NodeMCU
Fundamentals & Programming

Presented by

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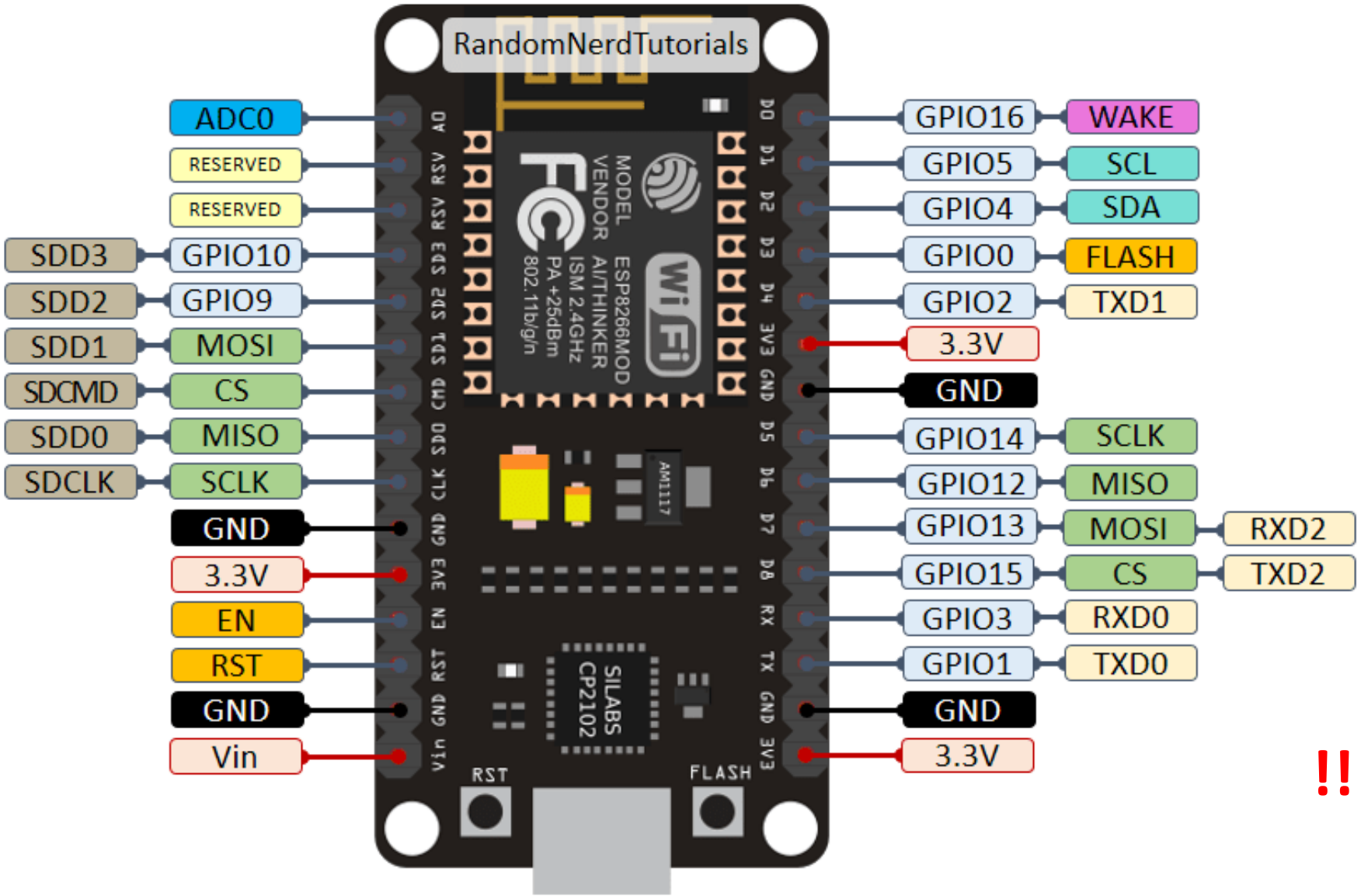
Introduction

