

INTRODUCTION To IoT

Spring 2024 LAB5

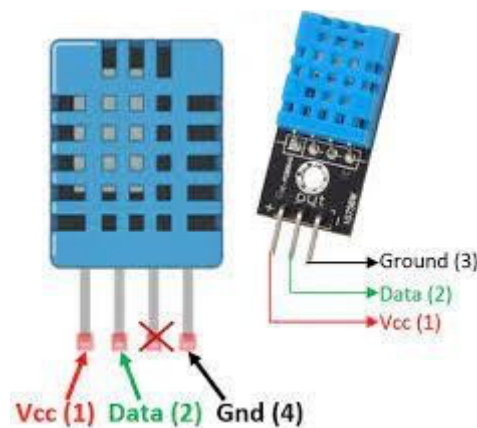
Introduction:

In this lab session, you will be interfacing a DHT11 temperature-humidity sensor with the ESP32 and write the outputs to the serial monitor. Once that is done, you will be working on setting a threshold value to make decisions to drive a servo motor.

Part-1) DHT11 Temperature & Humidity sensor on ESP32 using Arduino IDE

a) Introduction and understanding the DHT11 sensor:

- i. The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.
- ii. The DHT11 is chosen because it is lab calibrated, accurate and stable and its signal output is digital.
- iii. Most important of all, it is relatively inexpensive for the given performance.
- iv. Below is the pinout diagram of the DHT11 sensor



- v. DHT11 Specifications:
 - 1) Operating Voltage: 3.5V to 5.5V
 - 2) Operating current: 0.3mA (measuring) 60uA (standby)
 - 3) Output: Serial data
 - 4) Temperature Range: 0°C to 50°C
 - 5) Humidity Range: 20% to 90%
 - 6) Resolution: Temperature and Humidity both are 16-bit
 - 7) Accuracy: $\pm 1^\circ\text{C}$ and $\pm 1\%$
- vi. Please refer to the data sheet for more information about the DHT11 sensor. Link to the data sheet [here](#).

b) Components required for this exercise:

- i) DHT11 sensor
- ii) ESP32
- iii) Breadboard
- iv) Few jumper wires

c) Circuit Diagram:

- i. Data pin of DHT11 is connected to any digital GPIO pin of the ESP32.
- ii. The +VCC of DHT11 goes into +3.3V of the ESP32.
- iii. GND of the DHT11 goes into Ground Pin (GND) of the ESP32.

d) Library Files:

Following two libraries will be required to run this code. Download the zip file, extract the same and copy this to your Arduino library folder.

- i) Library 1: You may download library file from [here](#).
- ii) Library 2: You may download library file from [here](#).

e) Pseudocode:

- i. Include the library of the DHT11 temperature and humidity sensor using `#include "DHT.h"`
- ii. Define the DHTtype and digital pin, in this case type is DHT11 and digital pin(any digital pin) using `#define DHTTYPE` and `#define dht_dpin`.
- iii. Instantiate the DHT `dht(dht_dpin, DHTTYPE)`
- iv. In the setup block, use `dht.begin()`, `Serial.begin()` to begin the serial communication. Use `delay()` to give an appropriate delay.
- v. In the loop block, use float variables to read the temperature and humidity values from the sensor using `dht.readHumidity()`, `dht.readTemperature()`; `Serial.print()/Serial.println()` to print the values on the serial monitor and give an appropriate delay using `delay()` according to the frequency of sensor.
- vi. You can refer to the example codes in the library you already downloaded for the syntaxes as well as some additional points.

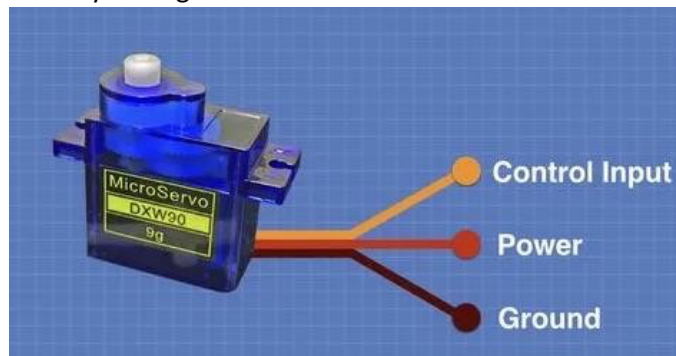
f) Expected output:

- i. The output values should be the temperature and humidity values measured by the DHT11 sensor at each instant it is sensing corresponding to your delay.
- ii. After getting the values plot the mean of these values every minute on the serial plotter
- iii. Compare your values with the room temperature and verify if the output temperature value is not too far from it, else your sensor is not working.
- iv. Try playing around with the sensor a little like blowing on to it etc. which should increase the temperature and verify.

Part-2) Controlling the servo motor by setting threshold:

a) Introduction and understanding the servo motor:

- i. Servo motors are geared DC motors that have an integrated servomechanism with a feedback loop to allow precise positioning of the motor shaft. A high gear ratio allows a small servo to have an impressive torque rating.
- ii. Most servos are limited in rotation to either 180 or 270 degrees, with 180-degree servo motors being more common. There are specially modified servo motors that can rotate beyond 360-degrees, but we won't be working with those today.
- iii. Servo motors come in a wide range of sizes and can be controlled either with an analog PWM signal or with a digital I/O signal. The inexpensive servos we use for hobbyist applications are usually analog servo motors.



b) Components required for this exercise:

- i. DHT11 sensor
- ii. ESP32
- iii. Servo motor
- iv. Breadboard
- v. Few jumper wires

c) Circuit Diagram:

- i. The control pin of servo is connected to any PWM pin of the ESP32.
- ii. The +VCC of servo goes into +3.3V of the ESP32.
- iii. GND of the servo goes into Ground Pin (GND) of the ESP32.

d) Library Files:

The [ESP32 Arduino Servo Library](#) makes it easier to control a servo motor with your ESP32, using the Arduino IDE. Follow the next steps to install the library in your Arduino IDE:

1. [Click here to download the ESP32 Arduino Servo Library](#). You should have a .zip folder in your Downloads folder
2. Unzip the .zip folder and you should get *ESP32-Arduino-Servo-Library-Master* folder
3. Rename your folder from *ESP32-Arduino-Servo-LibraryMaster* to *ESP32_Arduino_Servo_Library*
4. Move the *ESP32_Arduino_Servo_Library* folder to your Arduino IDE installation libraries folder
5. Finally, re-open your Arduino IDE

e) Pseudocode:

- i. Include the library of the servo motor using `#include "Servo.h"`
- ii. Create a servo object and declared the initial angle of the servo motor.
- iii. Adjust the baud rate in the setup function `Serial.begin()`.
- iv. Define the pin at which the servo motor is connected to the ESP32
- v. Inside the main loop, write the condition for setting thresholds for temperature and humidity values (the threshold values depend on your respective environmental conditions)
- vi. Inside the above loop apply the condition in between 0 and 180 degrees, the servo motor's angle need to be changed. (The change in angle of servo is up to you)
- vii. You can refer to the example codes in the library you already downloaded for the syntaxes as well as some additional points.

f) Expected output:

- i. The output values should be the temperature and humidity values measured by the DHT11 sensor at each instant it is sensing corresponding to your delay.
- ii. If the temperature and humidity values meet the thresholds, then the servo motor angle should be changed.
- iii. After that add at least one more threshold on the values and map the servo hand to different angles.