IoT With ESP8266

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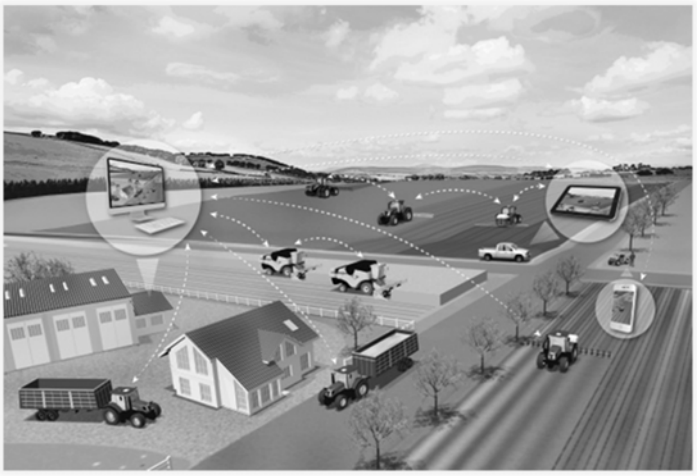
AGENDA FOR 1 DAYS TRAINING

- IoT Concept and Applications
- Environment and Equipment of system
- Start with Developing tools kit
- Workshop#1 Test board NodeMCU V2
- Workshop#2 temperature and humidity sensor
- Workshop#3 Mini project IoT 2way switch control via Smart Phone

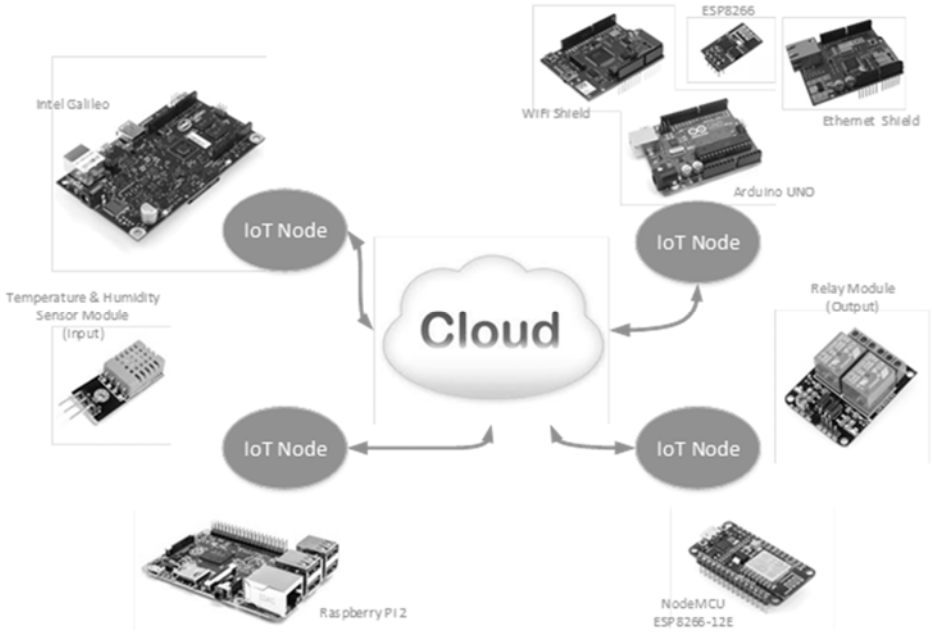
IoT Concept



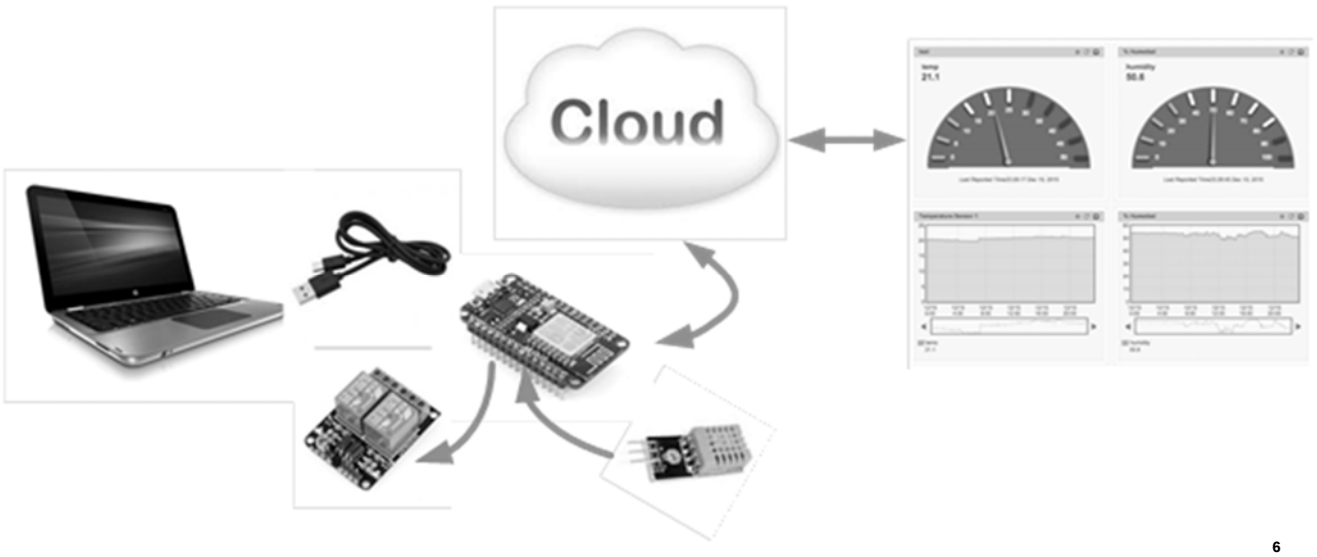
Internet of Things (IoT) Components

- Things
- Sensors & Controls I/O
- Internet connect devices
- Data
- Cloud Service

IoT Development guide

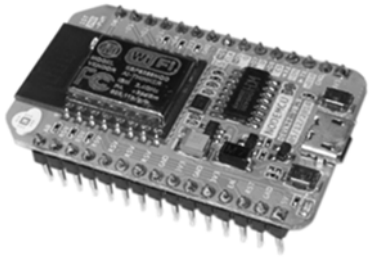


SYSTEM DESIGN CONCEPT



About NodeMCU ESP8266

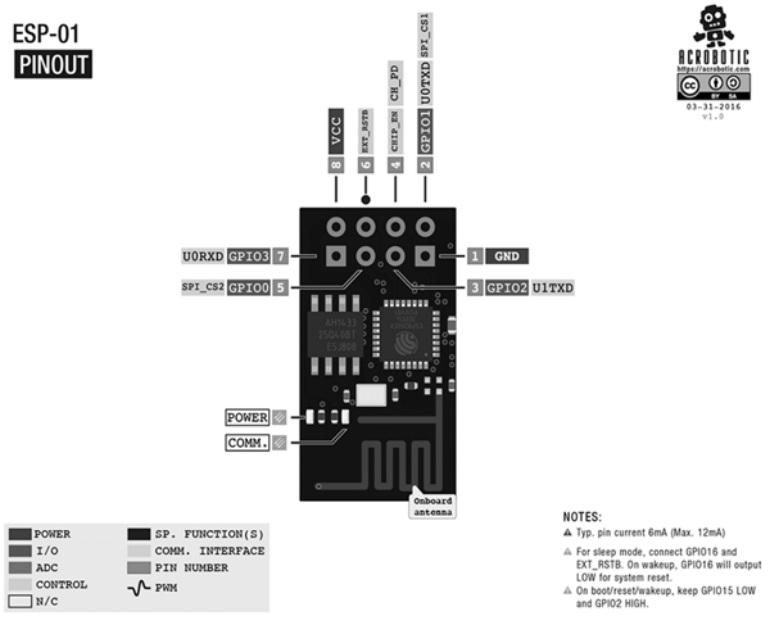
ESP8266(ESP-01)



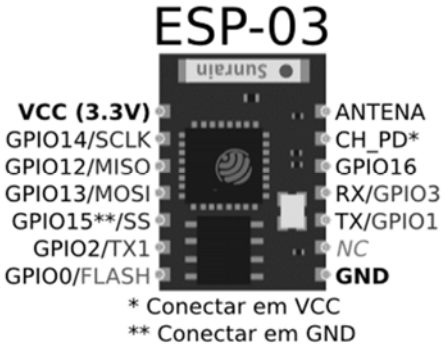
NodeMCU Devkit 0.9 (ESP-12) Version 1

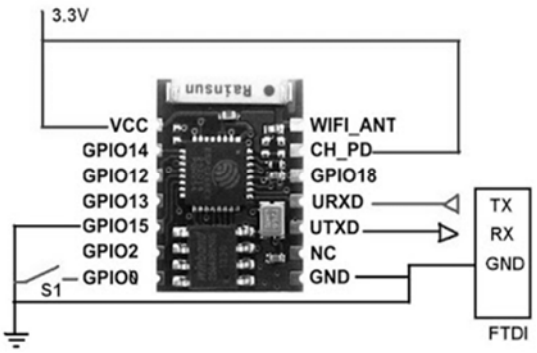
NodeMCU Devkit 1.0 (ESP-12E) Version 2

ESP8266 (ESP-01)