- Low-cost open source Internet of Things (IoT) platform
- Espressif Systems Wi-Fi System on Chip (SoC)
  - ✓ESP8266
  - ESP32
- Programming
  - ESPlorer IDE
    - Lua scripts
  - ✓Arduino IDE
    - ✓Arduino language (C/C++)

NodeMCU Specifcations & Comparison with Arduino Uno

Feature	NodeMCU (ESP-12E)	Arduino Uno
Microcontroller	Tensilica Xtensa LX106 CPU – 32 bit + Wifi (2.4 GHz)	ATMega328P AVR – 8 bit
RAM / ROM	128 kB / 4 MB	2 kB / 32 kB
Speed	80 MHz	16 MHz
GPIO	D0-D8 (9)	D2-D13 (12)
Voltage Levels	**3.3 V**	**5 V**
ADC	A0 (1)	A0-A5 (6)
ADC Resolution	10-bit	10 bit
Communication	UART / I2C / SPI	UART / I2C / SPI
Wireless Communication (inbuilt)	Wifi	No
Cost (Rs.)	350-400	450-500

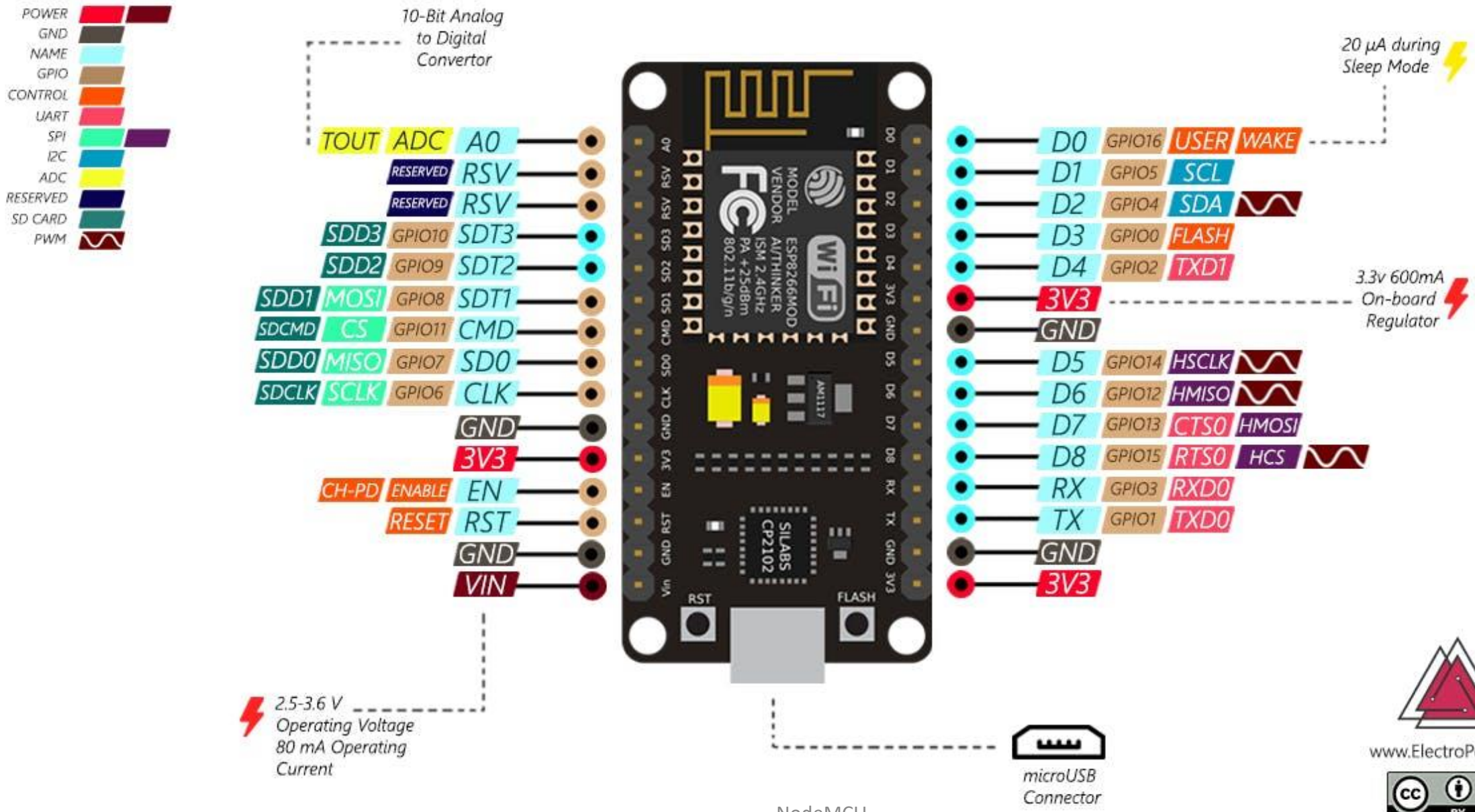
Pin Diagram



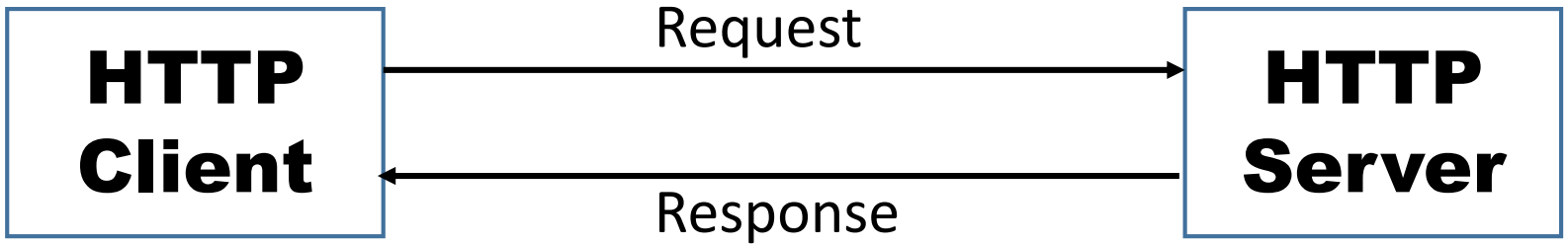
- GPIO (D0-D8)
- ADC (A0)
- I2C
- SPI
- UART
- Built-in LED
  - (D0 [GPIO16], D4 [GPIO2])
    → Sinking / Inverted

!!! 3.3 V Logic Level

Pin Diagram (Contd.)



