Saintgits College of Engineering, Kottayam

Department of Electronics and Computer Engineering

Weather Monitoring System using ESP8266 NodeMCU

IoT-Based Microproject Report

Submitted by:

Name	**Roll No.**
Jeffin Jaison	33
Aswin Sudev	20
Ashwin Gireesh	19

Under the Guidance of:

Dr. Pradeep C

Date of Submission: 17 October 2025

Course: S3 Electronics and Computer Engineering

Institution Email IDs:
jeffinj.er2428@saintgits.org, aswins.er2428@saintgits.org, ashwing.er2428@saintgits.org

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Submitted in partial fulfillment of the requirements for the course
Internet of Things (IoT) Microproject – Phase 2

Abstract

This project presents an IoT-based weather monitoring system using the ESP8266 NodeMCU integrated with sensors such as DHT11 (temperature and humidity), rain sensor, and LDR (light-dependent resistor). The system continuously collects environmental data and uploads it to the cloud platform ThingSpeak for real-time monitoring. The objective is to develop a low-cost, scalable, and easily deployable solution for remote weather observation and data analysis. Data are visualized on ThingSpeak dashboards for live tracking and historical analysis.

1 Introduction

Monitoring weather parameters such as temperature, humidity, rainfall, and light intensity is essential for agriculture, environmental analysis, and smart city applications. Traditional weather stations are expensive and region-limited. With advances in IoT technology, low-cost microcontrollers and sensors now enable real-time remote monitoring. This project designs and implements an IoT-based weather monitoring system using the ESP8266 NodeMCU that gathers data and uploads it to ThingSpeak for visualization and analysis.

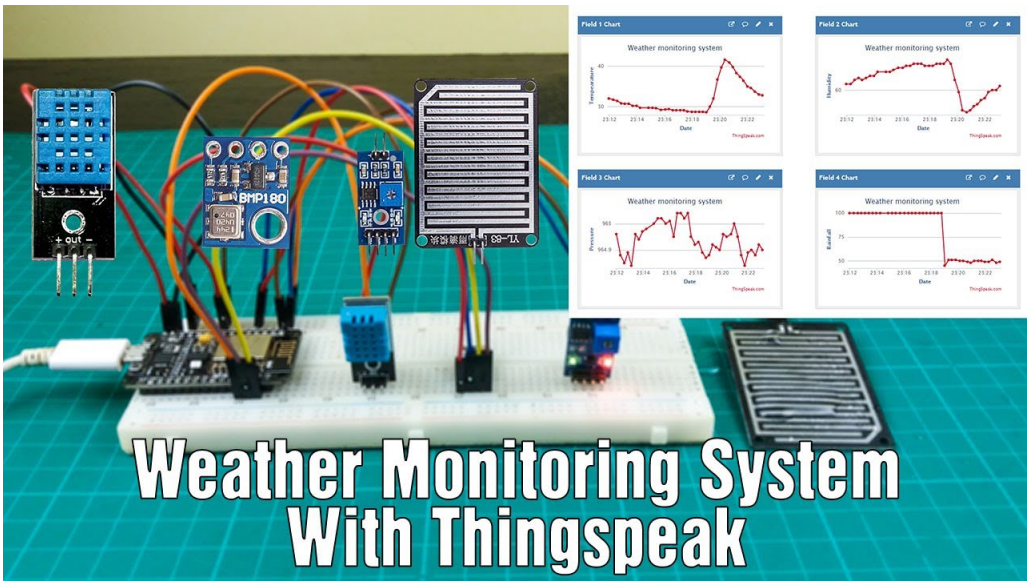

Figure 1: Overview and flow of the IoT-based Weather Monitoring System.

2 Baseline or Initial Experiments

Each sensor—DHT11, rain sensor, and LDR—was tested individually with the NodeMCU to ensure accurate readings. The DHT11 was used to verify humidity and temperature accuracy, the rain sensor for sensitivity in wet conditions, and the LDR for light intensity variation. Data were observed via the serial monitor before cloud integration to confirm calibration and correct pin interfacing.