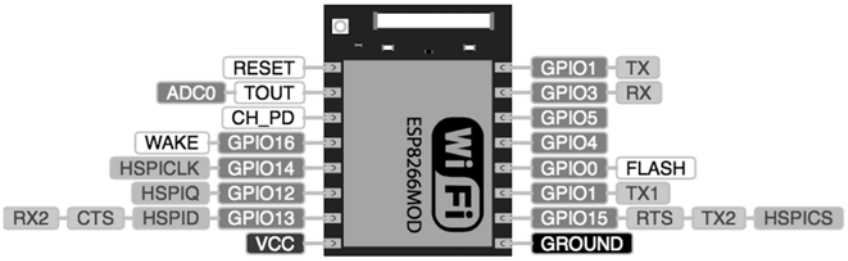


ESP8266 (ESP-03)

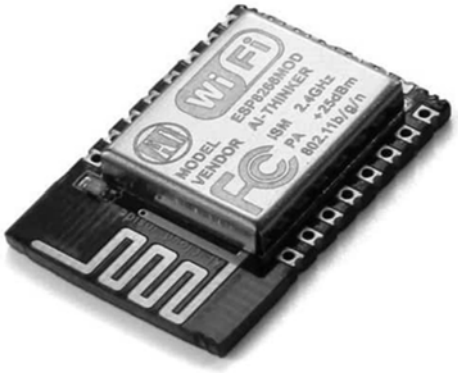


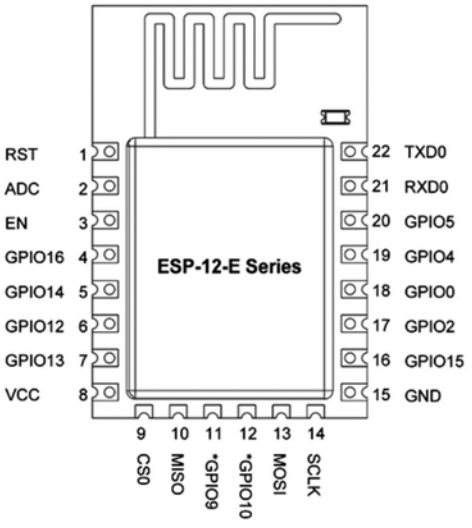


ESP8266 (ESP-07)



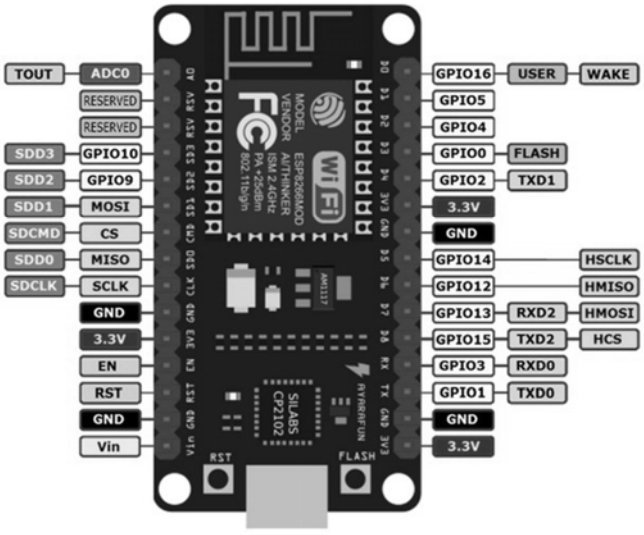
ESP8266 (ESP-12E)



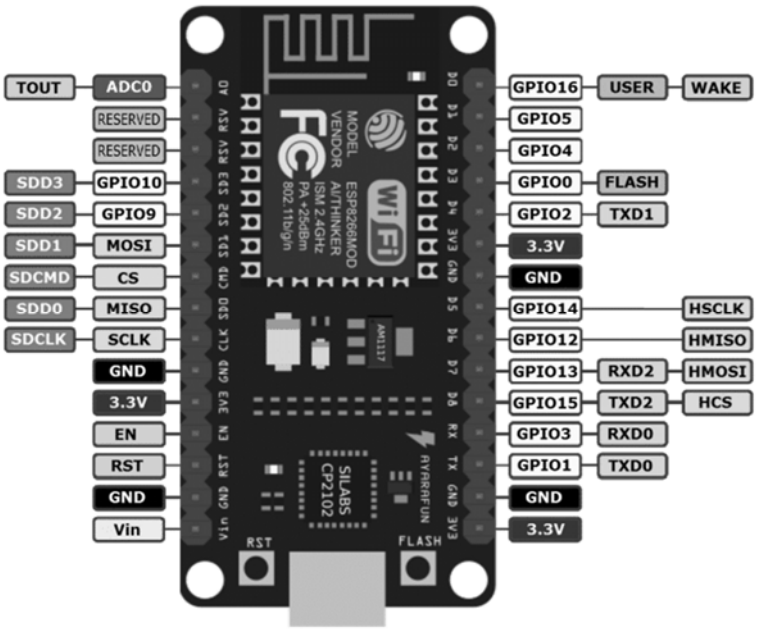


ESP8266 NodeMCU V1 Pin layout

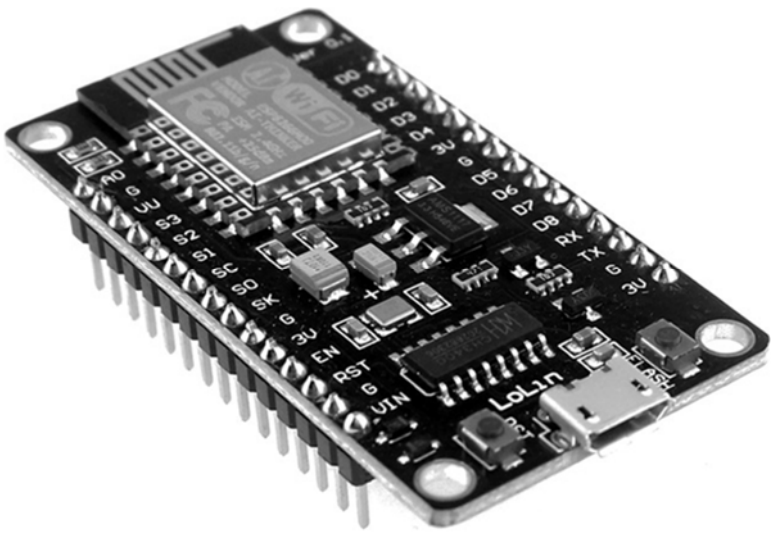
NodeMCU ESP12 Dev Kit V1.0 Pin Definition:



