IoT

ESP 8266

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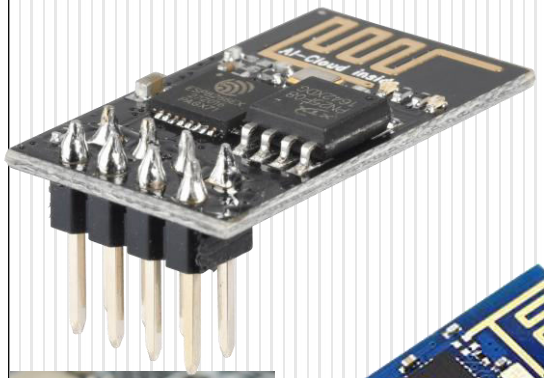
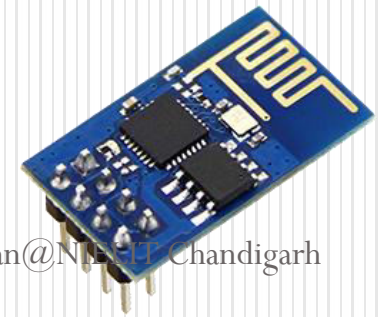




Agenda

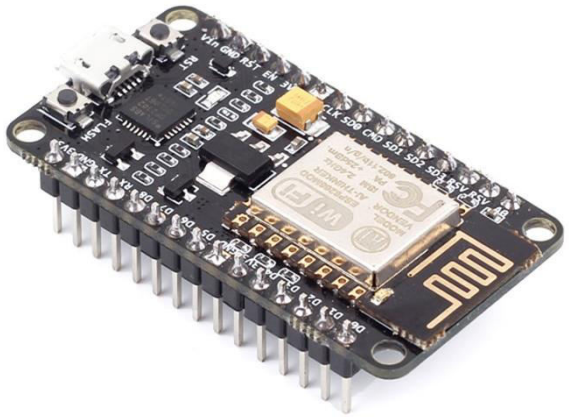
- Types
- Usage
- Interfacing with Arduino
- Commands

ESP 8266

- System on Chip (SoC)
- Low cost
- Full TCP/IP stack (!!!!)
- Can be flashed with different firmwares
- Can also be programmed with Arduino IDE
- Many models

