International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

# DHT11 Sensor:
# A Comprehensive Study on Temperature and Humidity Sensor

**Jana Divyashree, Vinayaka A V, Veeru N Arkasali, Rakshitha K B**

*Students, Department of Electronics & Communication Engineering*

**Manju Haller, Lecturer**

*Department of Electronics & Communication Engineering*

D.R.R GOVERNMENT POLYTECHNIC, DAVANGERE

----------***----------

***Abstract:*** ***The DHT11 sensor is a fundamental component in the realm of sensor technology, offering a simple yet effective solution for measuring temperature and humidity. This paper presentation aims to provide a comprehensive overview of the DHT11 sensor, highlighting its key attributes, operating principles, and practical applications. It is a compact and affordable sensor that utilizes a capacitive humidity sensor and a thermistor to accurately measure both temperature and humidity. Its digital output makes it easy to interface with microcontrollers and data acquisition systems, making it a popular choice for DIY enthusiasts, hobbyists, and professionals alike.***

***Keywords:***

1.Arduino IDE program software.

2.Development board ESP8266.

3.DHT 11

## INTRODUCTION

The DHT11, short for Digital Humidity and Temperature Sensor 11, is a compact and economical sensor module designed for the measurement of both ambient temperature and relative humidity. This sensor is frequently utilized in a diverse range of electronic projects, including environmental monitoring systems, weather stations, home automation, HVAC (Heating, Ventilation, and Air Conditioning) control, and various other applications that require accurate and reliable temperature and humidity data.

The DHT11 sensor is comprised of a few key components, including a humidity sensing element, a temperature sensing element, and an integrated signal conditioning and analog-to-digital conversion circuit. The humidity sensing element is 98typically a capacitive-type sensor that changes its capacitance in response to variations in the surrounding air's moisture content. The temperature sensing element is typically a thermistor, which is sensitive to changes in temperature and produces electrical resistance variations accordingly.

The DHT11 operates on a single-wire digital communication protocol, making it simple to interface with microcontrollers and other digital devices. It communicates with the host system by sending out a series of digital pulses, and the host system can request temperature and humidity data from the sensor using a predefined protocol.

## COMPONENTS REQUIRED

**1)Arduino IDE program software:** Arduino IDE is an open-source software platform used for programming Arduino microcontroller boards.

Arduino IDE is a user-friendly integrated development environment. It simplifies programming for Arduino boards using C/C++. It offers a code editor with syntax highlighting and auto completion. Libraries and examples are included to facilitate code development. A simple interface uploads code to the connected Arduino hardware. It supports various Arduino board models and compatible hardware. Serial monitoring tools assist in debugging and data exchange. Arduino IDE is free and available for Windows, macOS, and Linux.


Fig-1 Arduino IDE

**Development board ESP8266:**

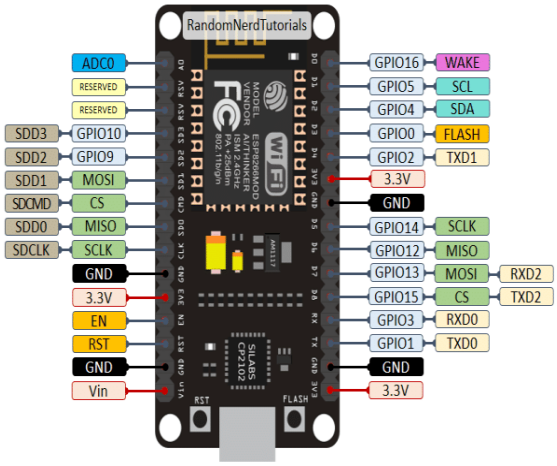



Fig-2 NodeMCU ESP8266

**Connectivity:** The ESP8266 can connect to Wi-Fi networks and GSM, enabling the irrigation system to access the internet. This connectivity can be used for remote monitoring, control, and data exchange.

**Sensor Integration:** You can connect various sensors to the ESP8266, such as soil moisture sensors, DHT11, Soil pH sensor, or rain sensor. The ESP8266 can collect data from these sensors, providing real-time information about soil conditions and weather forecasts.

**Automation:** Using the data collected from sensors, the ESP8266 can implement automation rules to optimize irrigation. For example, it can trigger irrigation only when soil moisture levels drop below a certain threshold or when rain is not expected.

**Power efficiency:** Implement power-saving features to ensure the ESP8266 operates efficiently and conserves energy, especially if the system relies on battery power.

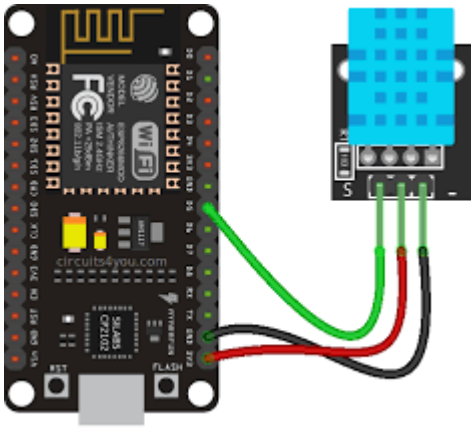
**Scalability:** The ESP8266 can be used in both small-scale and large-scale smart irrigation systems, making it versatile for various applications.