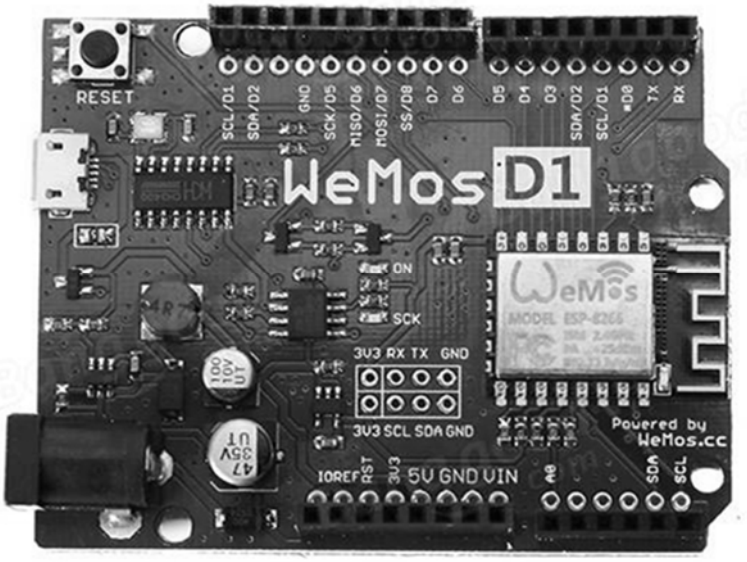
ESP8266 NodeMCU V2 Pin layout



ESP8266 NodeMCU V3 Pin layout

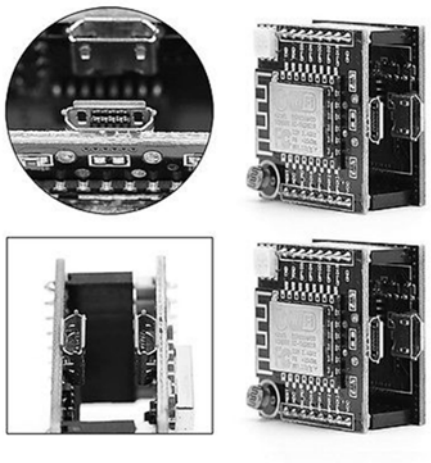


WeMos D1

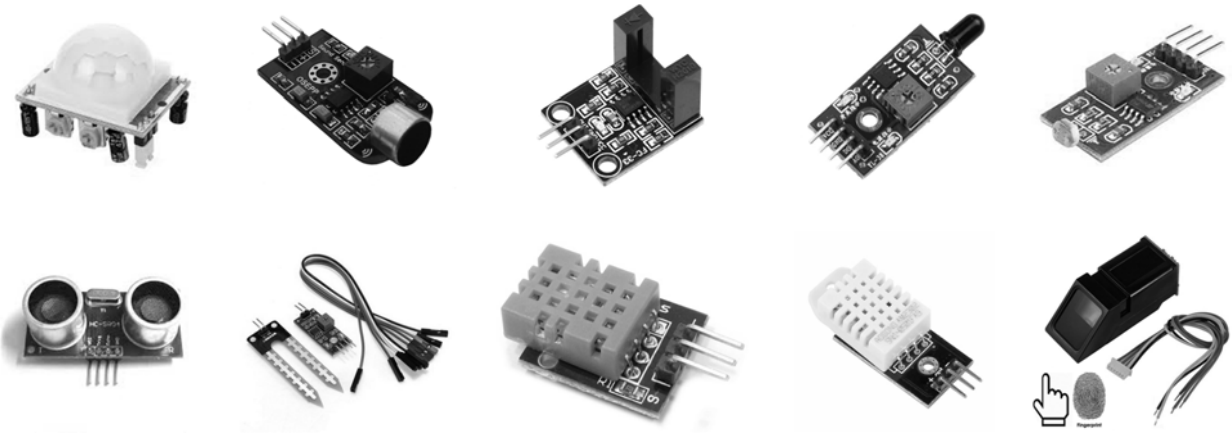


WeMos D1 Mini

Witty cloud Mini NodeMCU



SENSOR & CONTROL MODULES



SENSOR & CONTROL MODULES

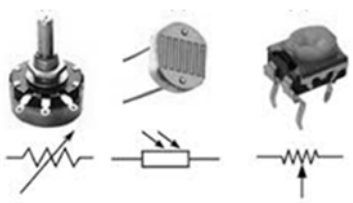




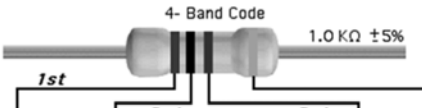



BASIC ELECTRONIC DEVICES

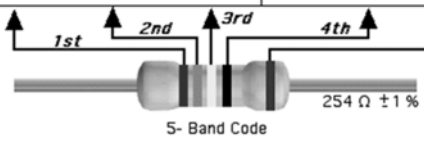
Resistor



RESISTOR COLOR CODE GUIDE

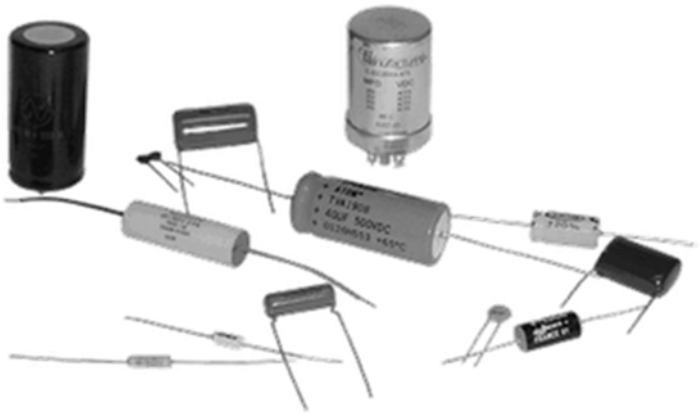


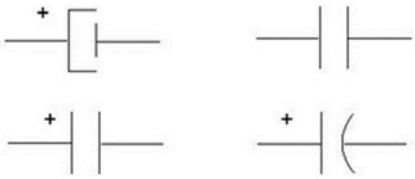
Color	1st Band	2nd Band	3rd Band	Decimal Multiplier		Tolerance
Black	0	0	0	1	1	
Brown	1	1	1	10	10	± 1%
Red	2	2	2	100	100	± 2%
Orange	3	3	3	1K	1,000	
Yellow	4	4	4	10K	10,000	
Green	5	5	5	100K	100,000	
Blue	6	6	6	1M	1,000,000	
Violet	7	7	7	10M	10,000,000	
Gray	8	8	8		100,000,000	
White	9	9	9		1,000,000,000	
Gold					0.1	± 5%
Silver					0.01	± 10%
None						± 20%

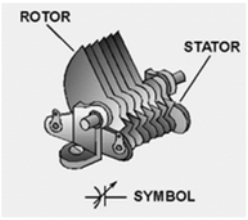


BASIC ELECTRONIC DEVICES

Capacitor

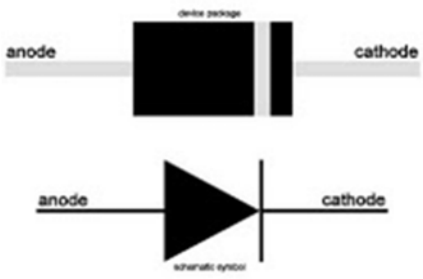




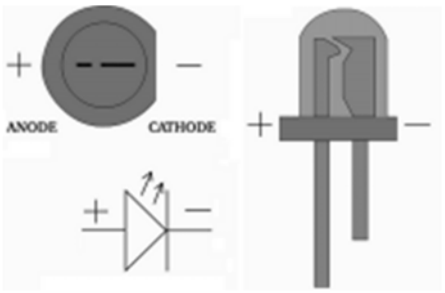


BASIC ELECTRONIC DEVICES

Diode



LED



Tools for Develop

1. Arduino IDE and SDK for ESP8266
2. CP2012 USB to UART driver
3. Web Browser: Chrome or Firefox

Arduino IDE and SDK for ESP8266

Download and Install Arduino IDE

- https://www.arduino.cc/en/Main/Software

Additional Board Manager URLs

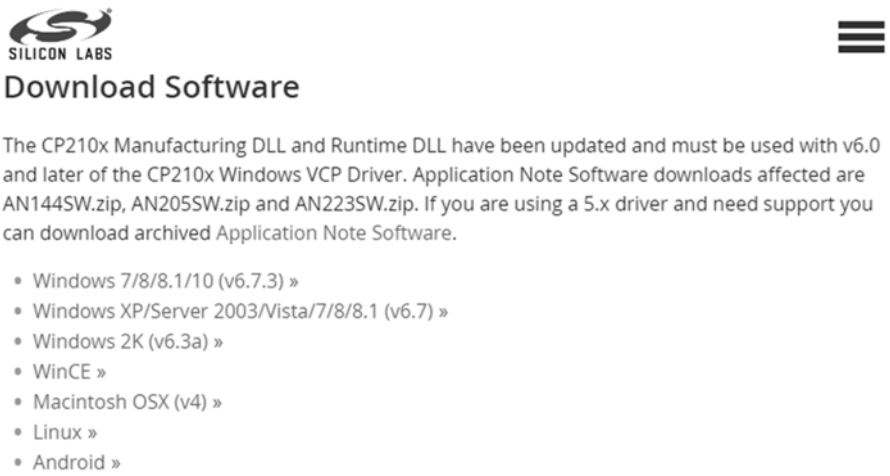
- http://arduino.esp8266.com/stable/package_esp8266com_index.json

Check Install ESP8266 in Boards Manager... Menu

- esp8266 by ESP8266 Community version 2.3.0 INSTALLED

CP2012 USB to UART driver

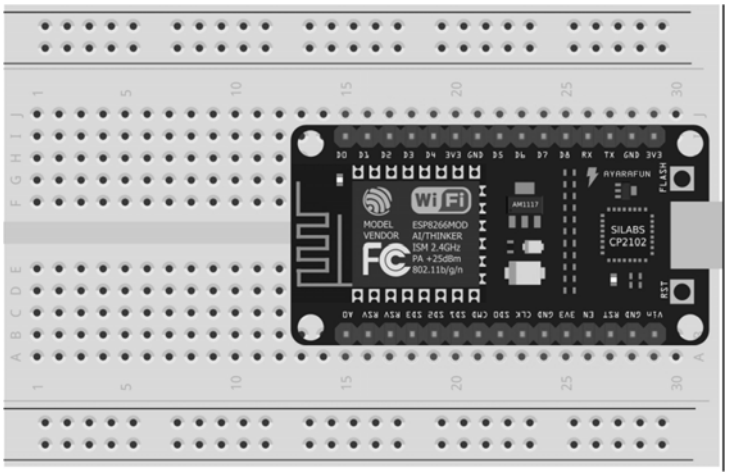
https://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx



Workshop#1
Start learning ESP8266 with Arduino IDE

- BLINK
- WIFI SCAN
- WEB SERVER

Workshop#1
Prepare hardware snap in breadboard



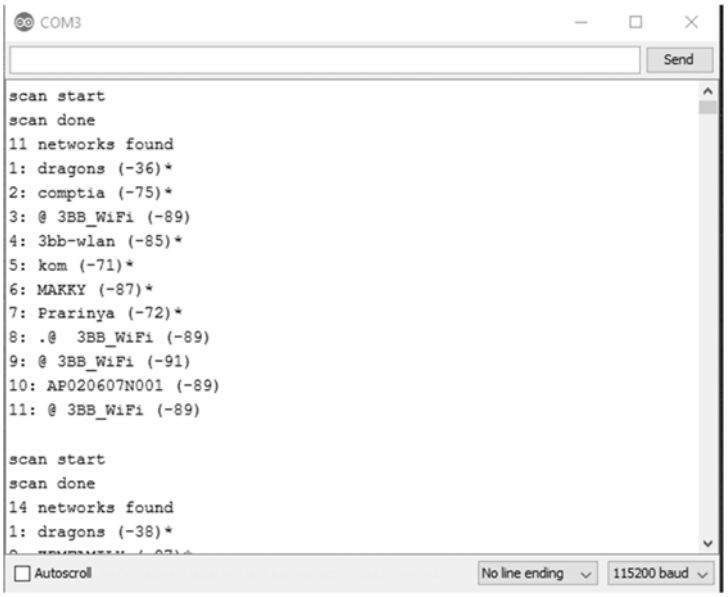
Workshop#1 [test board with blink]

```
void setup() {
  pinMode(LED_BUILTIN, OUTPUT);     // Initialize the LED_BUILTIN pin as an output
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, LOW);   // Turn the LED on (Note that LOW is the voltage
level
                                    // but actually the LED is on; this is because
                                    // it is acive low on the ESP-01)
  delay(1000);                      // Wait for a second
  digitalWrite(LED_BUILTIN, HIGH);  // Turn the LED off by making the voltage HIGH
  delay(2000);                      // Wait for two seconds (to demonstrate the active low LED)
}
```


