

Module 2a

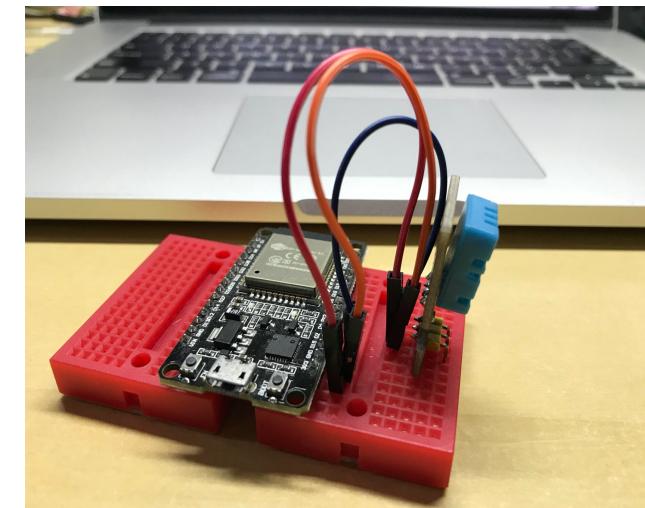
Getting Started with ESP32 & DHT11

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Project Overview

This is a tutorial on connecting temperature & humidity sensor, DHT11 to ESP32. This activity is to show that ESP32 able to work as Arduino Uno, Mega, Nano, etc. (in case that you do not have Uno or Mega around). At the end of the class, you will be able to:

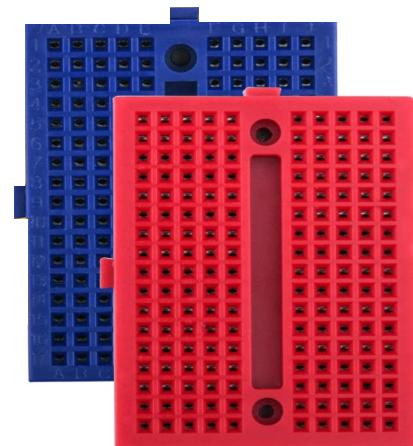
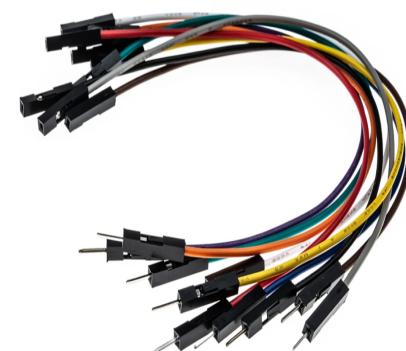
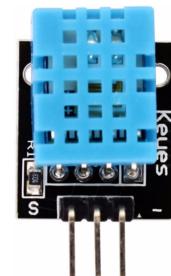
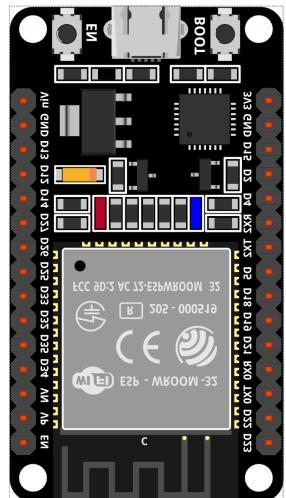
- Install additional library.
- Connection between ESP32 & DHT11.
- Capture temperature & humidity value and display at Serial Monitor.



