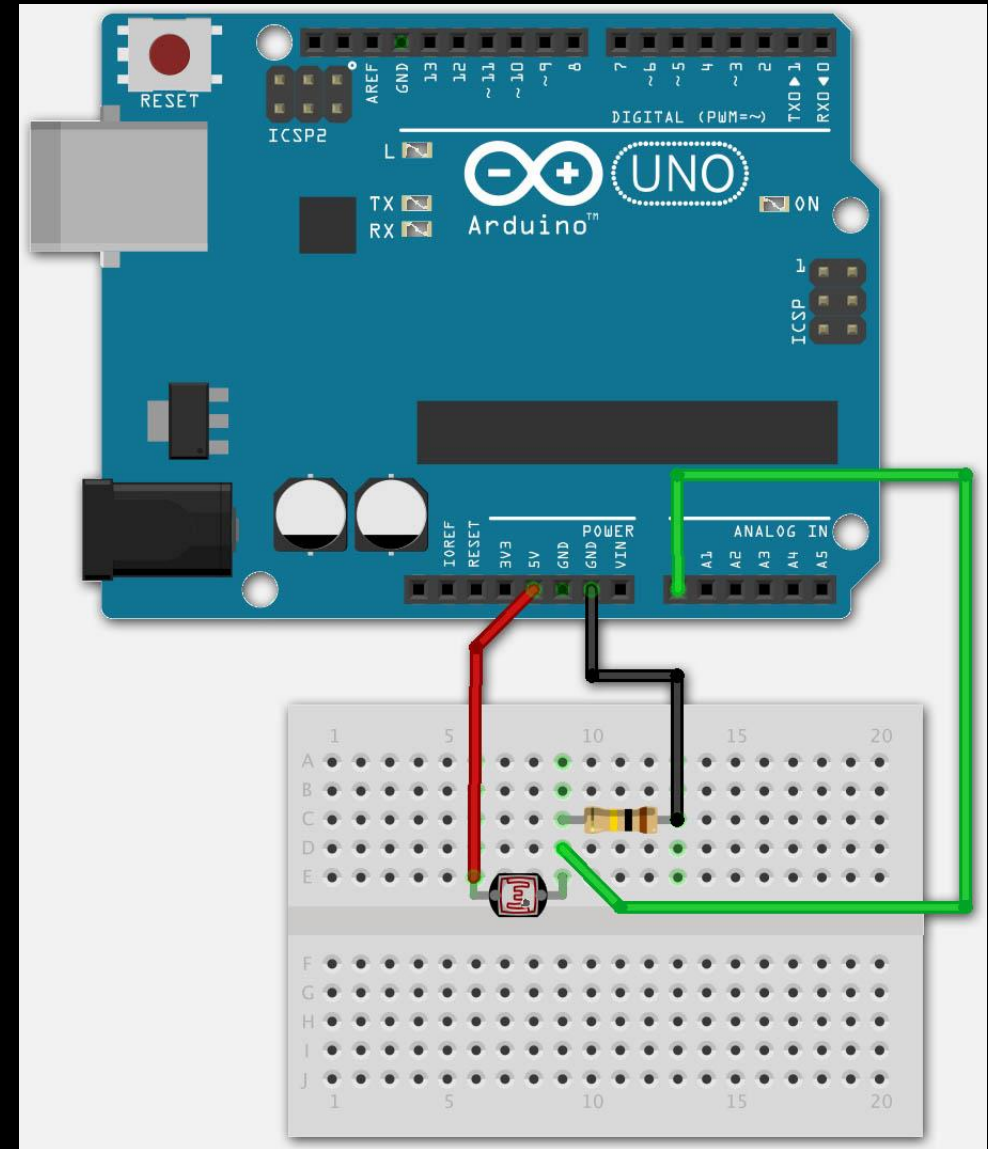
Task 5 : Alarm sound using Piezo buzzer

- tone (pin, frequency, duration)