Workshop#1 [Wifi scan] - sketch

```
#include "ESP8266WiFi.h"

void setup() {
  Serial.begin(115200);

  // Set WiFi to station mode and disconnect from an AP if it
was previously connected
  WiFi.mode(WIFI_STA);
  WiFi.disconnect();
  delay(100);

  Serial.println("Setup done");
}
void loop() {
  Serial.println("scan start");

  // WiFi.scanNetworks will return the number of networks
found
  int n = WiFi.scanNetworks();
  Serial.println("scan done");
if (n == 0)
    Serial.println("no networks found");
  else
  {
    Serial.print(n);
    Serial.println(" networks found");
    for (int i = 0; i < n; ++i)
    {
      // Print SSID and RSSI for each network found
      Serial.print(i + 1);
      Serial.print(": ");
      Serial.print(WiFi.SSID(i));
      Serial.print(" (");
      Serial.print(WiFi.RSSI(i));
      Serial.print(")");
      Serial.println((WiFi.encryptionType(i) ==
ENC_TYPE_NONE)?" ":"*");
      delay(10);
    }
  }
  Serial.println("");

  // Wait a bit before scanning again
  delay(5000);
}
```

Workshop#1 [Wifi scan] – serial monitor



Workshop#1 [wifiWeb server] – sketch

```
#include <ESP8266WiFi.h>

const char* ssid = “your-ssid";
const char* password = “your-password";

// Create an instance of the server
// specify the port to listen on as an argument
WiFiServer server(80);

void setup() {
  Serial.begin(115200);
  delay(10);

  // prepare GPIO2
  pinMode(2, OUTPUT);
  digitalWrite(2, 0);

  // Connect to WiFi network
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  // Start the server
  server.begin();
  Serial.println("Server started");

  // Print the IP address
  Serial.println(WiFi.localIP());
}
```

Workshop#1 [wifiWeb server] – sketch

```
void loop() {
  // Check if a client has connected
  WiFiClient client = server.available();
  if (!client) {
    return;
  }

  // Wait until the client sends some data
  Serial.println("new client");
  while(!client.available()){
    delay(1);
  }

  // Read the first line of the request
  String req = client.readStringUntil('\r');
  Serial.println(req);
  client.flush();

  // Match the request
  int val;
  if (req.indexOf("/gpio/0") != -1)
    val = 0;
  else if (req.indexOf("/gpio/1") != -1)
    val = 1;
  else {
    Serial.println("invalid request");
    client.stop();
    return;
  }

  // Set GPIO2 according to the request
  digitalWrite(2, val);

  client.flush();

  // Prepare the response
  String s = "HTTP/1.1 200 OK\r\nContent-Type:
text/html\r\n\r\n<!DOCTYPE HTML>\r\n<html>\r\nGPIO is now ";
  s += (val)?"high":"low";
  s += "</html>\n";

  // Send the response to the client
  client.print(s);
  delay(1);
  Serial.println("Client disonnected");

  // The client will actually be disconnected
  // when the function returns and 'client' object is detroyed
}
```

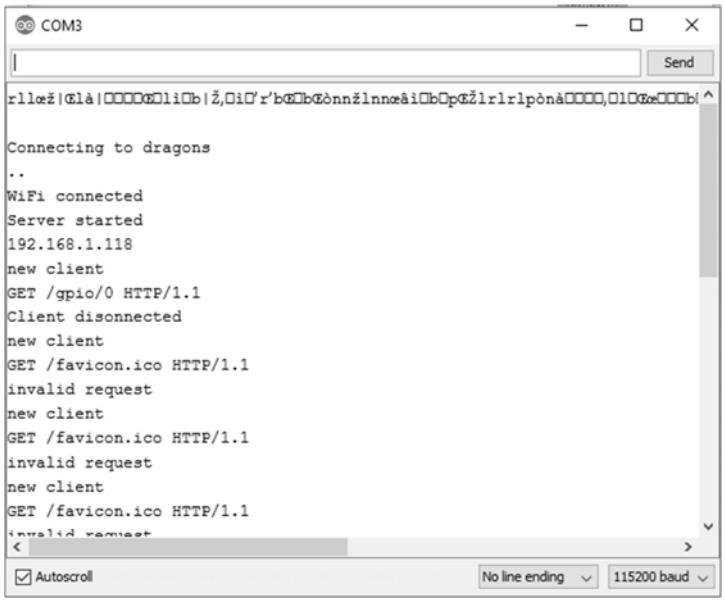

Workshop#1 [wifiWeb server] – sketch GPIO5

```
#include <ESP8266WiFi.h>

const char* ssid = “your-ssid";
const char* password = “your-password";

// Create an instance of the server
// specify the port to listen on as an argument
WiFiServer server(80);

void setup() {
  Serial.begin(115200);
  delay(10);

  // prepare GPIO5
  pinMode(5, OUTPUT);
  digitalWrite(5, 0);

  // Connect to WiFi network
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  // Start the server
  server.begin();
  Serial.println("Server started");

  // Print the IP address
  Serial.println(WiFi.localIP());
}
```

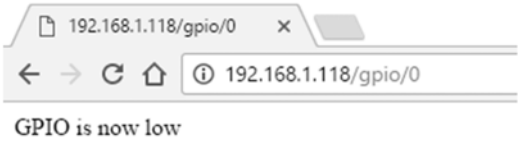
Workshop#1 [wifiWeb server] – sketch GPIO5

```
void loop() {
  // Check if a client has connected
  WiFiClient client = server.available();
  if (!client) {
    return;
  }

  // Wait until the client sends some data
  Serial.println("new client");
  while(!client.available()){
    delay(1);
  }

  // Read the first line of the request
  String req = client.readStringUntil('\r');
  Serial.println(req);
  client.flush();

  // Match the request
  int val;
  if (req.indexOf("/gpio/0") != -1)
    val = 0;
  else if (req.indexOf("/gpio/1") != -1)
    val = 1;
  else {
    Serial.println("invalid request");
    client.stop();
    return;
  }

  // Set GPIO5 according to the request
  digitalWrite(5, val);

  client.flush();

  // Prepare the response
  String s = "HTTP/1.1 200 OK\r\nContent-Type:
text/html\r\n\r\n<!DOCTYPE HTML>\r\n<html>\r\nGPIO is now ";
  s += (val)?"high":"low";
  s += "</html>\n";

  // Send the response to the client
  client.print(s);
  delay(1);
  Serial.println("Client disonnected");

  // The client will actually be disconnected
  // when the function returns and 'client' object is detroyed
}
```

