

IoT-Based Weather Monitoring System Using Smart Sensors

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Abstract

This research paper explains the complete design, development, testing, and implementation of an IoT based weather monitoring system. The system is designed to measure environmental conditions such as temperature, humidity, and heat index in real time. Smart sensors are connected with a microcontroller board and the measured data is shown on an OLED display. The same data can also be sent to internet cloud platforms for remote monitoring. The project is low cost, portable, and useful for students, farmers, industries, and smart city applications. This paper explains each component, circuit connection, working principle, results, advantages, limitations, and future scope in detail.

1. Introduction

Weather conditions directly affect agriculture, transportation, industries, and human life. Accurate weather information helps people plan daily activities and prevent losses. Traditional weather stations are expensive and fixed at specific locations. Because of this, many people cannot access real-time local weather data. Internet of Things technology solves this problem by connecting sensors with the internet. In this project, smart sensors continuously collect data and a controller processes the values. The output is shown on screen and can be uploaded online.

2. Components Explanation

1. Arduino Nano / NodeMCU Controller: This is the brain of the project. It reads sensor values and controls the display.
2. DHT11 Sensor: Measures temperature and humidity using an internal sensing element.
3. OLED Display: A small screen used to show live readings clearly.
4. Breadboard: Used for temporary circuit connections without soldering.
5. Jumper Wires: Connect all components electrically.
6. 9V Battery: Portable power supply for running the circuit.
7. LED Indicator: Shows power status or alerts.
8. USB Cable: Used for programming and testing.

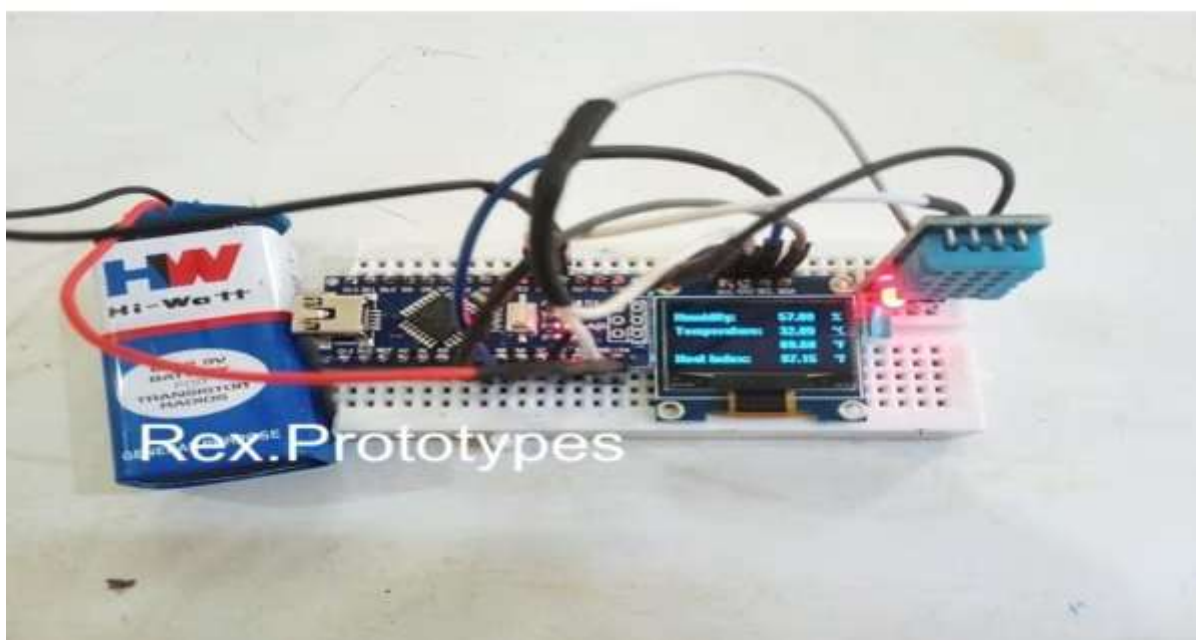
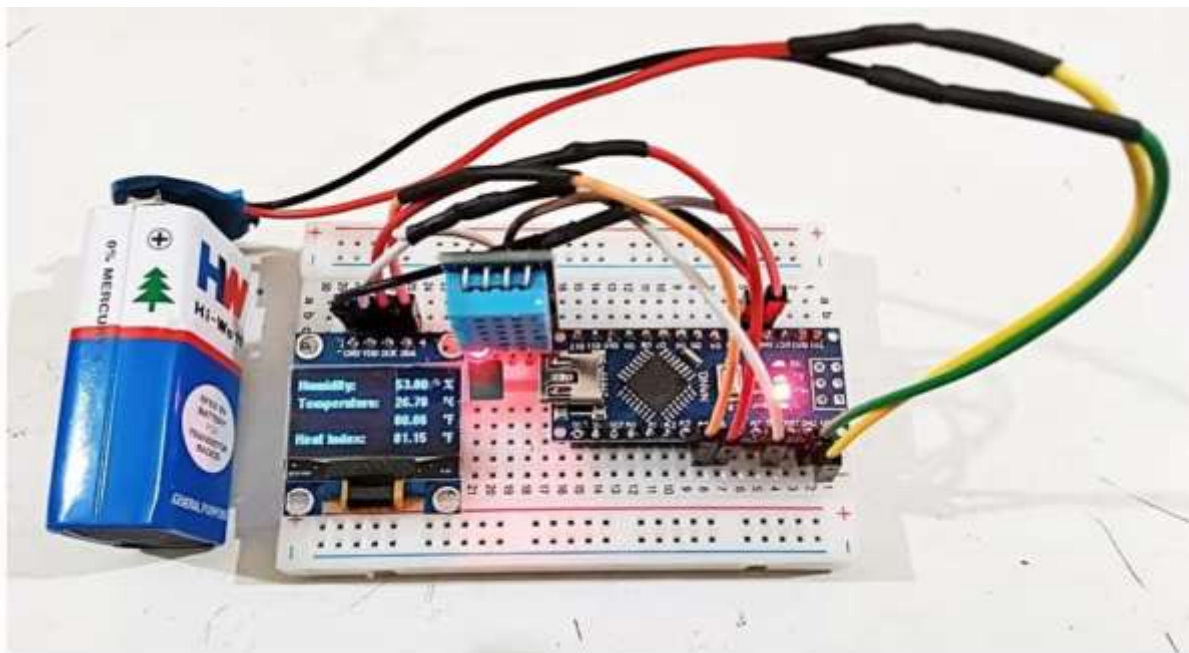
3. Working Principle