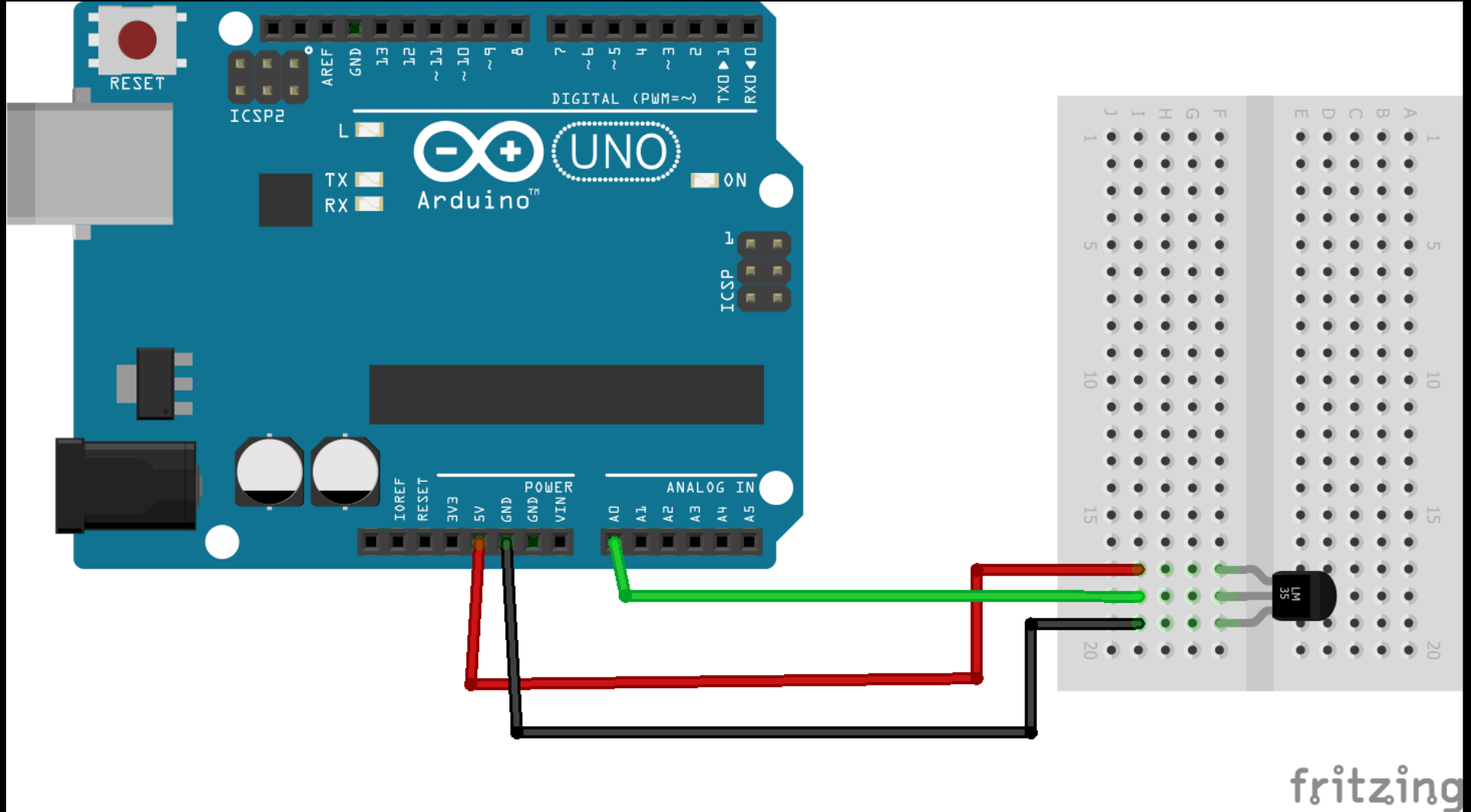


Task 6 : Read LDR light sensor

- Light Dependent Resistor
- `analogRead(pin)`
- Serial monitor
- Serial plotter



Task 7 : Read LM35 temperature sensor

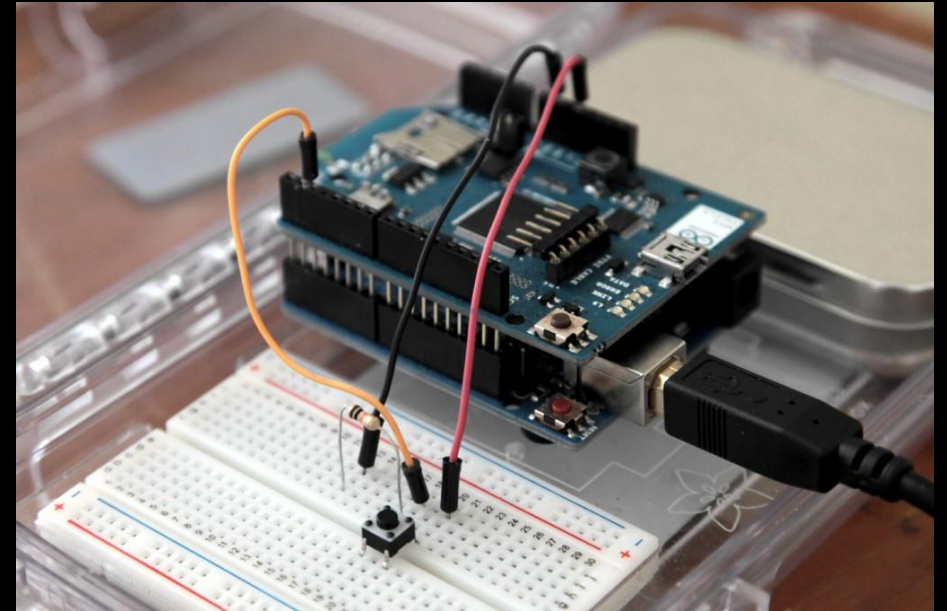