2a. Getting Started with ESP32 & DHT11

Components

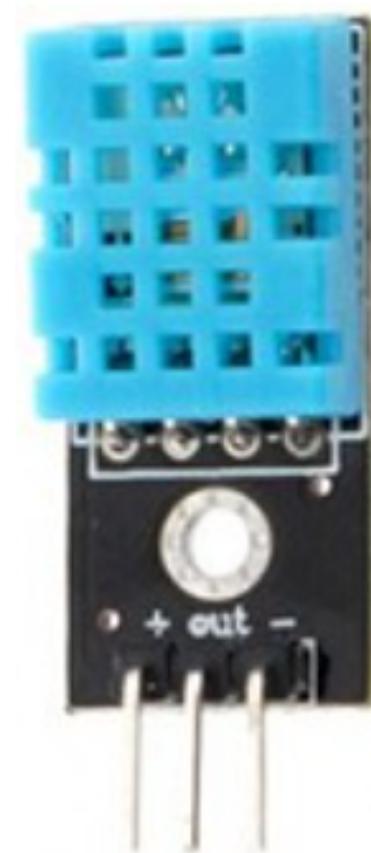
- 1 x ESP-32 Wifi+Bluetooth 2-In-1 Development Board for Arduino (30 pin) + Cable.
- 1 x Temperature & Humidity Sensor, DHT11.
- Jumpers (male to female).
- 2 x Mini Breadboard.



DHT11 Specifications

- Operating Voltage 3.3V to 5.5V.
- Humidity measurement range 20% to 90% RH.
- Humidity measurement accuracy $\pm 5\%$ RH.
- Humidity measurement resolution 1% RH.
- Temperature measurement range 0°C to 50°C [32°F to 122°F].
- Temperature measurement accuracy $\pm 2^\circ\text{C}$.
- Temperature measurement resolution 1°C.
- Signal transmission range 20m.
- Weight is about 8g PCB Size: 3.2cm*1.4cm.