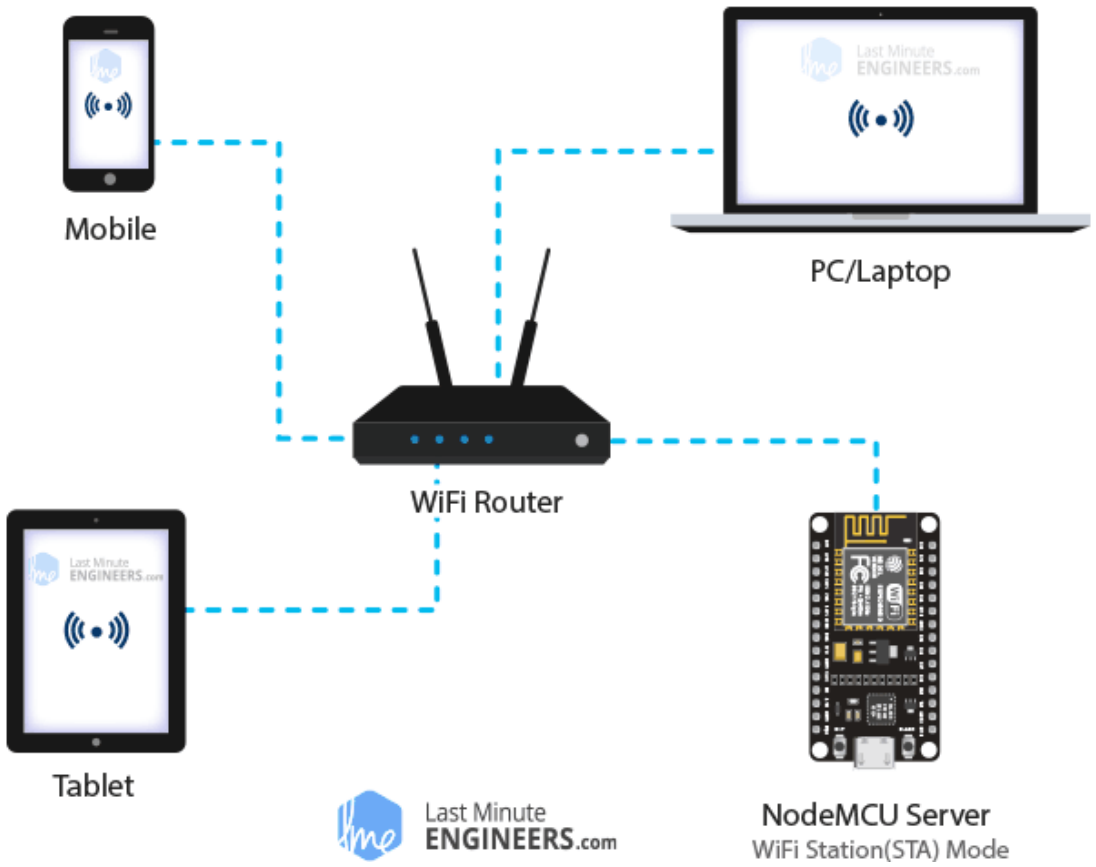
HTTP Client - Server



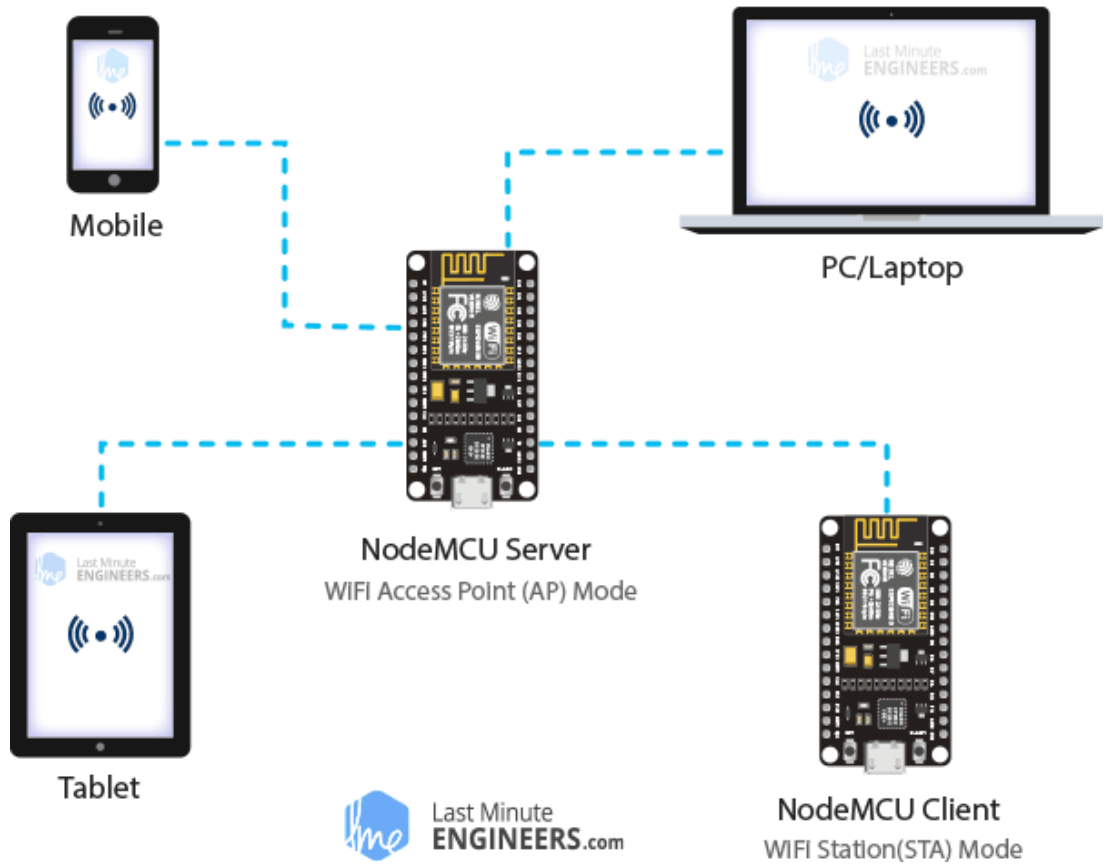
HTTP Status Code	Description
200	OK – Success
404	Not Found