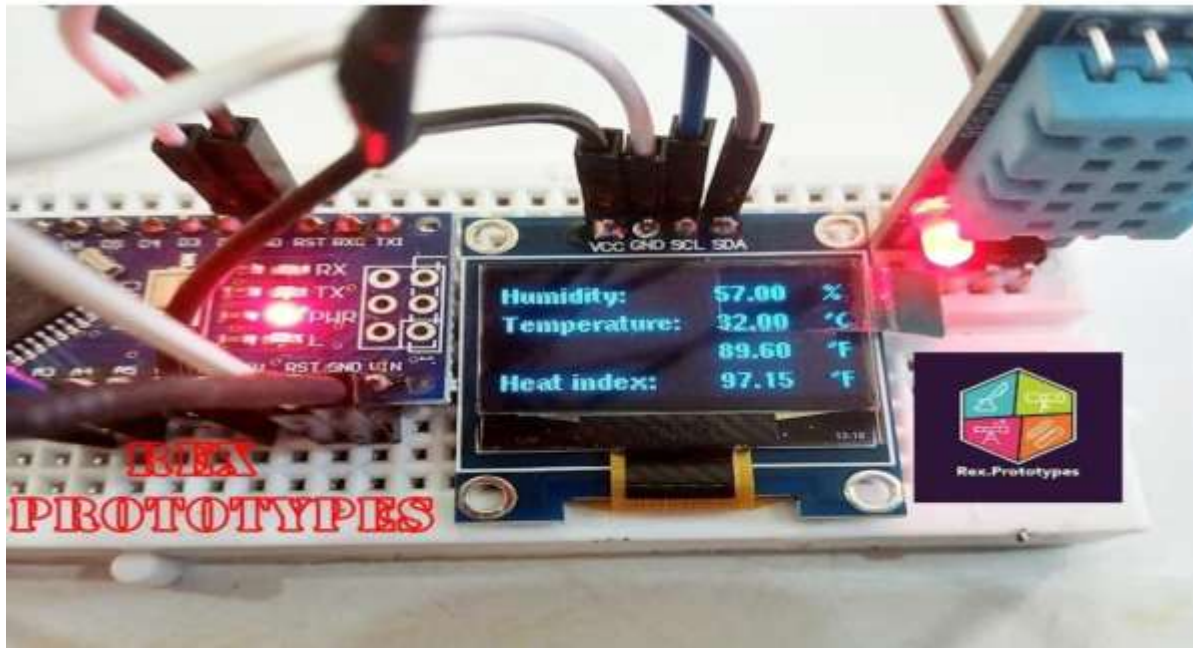
When power is supplied, the controller starts the program. The DHT11 sensor measures humidity and temperature after regular intervals. The controller converts raw data into useful values such as Celsius and Fahrenheit. Heat index is also calculated using formulas. These

values are displayed on the OLED screen. If Wi-Fi enabled controller is used, the same data is sent to cloud platforms like ThingSpeak or Blynk where graphs and dashboards can be generated.

4. Image Based Prototype Description

The project images show a compact breadboard setup. On the left side a 9V battery is connected for power. In the center, an Arduino Nano board is mounted. On the right side, the blue DHT11 sensor is visible. The OLED display is placed at the front side showing humidity, temperature, and heat index values. Multiple jumper wires connect the modules. Red LEDs indicate power and active operation. This arrangement proves the project can be built in a small portable form.





5. Methodology

First, all components were selected based on low cost and easy availability. Second, circuit wiring was completed on the breadboard. Third, source code was written in Arduino IDE using sensor libraries. Fourth, sensor values were tested and calibrated. Fifth, readings were displayed on OLED and observed for stability. Finally, optional cloud integration was configured for remote access.

6. Results and Analysis

The system successfully displayed humidity around 57%, temperature around 32°C, Fahrenheit around 89.6°F, and heat index around 97.15°F during testing. Values changed with environmental conditions. The display updated continuously. Power consumption remained low, making battery operation practical. Accuracy was acceptable for educational and prototype usage.

7. Advantages

Low cost system, portable size, real-time monitoring, easy to assemble, educational value, internet connectivity option, expandable design, and low power consumption.

8. Limitations

DHT11 has lower accuracy than advanced sensors. Battery backup is limited. Free cloud platforms may have restricted data storage. Outdoor use requires protective casing.

9. Future Scope

Future versions can include rainfall sensor, barometric pressure sensor, gas sensor, wind speed sensor, solar charging, mobile app alerts, machine learning prediction, and GPS based location tagging.

10. Conclusion

The IoT based weather monitoring system is an effective and modern solution for measuring environmental conditions. It combines sensors, embedded systems, and communication technology in one practical project. The prototype is useful for academic learning and real-world applications. This research confirms that smart low-cost systems can provide valuable weather information anytime and anywhere.

References

Arduino Official Documentation ESP8266 Technical Guide ThingSpeak Platform Guide

IoT Research Journals on Smart Monitoring