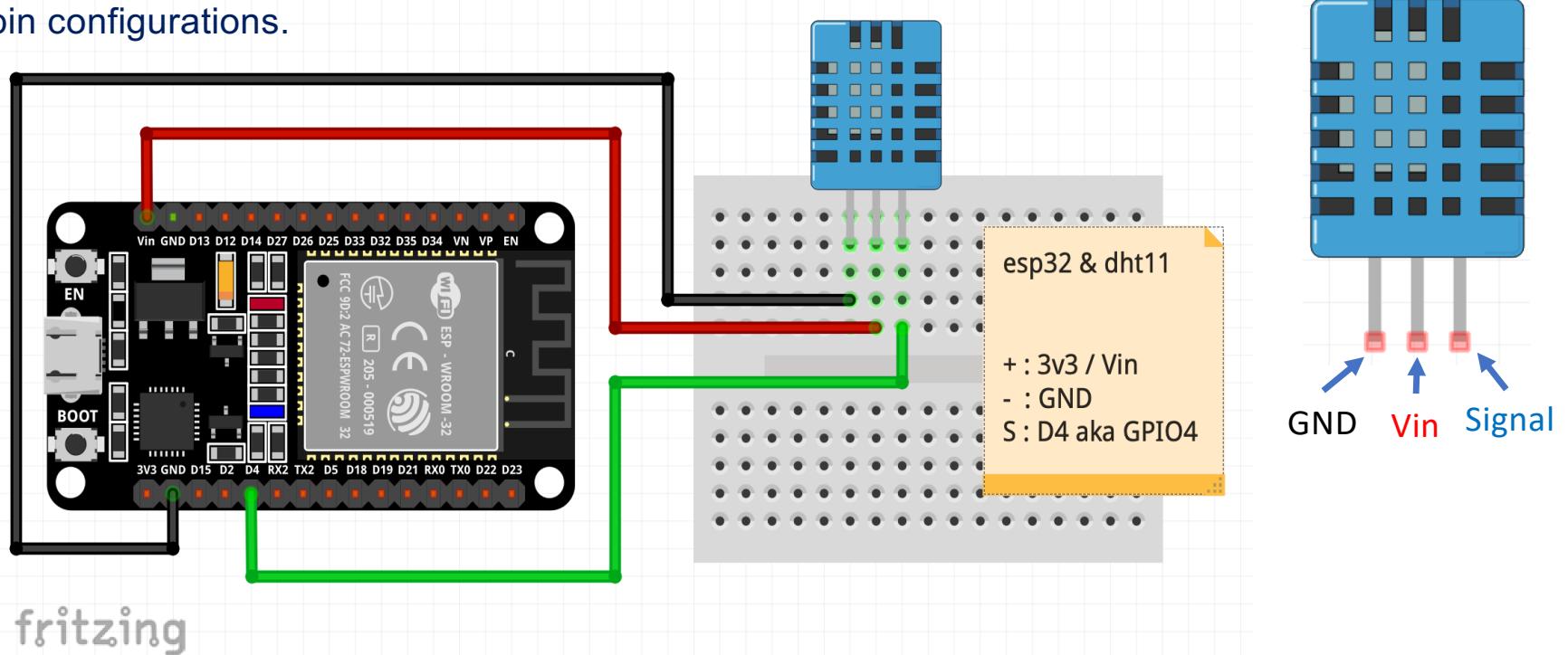
**RH = Relative Humidity



2a. Getting Started with ESP32 & DHT11

Schematic Diagram

→ Check a few time the connections that have been made before plugging ESP32 to USB port. This might prevent short circuit to DHT11. Watch out on sensors' pin. Same type, doesn't mean same pin configurations.