Operating Modes

Station (STA) Mode



Access Point (AP) Mode



HTML - Basics

```
<!DOCTYPE html>
<html>
<head>
<title>LED Control</title>
</head>
<body>
<h1>LED Control using WiFi</h1>
<p>Click to switch LED on and off.</p>
<form method="get">
<input type="button" value="LED ON" onclick="window.location.href='/ledon'">
<input type="button" value="LED OFF" onclick="window.location.href='/ledoff'">
</form>
</body>
</html>
```

Important Commands

ESP8266WebServer server(80)
WiFiClient client;
WiFi.begin(ssid, password);
WiFi.status()
WiFi.localIP()
WiFi.mode(WIFI_STA)
WiFi.status() != WL_CONNECTED
server.on("/", handle_OnConnect)
server.begin()
server.handleClient()
server.send(200, "text/html", SendHTML())
server.send(404, "text/plain", "Not found")
WiFi.softAP(ssid);
IPAddress myIP = WiFi.softAPIP();

Hardware Required

- NodeMCU (ESP8266 / ESP-12E)
- LED
- Potentiometer (10k)

Software

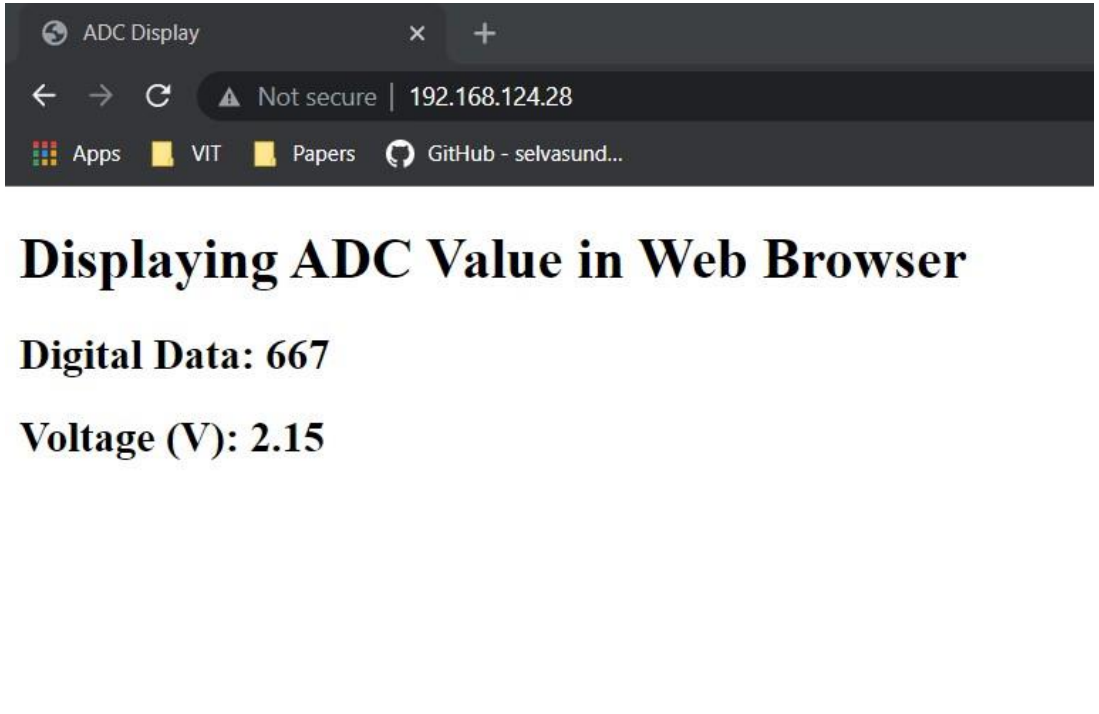
- Arduino IDE
- Preferences → Additional Board Manager URLs → Type: http://arduino.esp8266.com/stable/package_esp8266com_index.json
- Tools → Board Manager → esp8266
- Tools → Manage Libraries → ThingSpeak
- While Programming [Check Board & Port]