Task 8 : LDR sensor based light control

Task 9 : LM35 sensor based Temperature alarm

Part – 02 (WiFi with Arduino)

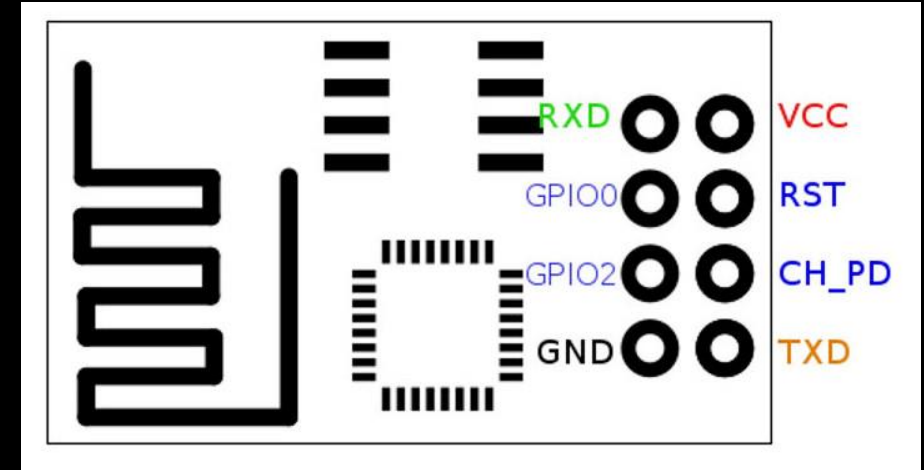
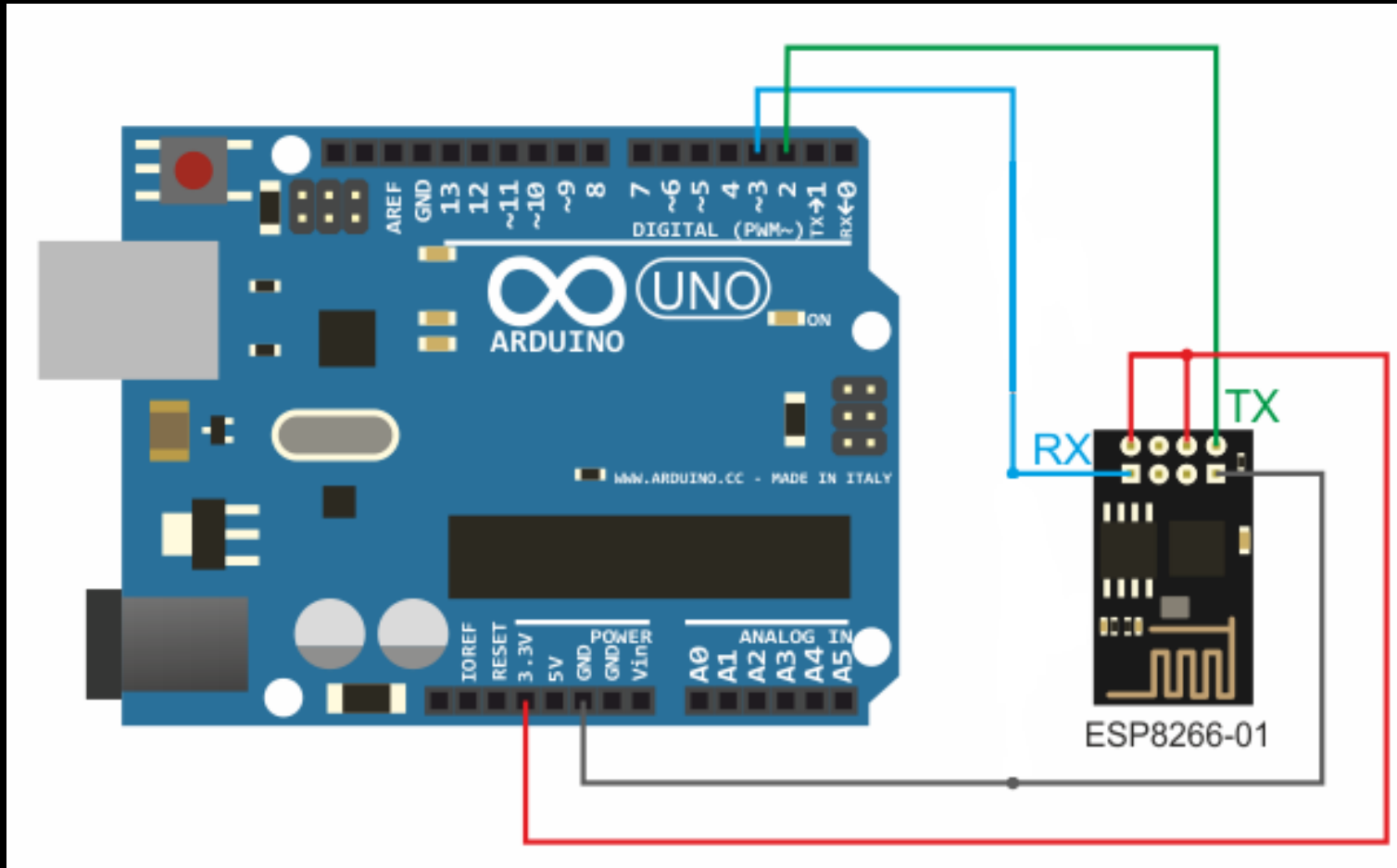
- WiFi shield, Ethernet Shield
 - official add-on from Arduino (costs 90\$ approx)
- Cheaper alternative – ESP8266 based WiFi chips (costs 5\$ approx)
- Chinese manufacturer – Espressif
- Various variants available.
- ESP-01