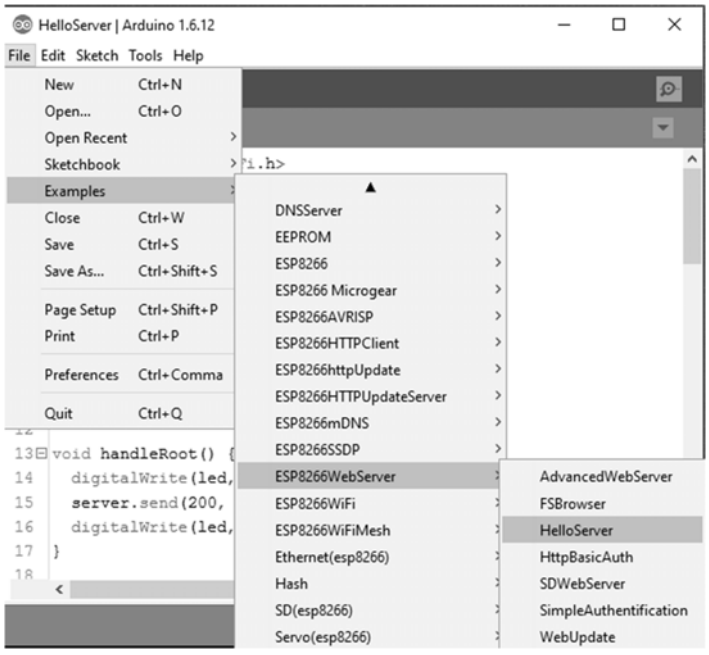

Workshop#1 [wifiWeb server] – serial monitor



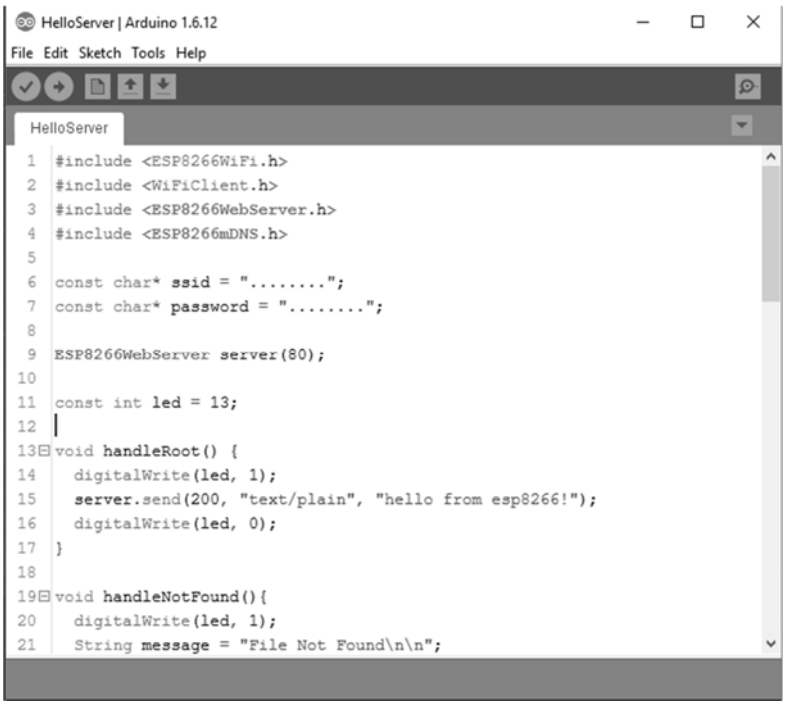
Workshop#1 [wifiWeb server] – web browser



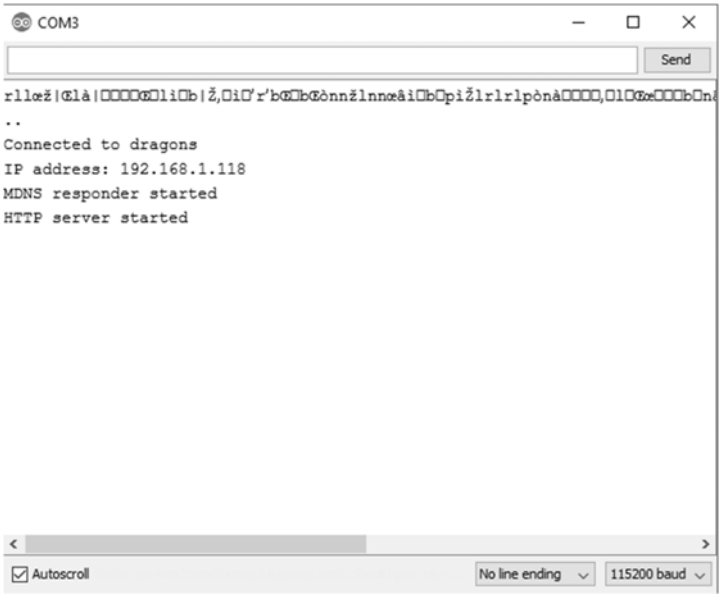
Workshop#1 [helloserver]



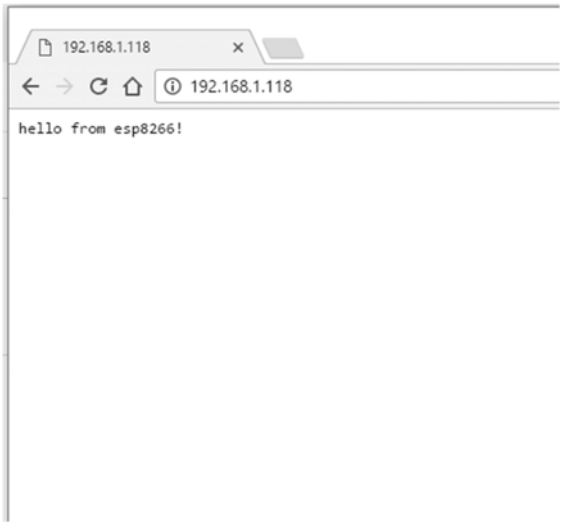
Workshop#1 [helloserver]



Workshop#1 [helloserver]-serial monitor



Workshop#1 [helloserver]-web browser



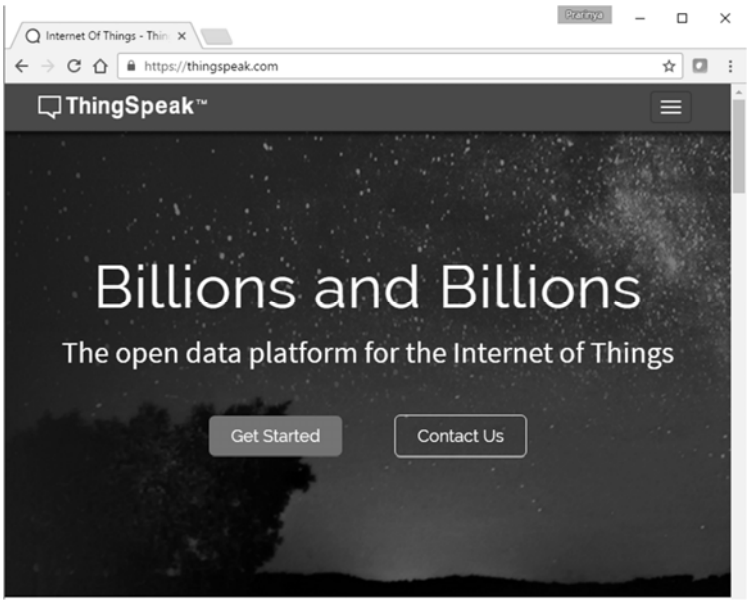
Workshop#2
upload data to cloud (thinkspeak)