ESP8266 Types

- NodeMCU



ESP01

ESP02

ESP03

ESP04

ESP05

ESP06

ESP07

ESP08

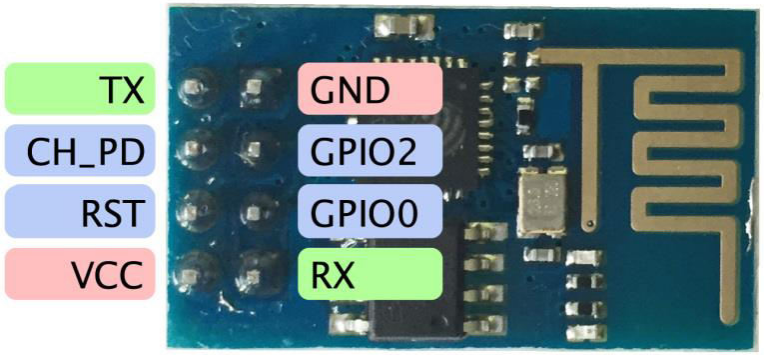
ESP09

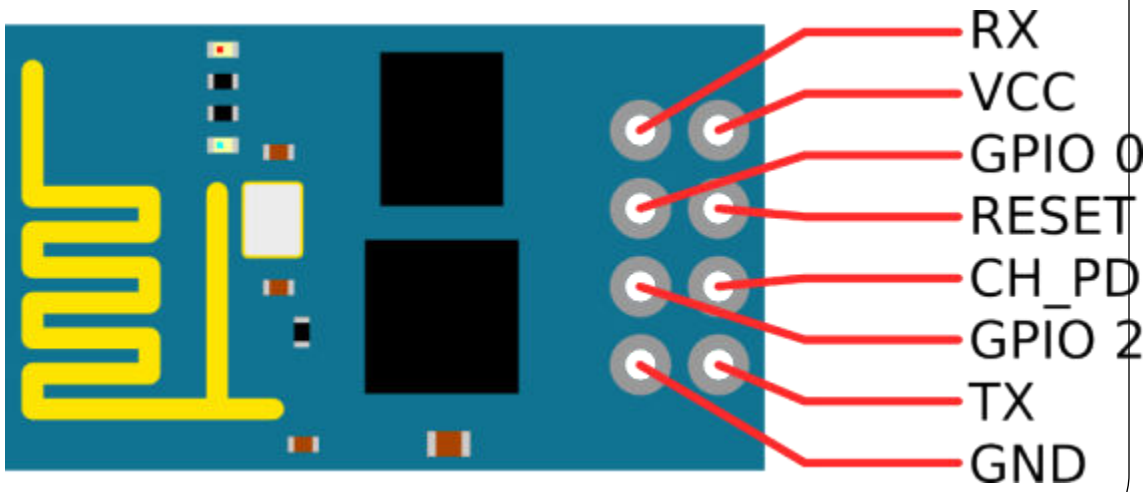
ESP10

ESP11

ESP12

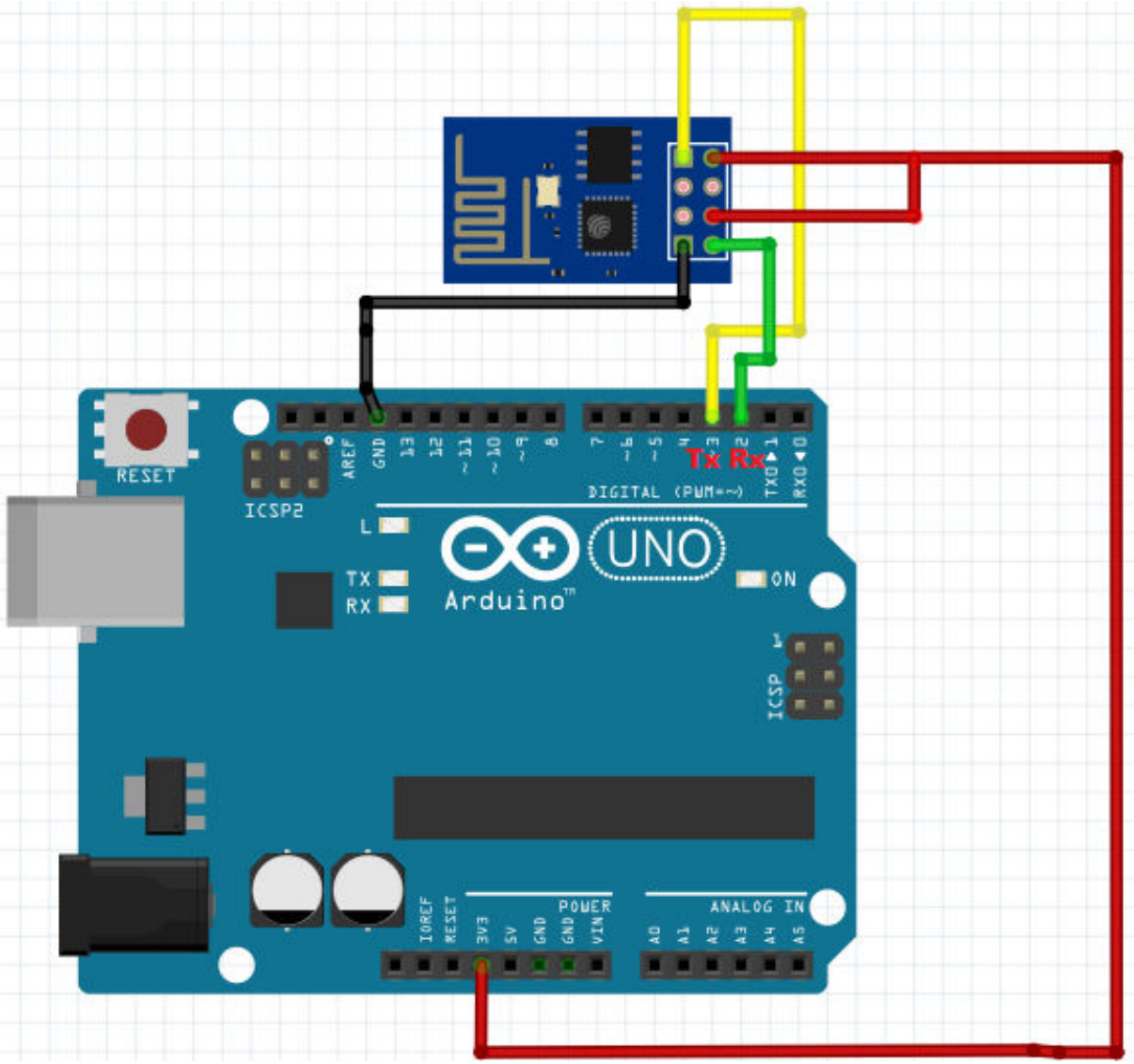
ESP 8266 Pinout





Arduino interfacing with ESP8266

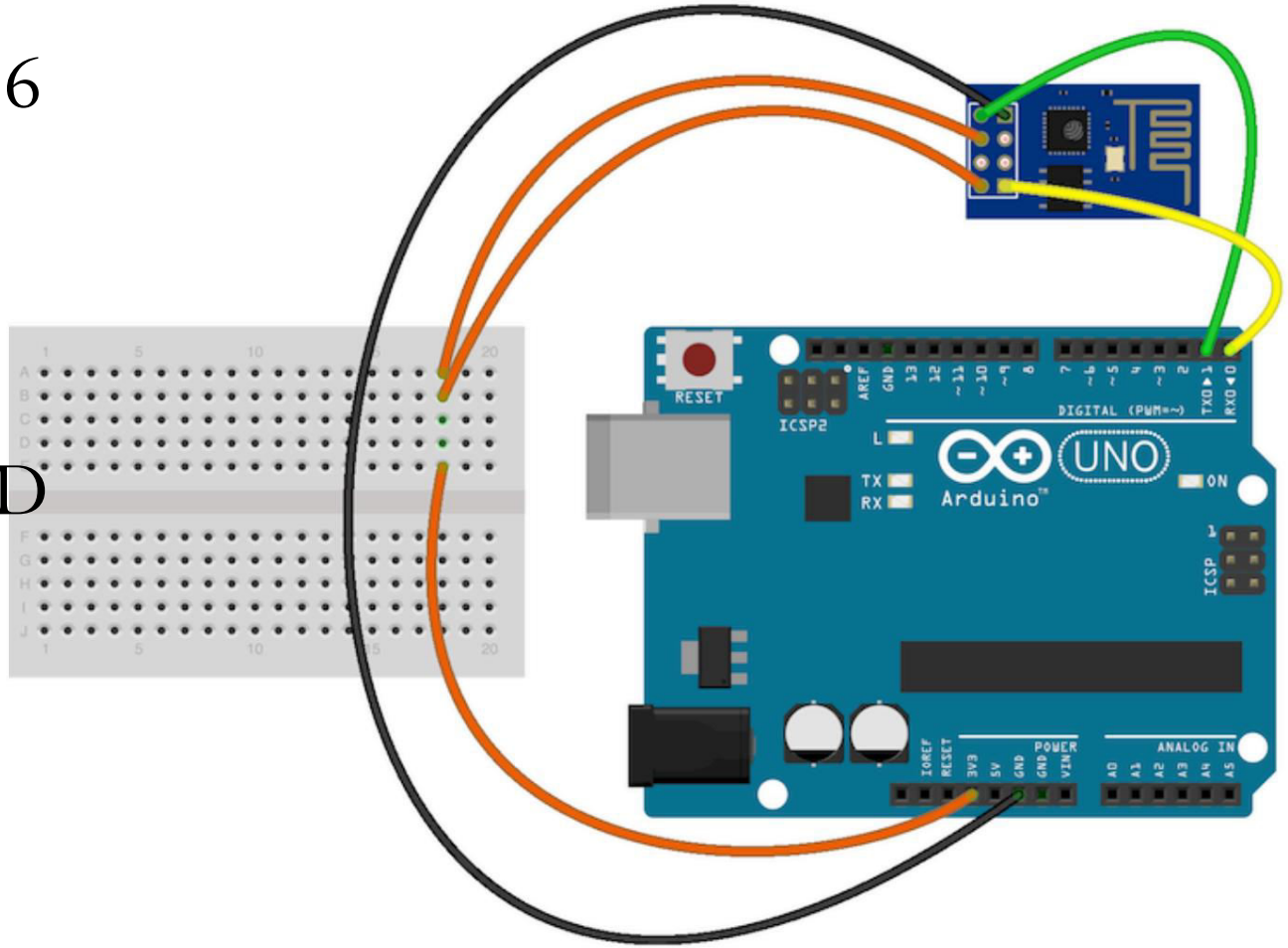
- Vcc
- Gnd
- Rx
- Tx



Arduino interfacing with ESP8266

Connections

Arduino	ESP8266
TX	RX
RX	TX
3.3V	VCC
3.3V	CH_PD
GND	GND



ESP8266-01

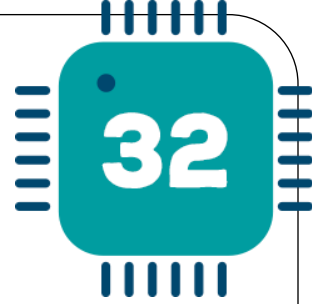
- 802.11 b/g/n
- Input power: 3.3V
- I/O voltage tolerance: 3.6V Max
- Regular operation current draw: ~70mA
- Peak operating current draw: ~300mA

Highly Integrated

- ESP8266EX is among the most integrated WiFi chips in the industry with the size of 5mm x 5mm
  - it integrates the antenna switches,
  - RF balun, power amplifier,
  - low noise receive amplifier, filters,
  - power management modules while requires minimal external circuitry.

http://espressif.com/products/hardware/esp8266ex/overview/

32-bit MCU



- ESP8266EX integrates Tensilica L106 32-bit micro controller (MCU) which features extra low power consumption and 16-bit RSIC.