3 Objectives of the Project

- To design and implement an IoT-based weather monitoring system using ESP8266 NodeMCU.
- To measure and display temperature, humidity, light intensity, and rainfall in real time.
- To transfer collected data to ThingSpeak for cloud visualization.
- To develop a scalable and low-cost system for continuous weather monitoring.

4 Working and Circuit Diagram

4.1 System Architecture and Working Principle

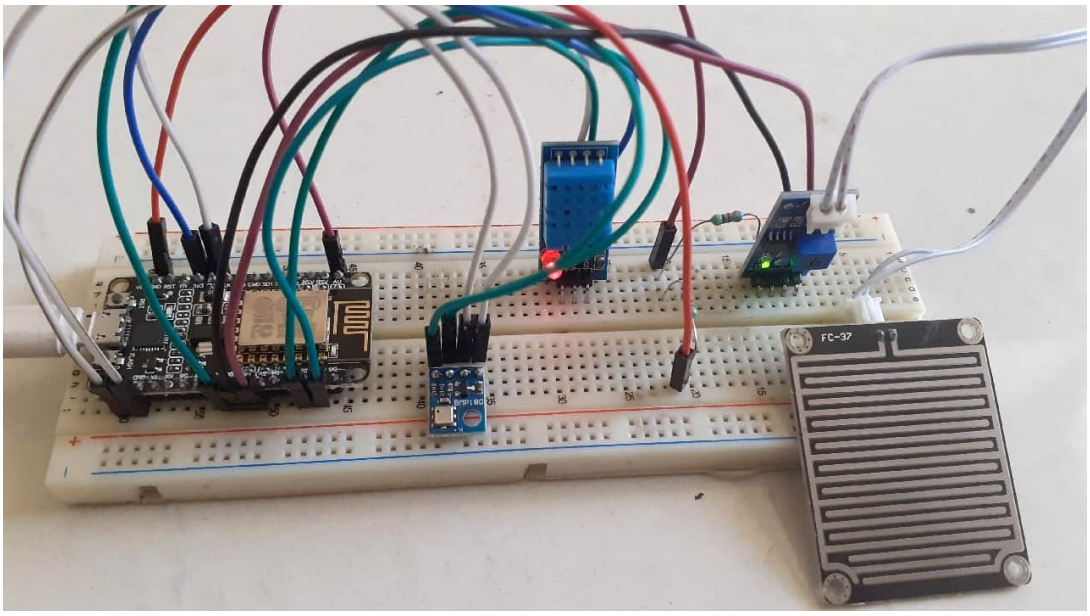

Figure 2: System architecture of the IoT-based Weather Monitoring System.

Working Principle:

- **DHT11:** Measures temperature and humidity and sends digital data to the NodeMCU.
- **Rain Sensor:** Detects water presence through analog signals to determine rainfall intensity.
- **LDR:** Measures light intensity based on resistance variation with brightness.

The NodeMCU processes the sensor data and uploads it to ThingSpeak via Wi-Fi. Users can view and analyze real-time environmental conditions on web or mobile dashboards. The system ensures continuous, low-maintenance monitoring.