Program Flow [Server + Station mode]

- ESP8266WebServer server(80) → Server
- setup
  - WiFi.begin(ssid,password)
  - WiFi.status() → Check whether connected
  - WiFi.localIP() → Get IP Address
  - server.on(link,function_call) → Created for each link (url)
    - server.send(200,"text/html",html_program [separate function is created]) → Inside function_call
  - server.begin()
  - pinMode (input/output)
  - Serial port → Debugging purpose
- loop
  - Read / Write pins [Analog/Digital]
  - server.handleClient()

Demo 1: LED Control using Wifi – Station Mode

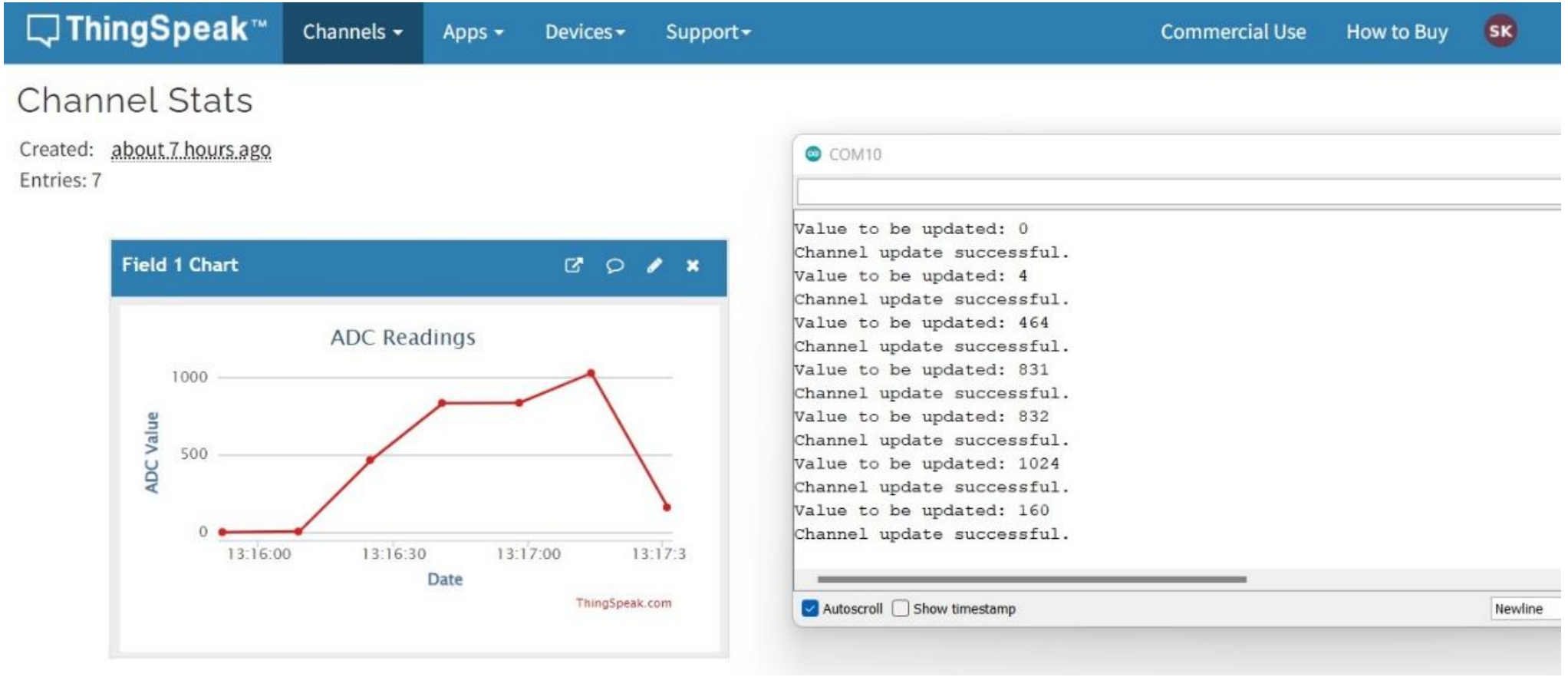
Demo 2: Displaying ADC Value in Web Browser