**4.DHT 11:**


Fig-3 DHT 11 (Temperature and Humidity Sensor)

Using a DHT11 sensor we can detect the temperature and humidity level surrounding environment. GSM sends the notifications to the user about the temperature and humidity level in yield.

## CIRCUIT DIAGRAM:




**CONNECTIONS:**

1. Power Supply Connections: Connect the VCC (Voltage) pin of the DHT11 to a 3.3V output on the ESP8266. The DHT11 operates at a lower voltage, and connecting it to 5V might damage the sensor. Connect the GND (Ground) pin of the DHT11 to a ground (GND) pin on the ESP8266.

2. Data Connection: Connect the Data pin of the DHT11 to any available GPIO pin on the ESP8266. Remember the GPIO pin number you choose, as you will need it in your code. Let's assume you connected it to GPIO 2.

3. Pull-up Resistor (Optional but recommended): To ensure stable communication between the DHT11 and ESP8266, it's recommended to add a 4.7k ohm pull-up resistor between the Data pin (the one connected to the DHT11) and the 3.3V power source. This helps prevent signal interference and ensures more reliable data transmission.

**ADVANTAGES:**

1. Affordability: The DHT11 sensor is cost-effective, making it an excellent choice for projects with budget constraints.

2. Ease of Use: It is straightforward to connect and interface with microcontrollers and other digital devices, making it accessible for beginners.

3. Digital Output: It provides digital temperature and humidity readings, eliminating the need for complex analog signal processing.

4. Low Power Consumption: It consumes minimal power, making it suitable for battery-powered or low-power applications.

5. Versatility: The DHT11 can be used in a variety of projects, including weather monitoring, home automation, and environmental sensing.

**DISADVANTAGES:**

1. Limited Accuracy: The DHT11 provides reasonably accurate measurements, but it is not as precise as some higher-end sensors.

2. Narrow Operating Range: The DHT11 is designed to work within a limited temperature and humidity range.

3. Non-Replaceable Sensor Element: If the sensor element in the DHT11 fails, it cannot be replaced or recalibrated. You would need to replace the entire sensor module.

4. Not Suitable for Harsh Environments: The DHT11 is not designed for use in harsh or industrial environments, where more robust sensors are typically required.

5. Limited Humidity Range: The humidity measurement range of the DHT11 is limited to 20% to 80%.

**CONCLUSION:**

"In conclusion, the DHT11 sensor serves as a versatile and cost-effective solution for temperature and humidity sensing across a range of applications. Its simplicity and ease of use make it a popular choice for hobbyists, students, and professionals in the field of sensor technology. Throughout this presentation, we have explored the working principle, internal components, and practical applications of the DHT11 sensor.

We have discussed its significance in weather monitoring, home automation, indoor agriculture, and more, highlighting its ability to provide valuable environmental data. However, it is essential to acknowledge the limitations of the DHT11, including its accuracy, operating range, and response time, which may restrict its use in applications requiring high precision.

As technology continues to advance, it is worth considering the evolving landscape of sensor technology, which offers a range of sensors with varying levels of accuracy and capabilities. Depending on the specific requirements of a project, one may need to evaluate whether the DHT11's performance aligns with those needs or if a more specialized sensor is warranted.

In the future, further research and development may lead to improved sensor technologies, addressing some of the DHT11's limitations. As we continue to explore the frontiers of environmental monitoring, automation, and data analysis, sensors like the DHT11 will remain integral to our ability to understand, adapt to, and shape the world around us."

This conclusion emphasizes the DHT11's strengths while acknowledging its limitations and suggests a consideration of alternative sensor technologies for specific applications. It also highlights the ever-evolving nature of sensor technology and the importance of staying informed about the latest advancements in the field.

**REFERENCE:**

T. Hariyanto, M. Rahayu, F. Satria and M. Y. Fadhlan, "Improving Temperature Sensor Accuracy in the IoT Trainer Kit by Linear Regression Method" 2019 International Conference on Mechatronics, Robotics and Systems Engineering (MoRSE), Bali, Indonesia, 2019.

"Temperature and Humidity Control in Greenhouses in Desert Areas". Shigeki Hirasawa, Mai Nakatsuka, Kunio Masui, Tsuyoshi Kawanami, Katsuaki Shirai Agricultural Sciences Vol.5 No.13, November 16, 2014

"Room-Temperature Humidity Sensing Using Graphene Oxide Thin Films". Gautam Naik, Sridhar Krishnaswamy *Graphene* Vol.5 No.1, December 3, 2015