- The CPU clock speed is 80 MHz.
- It can also reach a maximum value of 160 MHz.
- Real Time Operation System (RTOS) is enabled.
- Currently, only 20% of MIPS has been occupied by the Wi-Fi stack, the rest can all be used for user application programming and development.

Low Power

- ESP8266EX has been designed for mobile, wearable electronics and Internet of Things applications with the aim of achieving the lowest power consumption with a combination of several proprietary technologies.
- The power saving architecture operates in 3 modes:
  - active mode,
  - sleep mode and
  - deep sleep mode.

Robustness

- By integrating more components on-chip, we have made the solution to be the most robust and manufacturable.
- Our solutions also feature the widest operating temperature range, from -40°C to +125°C.

Coding

Interfacing ESP8266 with Arduino

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Software Serial

- The Arduino Uno has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection).
- The native serial support happens via a piece of hardware (built into the chip) called a UART.
- This hardware allows the Atmega chip to receive serial communication even while working on other tasks, as long as there room in the 64 byte serial buffer.
- The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial").

Reference : https://www.arduino.cc/en/Reference/SoftwareSerial

SoftwareSerial

- It is possible to have multiple software serial ports with speeds up to 115200 bps.

Limitations

- If using multiple software serial ports, only one can receive data at a time.
- Not all pins on the Mega and Mega 2560 support SoftwareSerial

ESP8266 - AT Command

- ESP8266, in it's default configuration, boots up into the serial modem mode.
- In serial mode communication is possible using a set of **AT commands**.

AT Commands

Basic	WiFI layer	TCPIP Layer
AT	AT+CWMODE	AT+CIPSTATUS
AT+RST	AT+CWJAP	AT+CIPSTART
AT+GMR	AT+CWLAP	AT+CIPSEND
AT+GSLP	AT+CWQAP	AT+CIPCLOSE
ATE	AT+CWSAP	AT+CIFSR
	AT+CWLIF	AT+CIPMUX
	AT+CWDHCP	AT+CIPSERVER
	AT+CIPSTAMAC	AT+CIPMODE
	AT+CIPAPMAC	AT+CIPSTO
	AT+CIPSTA	AT+CIUPDATE
	AT+CIPAP	+IPD