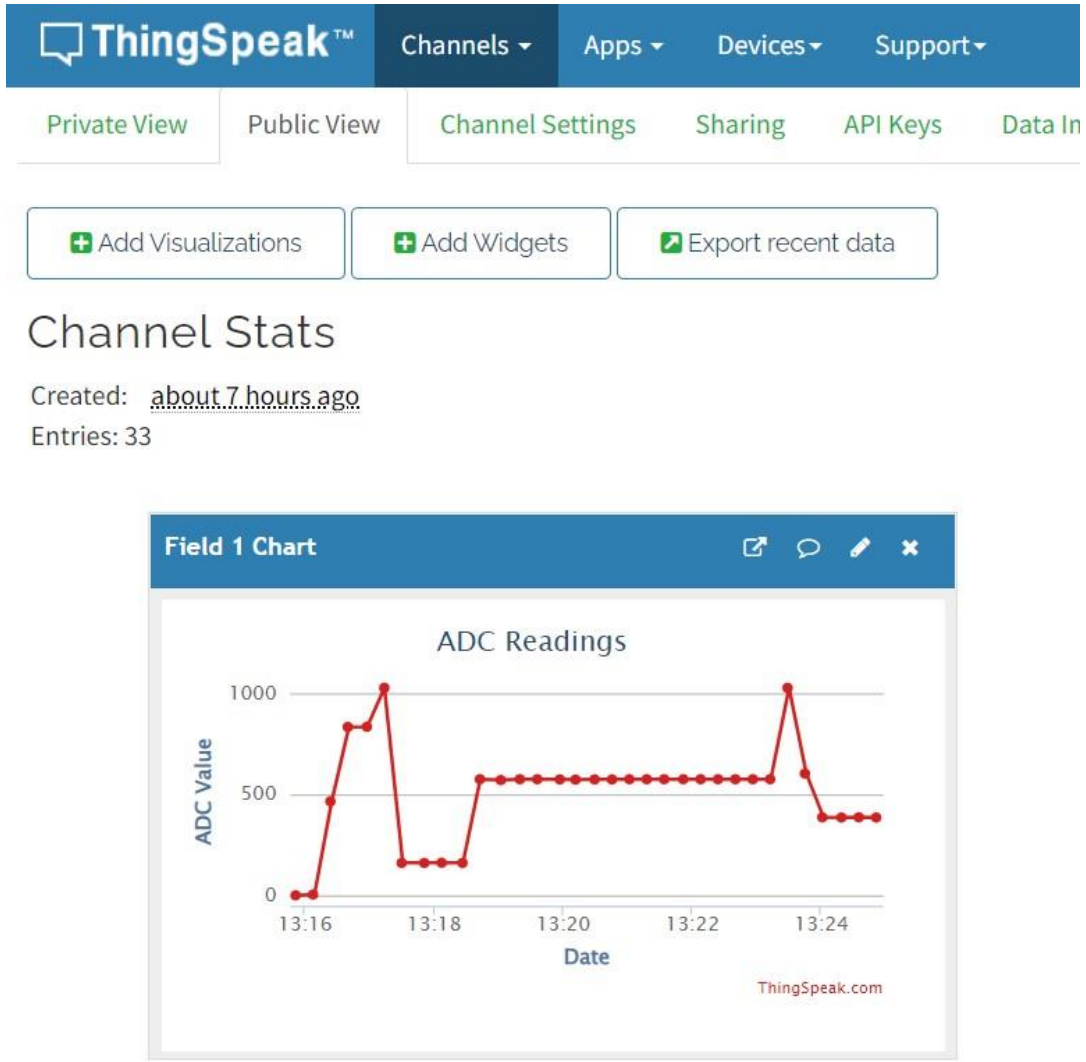
Program Flow [Client + Station mode + ThingSpeak]