- Apply Thinkspeak
- Test send data
- Customize visual board

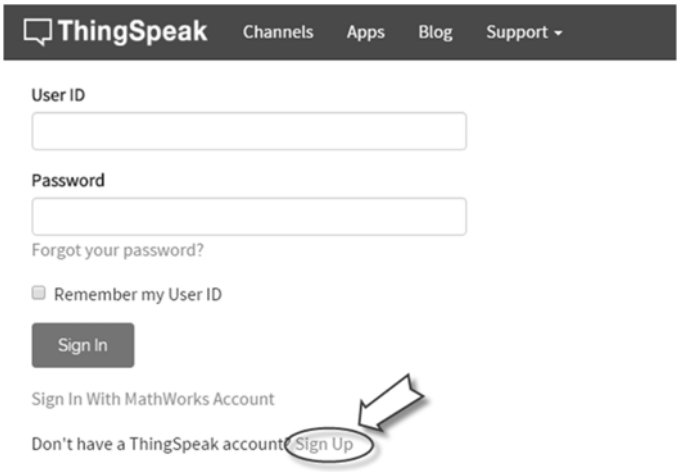
Workshop#2 Apply Thinkspeak

1. Register Thingspeak
2. Create New Channel
3. Receive API Key
4. Use API Key send data to server

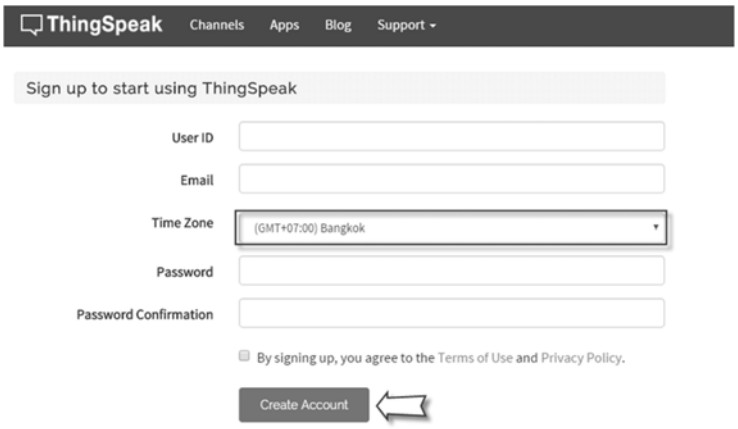
Workshop#2 Apply Thinkspeak



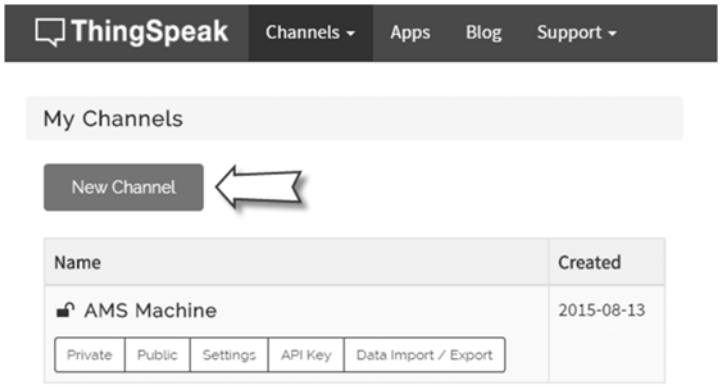
Workshop#2 Apply Thinkspeak



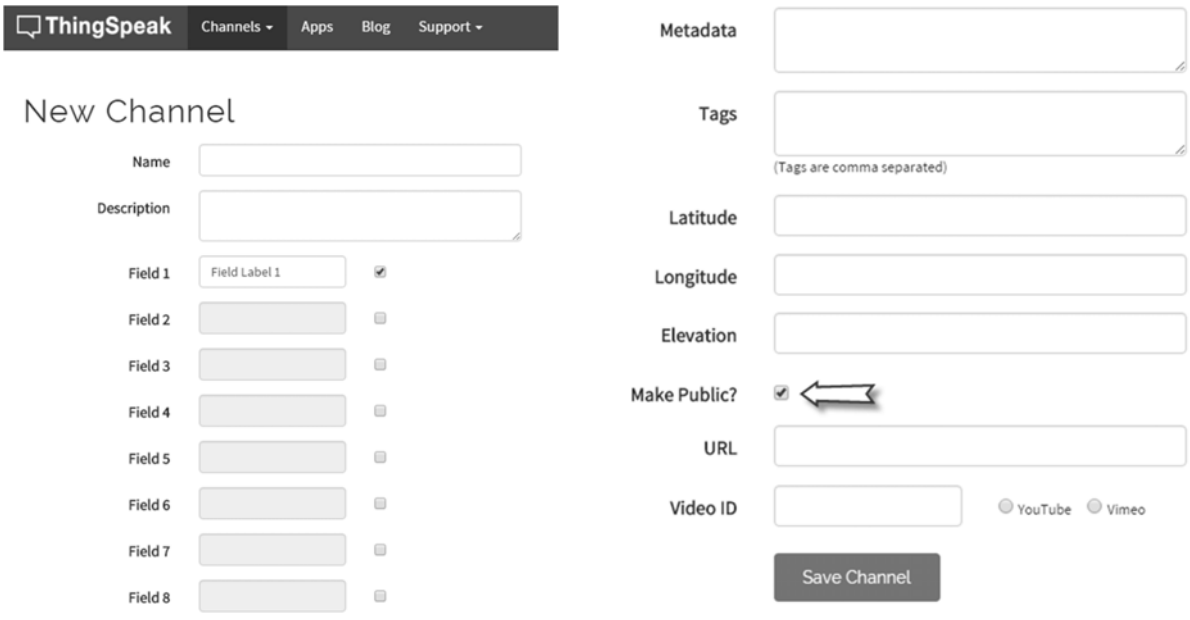
Workshop#2 Apply Thinkspeak



Workshop#2 Create New Channel



Workshop#2 Create New Channel



Workshop#2 Create New Channel

Data Import / Export

Update Channel Feed - GET

```
GET https://api.thingspeak.com/update?api_key=G7EEA1WJNU7CAG7W&field1=
0
```

Update Channel Feed - POST

```
POST https://api.thingspeak.com/update.json
     api_key=G7EEA1WJNU7CAG7W
     field1=73
```

Get a Channel Feed

```
GET https://api.thingspeak.com/channels/51581/feeds.json?results=2
```

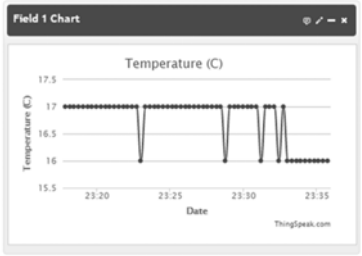
Get a Channel Field Feed

```
GET https://api.thingspeak.com/channels/51581/fields/1.json?results=2
```

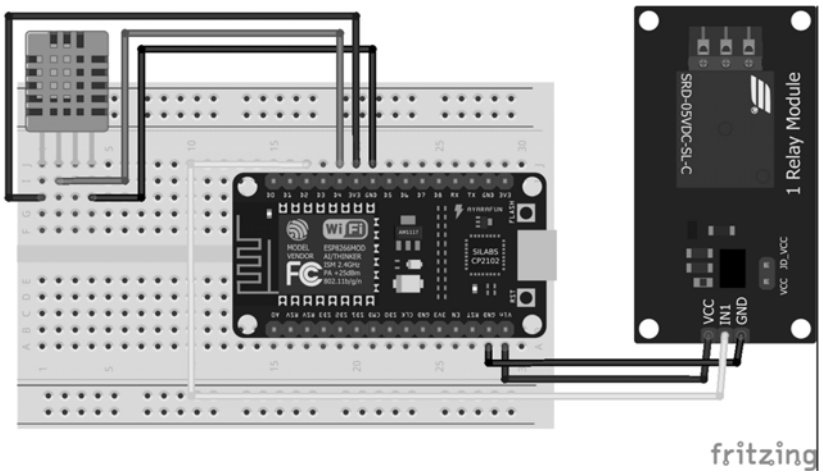
Get Status Updates

```
GET https://api.thingspeak.com/channels/51581/status.json
```


Workshop#2 Create New Channel



Workshop#2 connect hardware



Workshop#2 sketch for test

```
#include "DHT.h"
#include <ESP8266WiFi.h>

#define PUMP_RLY 4    // output drive relay for pump GPIO4 (D2)
#define DHTPIN 2     // what pin we're connected to GPIO2 (D4)
#define DHTTYPE DHT11   // DHT 11

#define DEBUG

#define DEBUG_PRINTER Serial

#ifdef DEBUG
#define DEBUG_PRINT(...) { DEBUG_PRINTER.print(__VA_ARGS__); }
#define DEBUG_PRINTLN(...) { DEBUG_PRINTER.println(__VA_ARGS__); }
#else
#define DEBUG_PRINT(...) {}
#define DEBUG_PRINTLN(...) {}
#endif

const char* ssid     = “SSID"; //Use own ssid
const char* password = “PASSWORD"; //use password of AP

DHT *dht;

void connectWifi();
void reconnectWifiIfLinkDown();
void initDht(DHT **dht, uint8_t pin, uint8_t dht_type);
void readDht(DHT *dht, float *temp, float *humid);
void uploadThingsSpeak(float t, float h);
```

```
void setup() {
  Serial.begin(115200);
  delay(10);
  pinMode(PUMP_RLY, OUTPUT); // Initialize the PUMP_RLY(4) pin as
an output
  digitalWrite(PUMP_RLY, HIGH);// Make sure relay is normal off

  connectWifi();

  initDht(&dht, DHTPIN, DHTTYPE);
}

void loop() {
  static float t_dht;
  static float h_dht;

  readDht(dht, &t_dht, &h_dht);
  if(h_dht < 30 || t_dht > 26) // condition for make relay on
  {
    digitalWrite(PUMP_RLY, LOW); //If condition true do this!
  } else
  {
    digitalWrite(PUMP_RLY, HIGH);
  }
  uploadThingsSpeak(t_dht, h_dht);

  // Wait a few seconds between measurements.
  delay(10 * 1000);
  reconnectWifiIfLinkDown();
}
```

Workshop#2 sketch for test

```
void reconnectWifiIfLinkDown() {
  if (WiFi.status() != WL_CONNECTED) {
    DEBUG_PRINTLN("WIFI DISCONNECTED");
    connectWifi();
  }
}

void connectWifi() {
  DEBUG_PRINTLN();
  DEBUG_PRINTLN();
  DEBUG_PRINT("Connecting to ");
  DEBUG_PRINTLN(ssid);

  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    DEBUG_PRINT(".");
  }

  DEBUG_PRINTLN("");
  DEBUG_PRINTLN("WiFi connected");
  DEBUG_PRINTLN("IP address: ");
  DEBUG_PRINTLN(WiFi.localIP());
}

void initDht(DHT **dht, uint8_t pin, uint8_t dht_type) {
  // Connect pin 1 (on the left) of the sensor to +5V
  // NOTE: If using a board with 3.3V logic like an Arduino Due
connect pin 1
  // to 3.3V instead of 5V!
  // Connect pin 2 of the sensor to whatever your DHTPIN is
  // Connect pin 4 (on the right) of the sensor to GROUND
  // Connect a 10K resistor from pin 2 (data) to pin 1 (power) of the
sensor

  // Initialize DHT sensor for normal 16mhz Arduino
  // NOTE: For working with a faster chip, like an Arduino Due or
Teensy, you
  // might need to increase the threshold for cycle counts
considered a 1 or 0.
  // You can do this by passing a 3rd parameter for this threshold.
It's a bit
  // of fiddling to find the right value, but in general the faster the
CPU the
  // higher the value.  The default for a 16mhz AVR is a value of 6.
For an
  // Arduino Due that runs at 84mhz a value of 30 works.
  // Example to initialize DHT sensor for Arduino Due:
  //DHT dht(DHTPIN, DHTTYPE, 30);

  *dht = new DHT(pin, dht_type, 30);
  (*dht)->begin();
  DEBUG_PRINTLN(F("DHTxx test!"))  ;
}
```