Working File

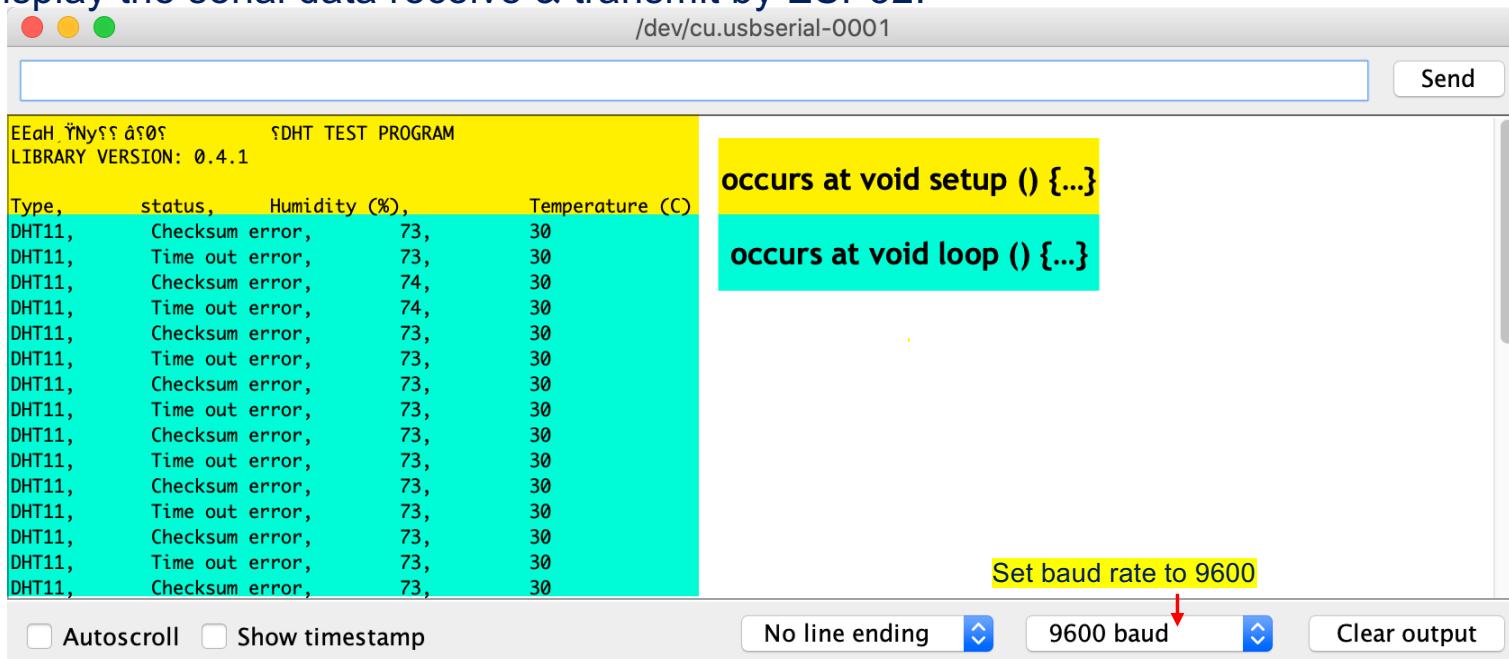
Installation of DHT11 library

- Install the DHT11 library by download it from <https://bit.ly/34FQdHr> ↓ Code ▾
- Do not **UNZIP** the “**dht11-main.zip**”.
- Launch the Arduino IDE.
- Click **Sketch > Include Library > Add .zip library ...** browse for “**dht11-main.zip**” & click to upload the zipped library.
- Click **File > Examples > Examples from Custom Libraries > dht11-main > dht_test**.
- Click upload button  to upload the sketch to ESP32 board. Ensure that you have selected the right board and set the current port. Don't forget to press **BOOT** button. Refer to **Troubleshoot** section if you have problem.

2a. Getting Started with ESP32 & DHT11

The Output

- Click  Serial Monitor to open a window and view the output.
- Both values will be update every 1 second.
- There are several versions of DHT11 libraries which may lead to Checksum error and Time out error, nevertheless, the reading for both humid and temp is correct.
- Display the serial data receive & transmit by ESP32.



The screenshot shows the Arduino Serial Monitor window. The title bar says "Serial Monitor" and the port is set to "/dev/cu.usbserial-0001". The main area displays the output of a DHT test program. The output starts with "DHT TEST PROGRAM LIBRARY VERSION: 0.4.1" followed by a table of 15 rows. Each row contains four columns: Type, status, Humidity (%), and Temperature (C). The "status" column consistently shows either "Checksum error" or "Time out error". The "Humidity (%)" and "Temperature (C)" columns show values of 73 and 30 respectively. To the right of the table, two error messages are highlighted in yellow boxes: "occurs at void setup () {...}" and "occurs at void loop () {...}". At the bottom right of the monitor window, there is a yellow box with the text "Set baud rate to 9600" and a red arrow pointing to the "9600 baud" dropdown menu. The footer of the monitor window includes checkboxes for "Autoscroll" and "Show timestamp", and buttons for "No line ending", "9600 baud", and "Clear output".

Type,	status,	Humidity (%)	Temperature (C)
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30
DHT11,	Checksum error,	74,	30
DHT11,	Time out error,	74,	30
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30
DHT11,	Checksum error,	73,	30
DHT11,	Time out error,	73,	30

Code Explanation

- Filename: **dht11_test.ino** .
- This sketch consists of 2 functions:

void setup(), void loop()

- The sketch starts with:

dht11.h : an Arduino low cost library for temperature & humidity sensor.

dht11 DHT : create DHT object to access the functions within the library.

#define DHT11_PIN 4 : set pin D4 as input signal from DHT11.

```
5 #include <dht11.h>
6 dht11 DHT;
7 #define DHT11_PIN 4
```

Code Explanation

Line #9 - #16 took place in void setup() function

- The **void setup() {...}** function is the first function to run. Lines written in here run once at the very beginning. Every power up, reset or upload new sketch, ESP32 will invoke setup() function. Initialization of pin modes and variables also will be done here.
- Serial communication at respective port will start with data rate of 9600. This will allow us to see information/values/data/send & receive/input & output activities in ESP32 on your computer/laptop thru Serial Monitor by using **Serial.print()** command.

```
9 void setup(){  
10  Serial.begin(9600);  
11  Serial.println("DHT TEST PROGRAM ");  
12  Serial.print("LIBRARY VERSION: ");  
13  Serial.println(DHT11LIB_VERSION);  
14  Serial.println();  
15  Serial.println("Type,\tstatus,\tHumidity (%),\tTemperature (C)");  
16 }
```