- WiFiClient client → client
- setup
  - WiFi.begin(ssid,password)
  - WiFi.status() → Check whether connected
  - WiFi.mode(WIFI_STA) → Station mode
  - ThingSpeak.begin(client)
  - pinMode (input)
  - Serial port → Debugging purpose
- loop
  - Read pins [Analog/Digital]
  - ThingSpeak.writeField(channel_number, field, value, write_API_Key)

Demo 3: Sending ADC Values to ThingSpeak



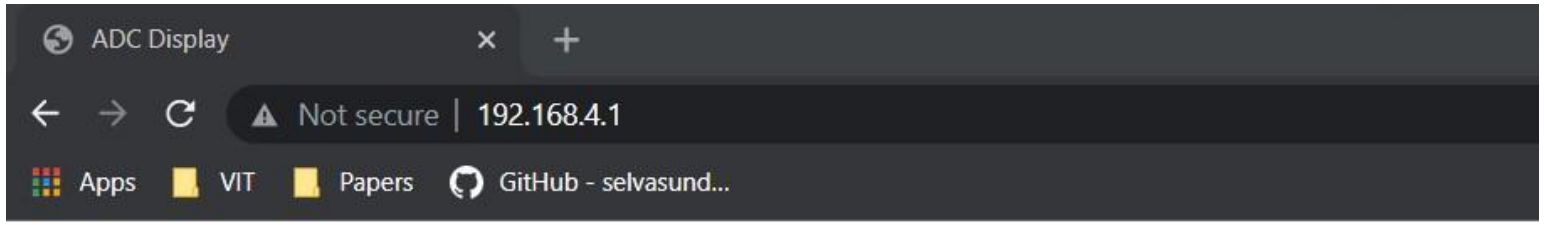
Demo 3: Sending ADC Values to ThingSpeak (Cont.)



Program Flow [Server + AP mode]

- ESP8266WebServer server(80) → Server
- setup
  - WiFi.softAP(ssid);
  - IPAddress myIP = WiFi.softAPIP()→ Get IP Address
  - server.on(link,function_call) → Created for each link (url)
    - server.send(200,"text/html",html_program [separate function is created]) → Inside function_call
  - server.begin()
  - pinMode (input/output)
  - Serial port → Debugging purpose
- loop
  - Read / Write pins [Analog/Digital]
  - server.handleClient()

Demo 4: Displaying ADC Value in Web Browser – AP Mode



Displaying ADC Value in Web Browser [AP Mode]

Digital Data: 798

Voltage (V): 2.57

GitHub Link for Programs

https://github.com/selvasundar93/NodeMCU_Examples

References

1. https://www.electronicwings.com/nodemcu/getting-started-with-nodemcu-using-arduino-ide
2. https://www.teachmemicro.com/display-sensor-data-nodemcu-web-server/
3. https://lastminuteengineers.com/creating-esp8266-web-server-arduino-ide/
4. https://randomnerdtutorials.com/esp8266-nodemcu-thingspeak-publish-arduino/
5. https://www.youtube.com/watch?v=JCJ4OKv4uto

Q & A

Thank You