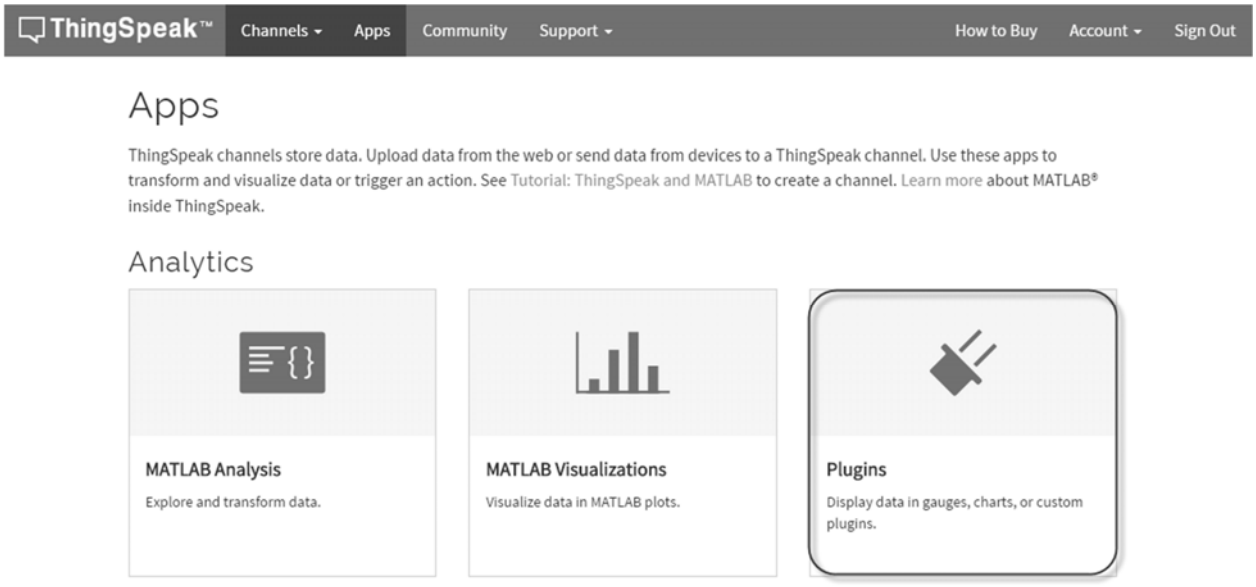

Workshop#2 sketch for test

```
void uploadThingsSpeak(float t, float h) {
  static const char* host = "api.thingspeak.com";
  static const char* apiKey = “YOUR_APIKEY";

  // Use WiFiClient class to create TCP connections
  WiFiClient client;
  const int httpPort = 80;
  if (!client.connect(host, httpPort)) {
    DEBUG_PRINTLN("connection failed");
    return;
  }
  // We now create a URI for the request
  String url = "/update/";
  //  url += streamId;
  url += "?key=";
  url += apiKey;
  url += "&field1=";
  url += t;
  url += "&field2=";
  url += h;

  DEBUG_PRINT("Requesting URL: ");
  DEBUG_PRINTLN(url);

  // This will send the request to the server
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
          "Host: " + host + "\r\n" +
          "Connection: close\r\n\r\n");
}

void readDht(DHT *dht, float *temp, float *humid) {

  if (dht == NULL) {
    DEBUG_PRINTLN(F("[dht11] is not initialised. please call initDht()
first."));
    return;
  }

  // Reading temperature or humidity takes about 250 milliseconds!
  // Sensor readings may also be up to 2 seconds 'old' (its a very
slow sensor)
  float h = dht->readHumidity();

  // Read temperature as Celsius
  float t = dht->readTemperature();
  // Read temperature as Fahrenheit
  float f = dht->readTemperature(true);

  // Check if any reads failed and exit early (to try again).
  if (isnan(h) || isnan(t) || isnan(f)) {
    DEBUG_PRINTLN("Failed to read from DHT sensor!");
    return;
  }
```

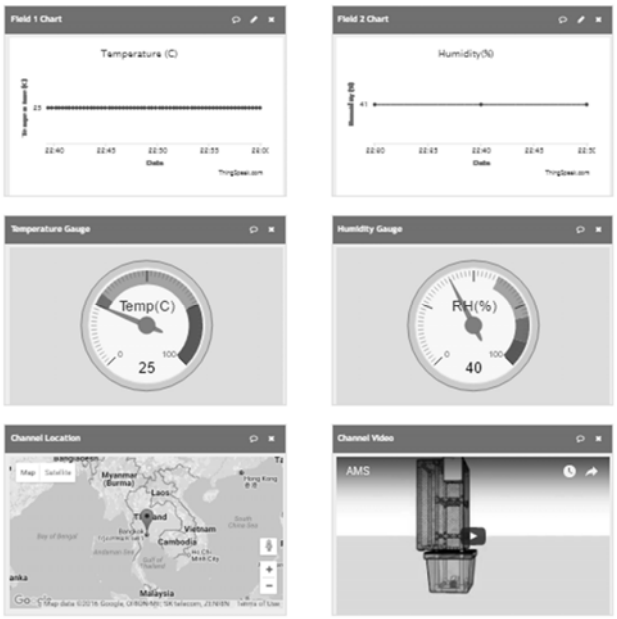
Workshop#2 sketch for test

```
// Compute heat index
  // Must send in temp in Fahrenheit!
  float hi = dht->computeHeatIndex(f, h);

  DEBUG_PRINT("Humidity: ");
  DEBUG_PRINT(h);
  DEBUG_PRINT(" %\t");
  DEBUG_PRINT("Temperature: ");
  DEBUG_PRINT(t);
  DEBUG_PRINT(" *C ");
  DEBUG_PRINT(f);
  DEBUG_PRINT(" *F\t");
  DEBUG_PRINT("Heat index: ");
  DEBUG_PRINT(hi);
  DEBUG_PRINTLN(" *F");

  *temp = t;
  *humid = h;
}
```