ESP8266 variants



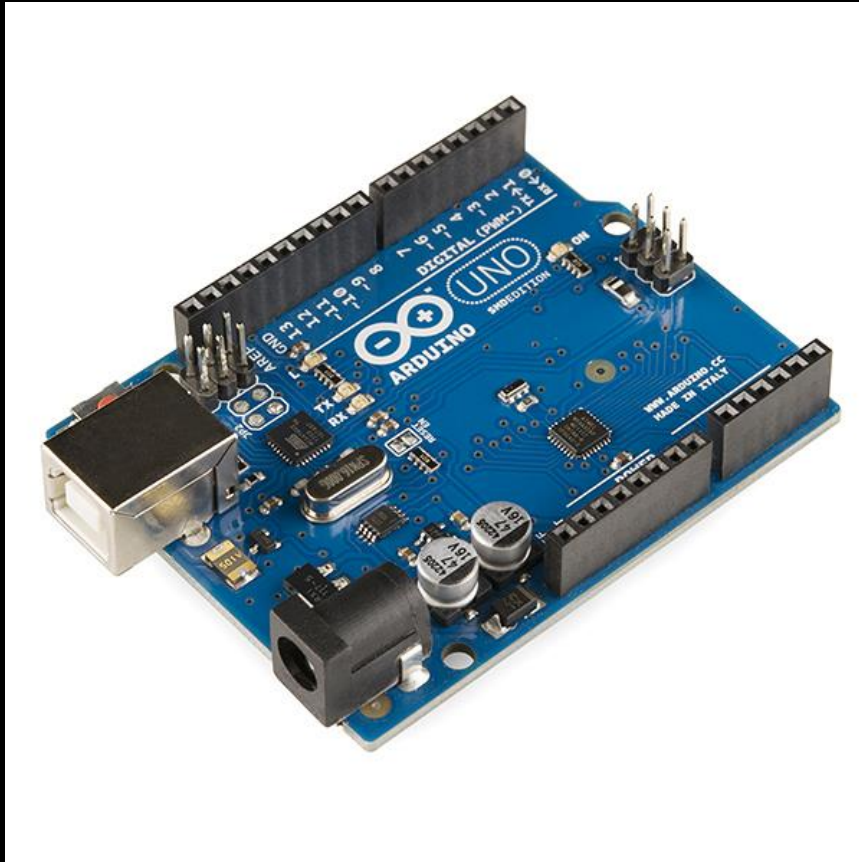
Connecting ESP8266 with Arduino



Arduino	ESP8266
3.3V	VCC, CH_PD
TX / 3	RX
RX / 2	TX
GND	GND

Arduino – ESP8266 communication

- AT firmware (AT commands)



AT request



AT response



WiFi Task – 1 : AT Communication

```
#include <SoftwareSerial.h>
```

```
SoftwareSerial esp8266(2,3); //ESP TX line to pin 2, ESP RX to pin 3
```

```
void setup()
```

```
{  
  Serial.begin(115200);  
  esp8266.begin(115200);  
}
```

```
void loop()
```

```
{  
  if(esp8266.available()) // check if the esp is sending a message  
  {  
    while(esp8266.available())  
    {  
      // The esp has data so display its output to the serial window  
      char c = esp8266.read(); // read the next character.  
      Serial.write(c);  
    }  
  }  
}
```

```
if(Serial.available())
```

```
{  
  delay(1000);  
  String command="";
```

```
  while(Serial.available()) // read the command  
  character by character
```

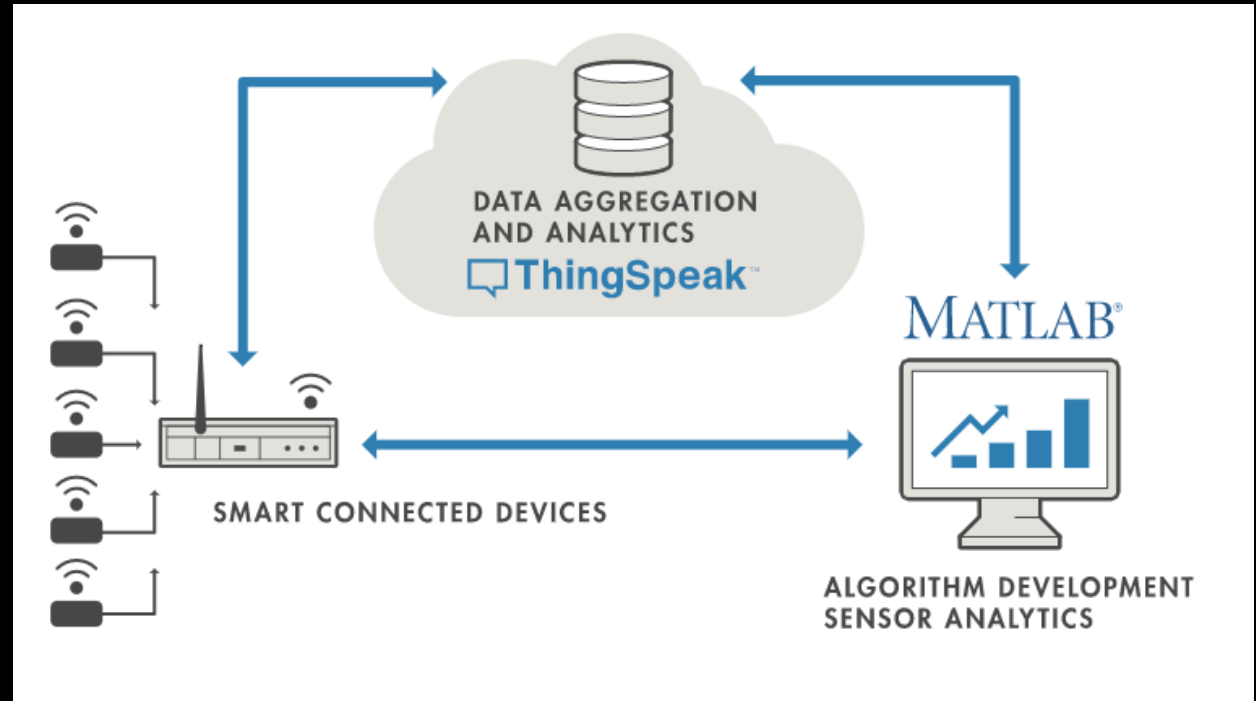
```
{  
  // read one character  
  command+=(char)Serial.read();  
}
```

```
  esp8266.println(command); // send the read  
  character to the esp8266
```

```
}
```