Code Explanation

Line #18 - #42 are in void loop() function

- The ***loop() {...}*** function will keep looping infinitely. The sketch written inside this function will run over & over as long the board is still turned on.
- Input such as sensors and output such as servos, motors & LEDs are written here. Calculation or formula can be written within this function. Not to forget, conditions & rules too.
- DHT11 will feed the reading to ESP32 via D4. At least 3 important information are fed into ESP32 via DHT11; DHTLIB status (0,1 or 2), humidity value & temperature reading.
- ***Serial.print(val, format)*** - ***val*** is data captured at D4; ***format*** can be decimal (0), binary (2), octal (3), etc. & determine number of floating point.
- Remember that writing a program is like baking a cake. You cannot simply skip the recipe order list otherwise the food become different.

Code Explanation

```
18 void loop(){
19     int chk;
20     Serial.print("DHT11, \t");
21     chk = DHT.read(DHT11_PIN);      // READ DATA
22     switch (chk){ ← Start of switch.. case statement
23         case DHTLIB_OK:
24             Serial.print("OK,\t");
25             break;
26         case DHTLIB_ERROR_CHECKSUM:
27             Serial.print("Checksum error,\t");
28             break;
29         case DHTLIB_ERROR_TIMEOUT:
30             Serial.print("Time out error,\t");
31             break;
32         default:
33             Serial.print("Unknown error,\t");
34             break;
35     } ← End of switch.. case statement
36     // DISPLAY DATA
37     Serial.print(DHT.humidity,1);
38     Serial.print(",\t");
39     Serial.println(DHT.temperature,1);
40
41     delay(1000);
42 }
```

2a. Getting Started with ESP32 & DHT11

Simpler Sketch

The screenshot shows the Arduino IDE interface with the following details:

- Title Bar:** sketch_dec21b_basic | Arduino 1.8.10
- Sketch Area:** The code for `sketch_dec21b_basic` is displayed:

```
1 #include <dht11.h>
2 dht11 DHT;
3 #define DHT11_PIN 4 //GPIO4
4
5 void setup(){
6   Serial.begin(9600);
7 }
8
9 void loop(){
10 int chk = DHT.read(DHT11_PIN);
11 Serial.print("Temperature = ");
12 Serial.print(DHT.temperature);
13 Serial.print("Humidity = ");
14 Serial.println(DHT.humidity);
15 delay(10000); // pause for 10seconds
16 }
```
- Serial Monitor:** The monitor shows the output of the compilation process and the execution of the sketch:

```
Done compiling.
python /Users/[REDACTED]/Library/Arduino15/packages/esp32/hardware/esp32/1.0.4/tools/gen_esp32part
/Users/safyzansalim/Library/Arduino15/packages/esp32/tools/esptool_py/2.6.1/esptool --chip esp32 elf
esptool.py v2.6
Using library dht11 in folder: /Users/[REDACTED]/Documents/Arduino/libraries/dht11 (legacy)
/Users/[REDACTED]/Library/Arduino15/packages/esp32/tools/xtensa-esp32-elf-gcc/1.22.0-80-g6c4433a-5
```
- Status Bar:** Shows the board as "ESP32 Dev Module" connected to "/dev/cu.usbserial-0001".

QUESTIONS?

Questions?

EXERCISE

Change to other GPIO, upload new sketch and observe the output.
[10 minutes activity]

TROUBLESHOOT GUIDE

Failed to upload the sketch to ESP32? Follow these steps:

- Press REBOOT button until the IDE approaches **Connecting...** segment;
- **OR**, check whether you have chosen the correct **Board** and set the correct **PORT**;
 - * Choose the right board by going to **Tools > Boards > ESP32 Dev Module**
 - * Select the correct port at **Tools > Port > choose the appropriate serial port**
- **OR**, unplugging the board from USB and plugging back;
- **OR**, **Verify** to confirm that your sketch is error free;
- **OR**, Swap to other PC / Laptops;
- **OR**, Use different board;
- You are using micro-USB power cable instead of power & data cable.