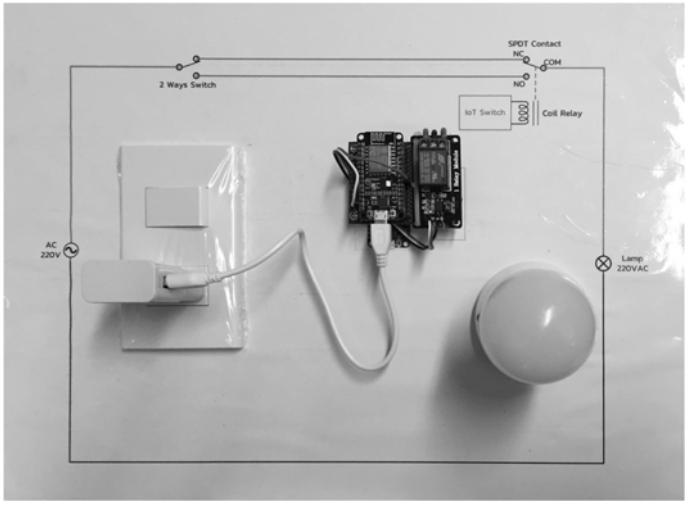

Customize visual board



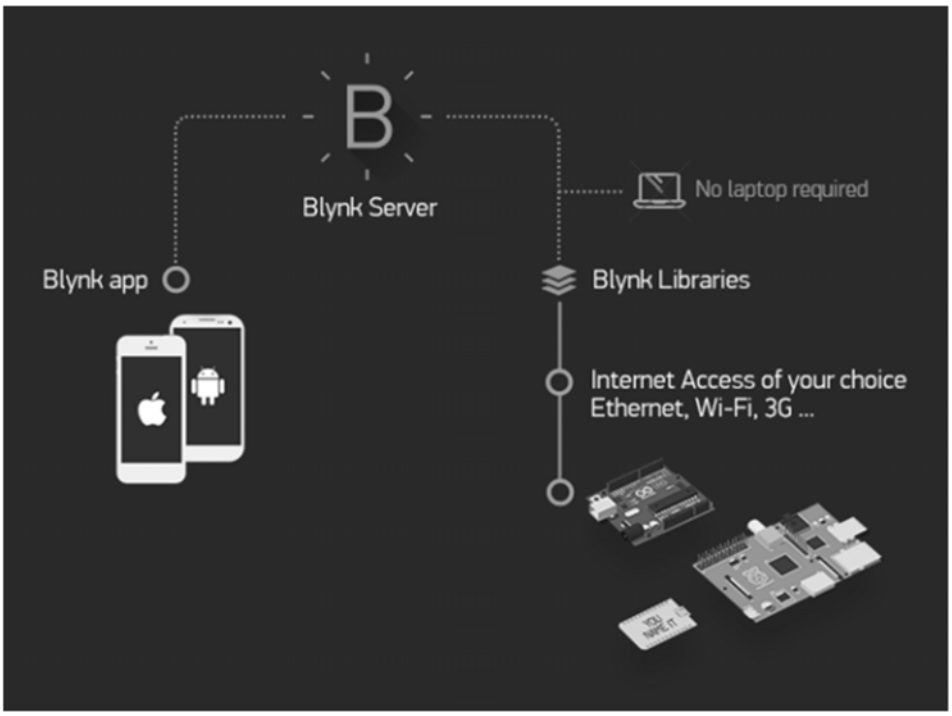
Customize visual board



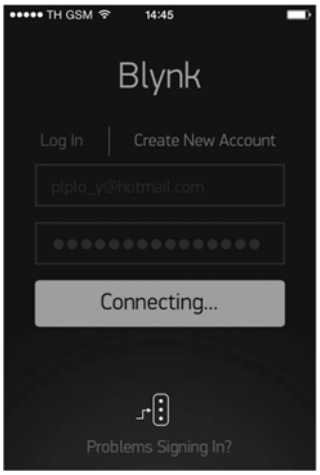
Workshop#3 Mini Project 2Way IoT Switch

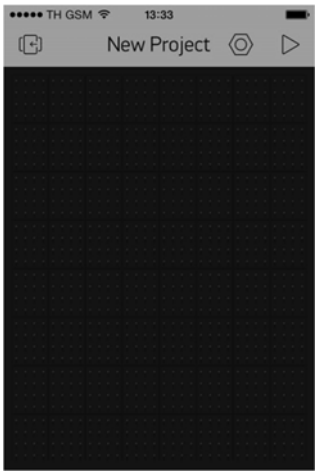


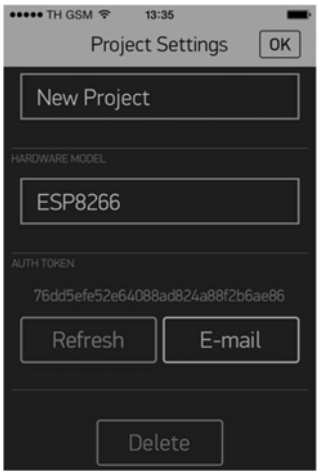
Workshop#3 Control IoT via Blynk

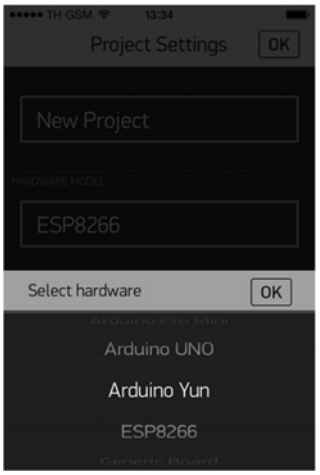


Workshop#3 Control IoT via Blynk









Workshop#3 Control IoT via Blynk

Auth Token for IoT Switch project and device New Device

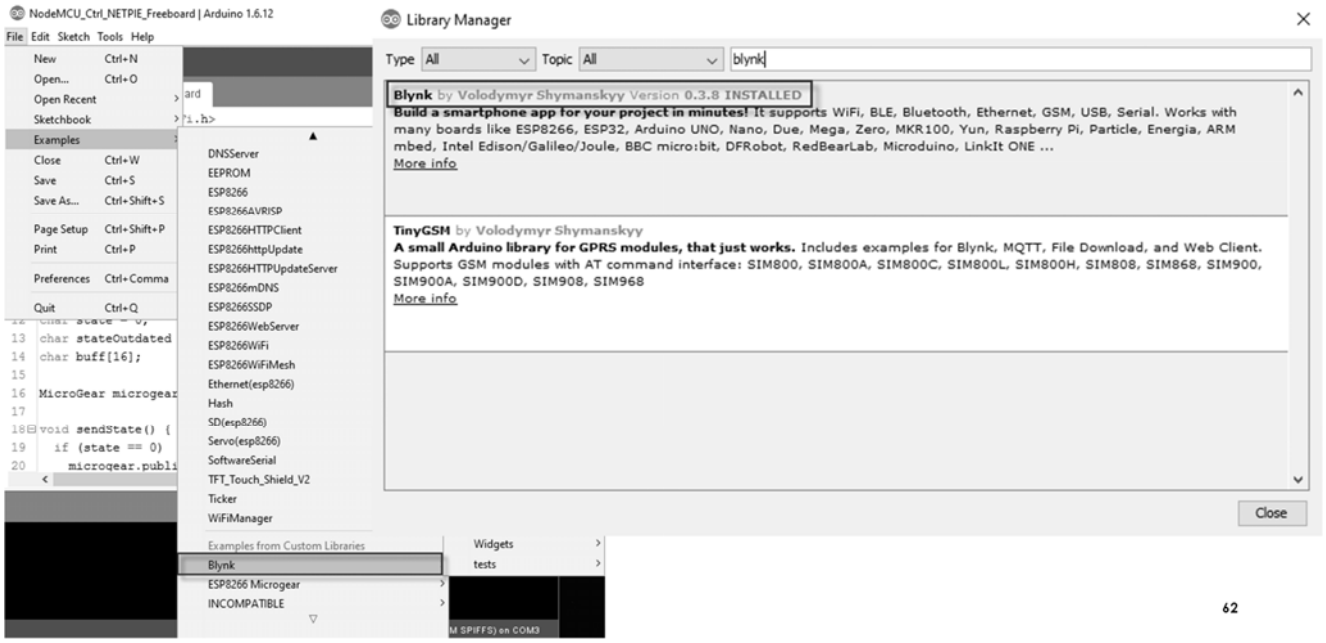
dispatcher@blynk.io

To prarinya_e@yahoo.com

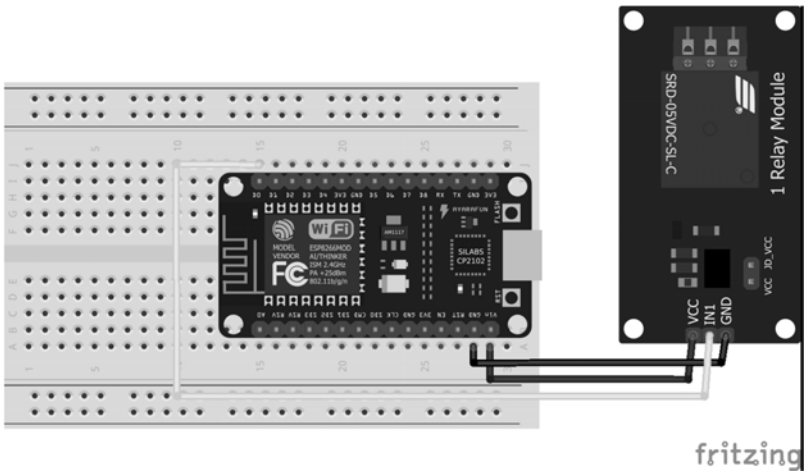
Auth Token for IoT Switch project "7c66a2b373a148b8a9b9470a0da38f87"

Happy Blynking!
-
Getting Started Guide -> http://www.blynk.cc/getting-started
Documentation -> http://docs.blynk.cc/
Latest Blynk library -> https://github.com/blynkkk/blynk-library/releases/download/v0.4.1/Blynk_Release_v0.4.1.zip
Latest Blynk server -> https://github.com/blynkkk/blynk-server/releases/download/v0.20.1/server-0.20.1.jar
-
http://www.blynk.cc
twitter.com/blynk_app
www.facebook.com/blynkapp

Workshop#3 Control IoT via Blynk



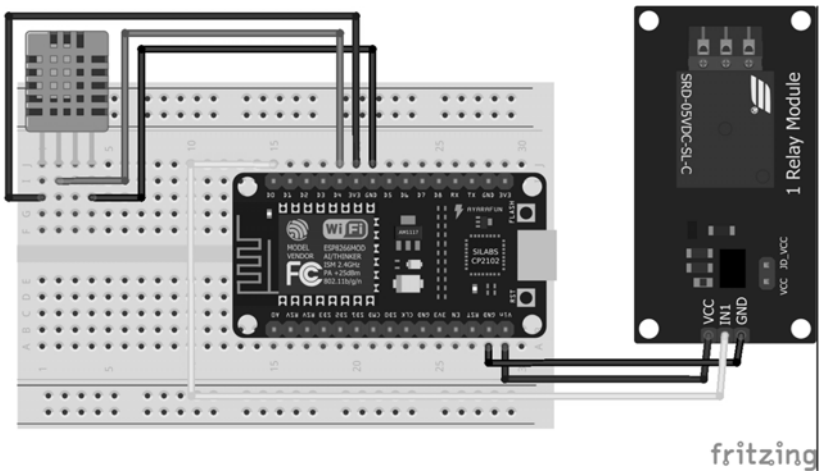
Workshop#3 Control IoT via Blynk



Workshop#3 Control IoT via Blynk

```
#define BLYNK_PRINT Serial    // Comment this out to
disable prints and save space
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "7c66a2b373a148b8a9b9470a0da38f87";

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "comptia";
char pass[] = "comptiatc";

void setup()
{
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
}

void loop()
{
  Blynk.run();
}
```

Workshop#3 Temp Control IoT via Blynk



Workshop#4 Control IoT via Blynk

```
#define BLYNK_PRINT Serial    // Comment this out to
disable prints and save space
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <SimpleTimer.h>

#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <DHT_U.h>

#define DHTPIN          12
#define DHTTYPE         DHT11

DHT_Unified dht(DHTPIN, DHTTYPE);

char auth[] = "8c028718194743109fd45f2fb720cc14";

SimpleTimer timer;
void setup()
{
  Serial.begin(115200);
  Blynk.begin(auth, "comptia", "comptiatc");

  dht.begin();

  // Setup a function to be called every second
  timer.setInterval(5000L, sendUptime);
}

void sendUptime()
{
  Blynk.virtualWrite(V5, millis() / 1000);
  sensors_event_t event;
  dht.temperature().getEvent(&event);
  if (!isnan(event.temperature)) {
    Blynk.virtualWrite(V1, event.temperature);
  }
  dht.humidity().getEvent(&event);
  if (!isnan(event.relative_humidity)) {
    Blynk.virtualWrite(V2, event.relative_humidity);
  }
}

void loop()
{
  Blynk.run();
  timer.run();
}
```

QUESTION....

FURTHER RESOURCES

- https://www.arduino.cc/
- https://thingspeak.com/
- https://netpie.io/
- https://espressif.com/en/products/hardware/esp8266ex/overview
- http://www.esp8266.com/
- http://www.blynk.cc/
- https://www.rs-online.com/designspark/rs-toolbox

COURSE FEEDBACK AND INSTRUCTOR EVALUATION

FINAL QUESTION….

Email: prarinya.e@gmail.com


THANK
YOU !