Arduino Code

```
void setup()
{    Serial.begin(115200);          // Begin serial monitor to receive 115200
                                    // bits per second (BAUD RATE)
     WiFi_Serial.println("AT+UART_DEF=9600,8,1,0,0");
     // set WiFi Send/Receive at 115200 bits per second
     // (BAUD RATE) to 9600 bits per second
    WiFi_Serial.begin(9600);
     // Begin SoftwareSerial with ESP at 9600 bps (BAUD RATE)
    WiFi_Serial.println("ATE0"); // turn echo off
    WiFi_Serial.println("AT+CWQAP");
    // Disconnect from previous network connections
}
```

```
void WIFI_Check()
{
 WiFi_Serial.println("AT"); // send a Attention command
 if (WiFi_Serial.available())
 {
     if (WiFi_Serial.find("OK")) // check with expected output
     {
      Serial.println("WIFI PLUGGED ON TO THE BOARD..!");
       WiFi_Serial.println("AT+CWMODE=1");
                                  //set mode to client mode
      isESPonBoard = true;
     }
 }  else  {
     Serial.println("WIFI NOT PLUGGED..!   ");    Serial.println();
     Serial.println("PLUG IN YOUR WIFI CHIP");    Serial.println();
 }
}
```

AT+CWMODE - WIFI mode（station, AP, station + AP）

Variant	Command	Response	Function
Test	AT+CWMODE=?	+CWMODE:(1-3) OK	List valid modes
Query	AT+CWMODE?	+CWMODE:modeOK	Query AP's info which is connect by ESP8266.
Execute	AT+CWMODE= mode	OK	Set AP's info which will be connect by ESP8266.

mode： An integer designating the mode of operation either 1, 2, or 3.

1 = Station mode (client)

2 = AP mode (host)

3 = AP + Station mode (Yes, ESP8266 has a dual mode!

void connectWiFi()

```
{
 WiFi_Serial.println("AT+CWJAP?");
          //check if WIFI connected to any WiFi network
 if (WiFi_Serial.available())
 {    if (WiFi_Serial.find("No AP"))
          //we receive response "No AP" when not connected to any network
     {       Serial.println("NOT CONNECTED TO WIFI NETWORK");
          Serial.println("Trying to Connect to WiFi Network");
      }
      String cmd = "AT+CWJAP=\"";     // connected to specified
                    //network passing mentioned WiFi username and password
      cmd += SSID;    cmd += "\",\"";   cmd += PASS;      cmd += "\"";
      WiFi_Serial.println (cmd);
```

void connectWiFi() …. Contd…

```
    Serial.println("-->"+cmd);
    if (WiFi_Serial.available())
    {     String RES_input = "";
          while (WiFi_Serial.available()) // read data into a variable
          {         RES_input += (char)WiFi_Serial.read();       }
          Serial.println(RES_input);
          if (WiFi_Serial.find("WIFI CONNECTED"))
          {
               Serial.println("CONNECTED TO WIFI NETWORK");
               isESPconnectedtoAP = true;
          }
    }
}
```

```
void loop()
{
 Serial.println("Welcome to ESP8266 interfacing");
   while (1)
   {
        WIFI_Check();
       if (isESPonBoard == true) {
            connectWiFi(); postData();
       }
       delay(4000);
   }
}
```

void post()

```
{   //form the JSON string with the available sensor data
    String data;
    data += "{\"username\":\"" + String(username) ;
    data +=  "\",\"name\":\"";
    data += String(Device_No);
    data += "\",\"sample1\":\"";
    data += String( CELSIUS); //(unsigned char)
    data += "\",\"sample2\":\"";
    data += String(HUM);
    data += "\",\"sample5\":\"";
    data += String(CO2);
    data += "\"}";
```

void post() ….

```
// form the header to post the WiFi data
String uri = "/iot/cht/rec.php";
String port = "80";
String http_req = "POST " + uri +
    " HTTP/1.1\r\n Host: " + DST_IP + ":" +
    port + "\r\n  Accept: */*\r\n" +
    "Content-Length: "+data.length() + "\r\n" ;
String http_req1 =
    "Content-Type: application/json\r\n\r\n" ;
```

void post()

```
// starts a TCP connection
String cmd = "AT+CIPSTART=\"TCP\",\"";
 cmd += DST_IP;      cmd += "\",80";
  WiFi_Serial.println(cmd);
  WiFi_Serial.print("AT+CIPSEND=");
  WiFi_Serial.println(Total_req_data_Length);
  if (WiFi_Serial.find(">"));        // when ">" is response from
     WiFi that means it is ready to receive the total length of data
    {
     WiFi_Serial.print(http_req); //Send headder first
     WiFi_Serial.print(http_req1);
     WiFi_Serial.print(data); //later send data
    }
```