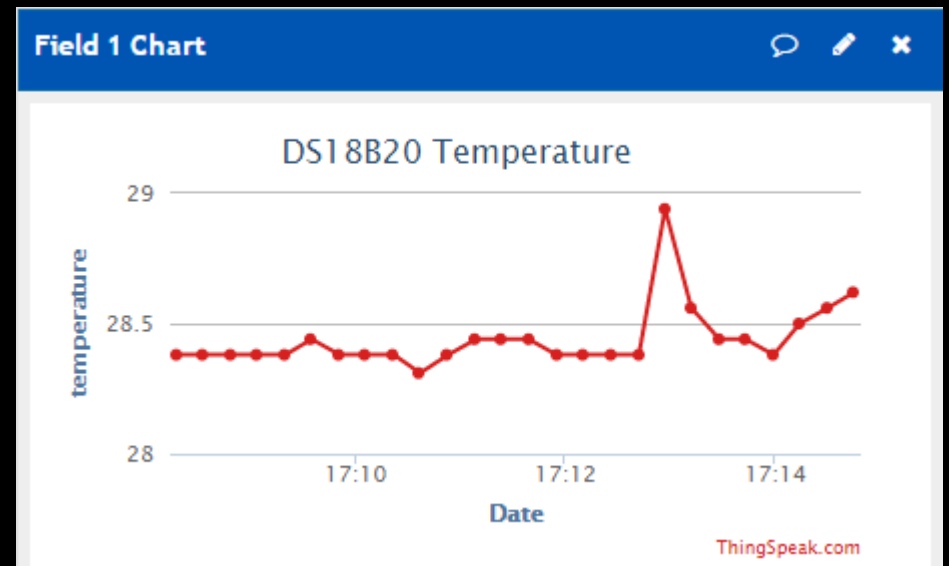
WiFi Task – 2 : Setup ThingSpeak

- <https://thingspeak.com/>
- Open IoT platform with MATLAB Analytics
- Sign up
- Create channel
- Upload sensor data



WiFi Task – 3 : Upload sensor data to ThingSpeak

- Write value to a Thingspeak channel :
 - AT+CIPSTART="TCP","184.106.153.149",80
 - AT+CIPSEND=<LENGTH OF HTTP GET MESSAGE>
 - GET /update?key=<WRITE API KEY>&field1=<VALUE>



WiFi Task – 4 : Read sensor data from ThingSpeak

- Read value from a Thingspeak channel :
 - AT+CIPSTART="TCP","184.106.153.149",80
 - AT+CIPSEND=<LENGTH OF HTTP GET MESSAGE>
 - GET <https://api.thingspeak.com/channels/<CHANNEL ID>/fields/<FIELD NUM>/last.txt>

IOT Projects



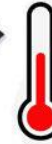
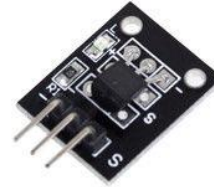
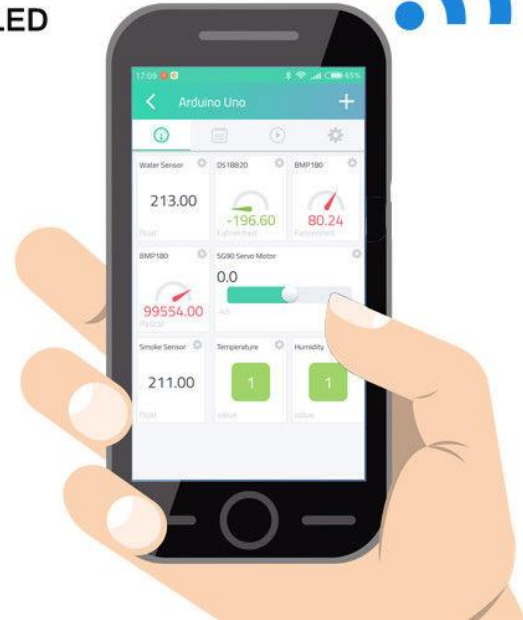
Water level Sensor



Tem&Humidity Sensor



LED



Temperature Sensor



PIR Motion Sensor

Buzzer



Thank You