4.2 Circuit Diagram

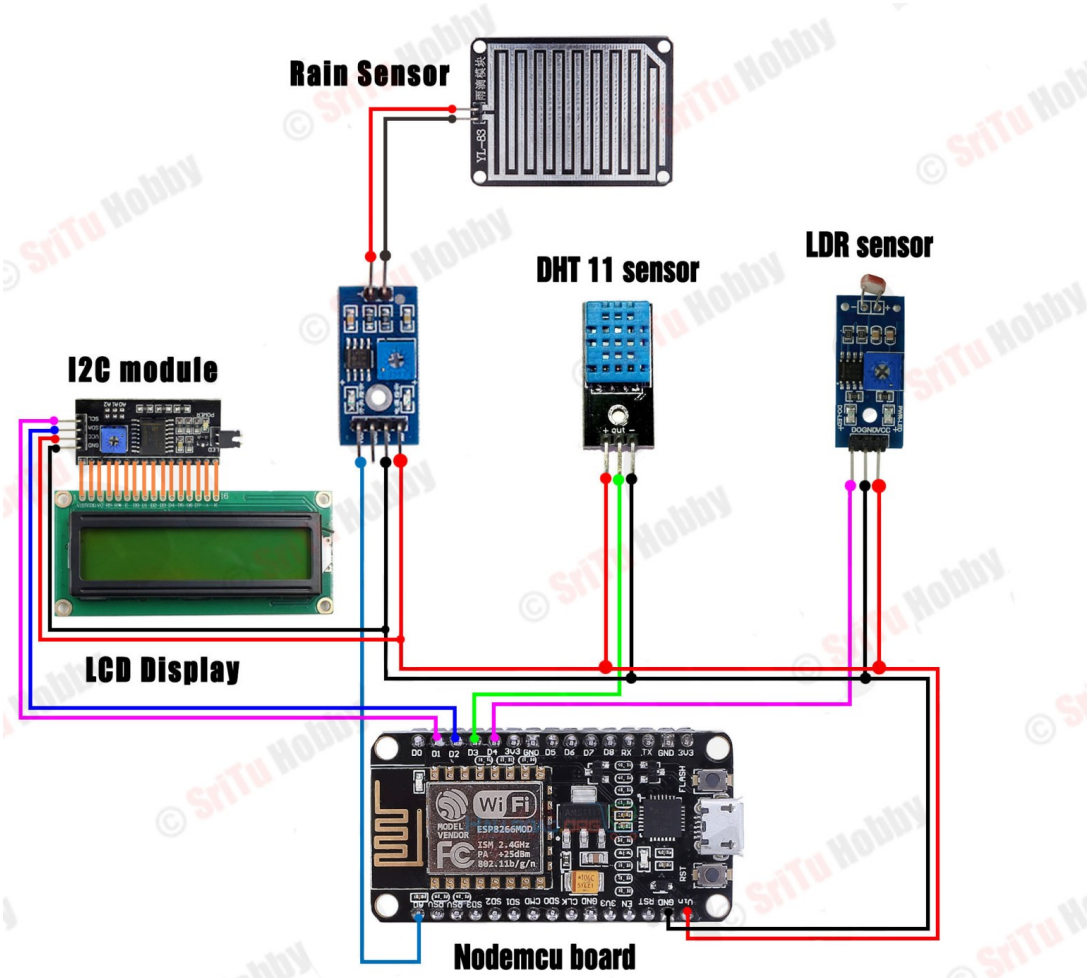

Figure 3: Circuit diagram showing NodeMCU connections to DHT11, Rain Sensor, and LDR.

5 Final Goals & Evaluation

- Build an IoT-based weather station using NodeMCU, DHT11, rain sensor, and LDR.
- Accurately record and upload environmental parameters to ThingSpeak.
- Evaluate system performance based on:
  - **Accuracy:** Compare sensor data with standard weather sources.
  - **Responsiveness:** Measure update intervals and transmission delay.
  - **Stability:** Test continuous data logging over time.
  - **Power Efficiency:** Analyze performance under minimal power usage.

6 Applications and Advantages

Figure 4: Applications of the IoT-based Weather Monitoring System.

- **Agriculture:** Helps farmers make informed decisions on irrigation and crop management.
- **Environmental Monitoring:** Provides real-time humidity, rainfall, and temperature data.
- **Smart Cities:** Aids in planning, disaster management, and energy optimization.
- **Remote Monitoring:** Access data from anywhere via ThingSpeak dashboards.

- **Scalability:** Additional sensors can be added for advanced weather analysis.
- **Cost-effective:** Utilizes affordable sensors and components.

7 Data & Technical Requirements

- **Microcontroller:** ESP8266 NodeMCU (Wi-Fi enabled, GPIO interface)
- **Sensors:** DHT11 (Temperature & Humidity), Rain Sensor, LDR
- **Power Supply:** 5V USB / Regulated Adapter
- **IoT Platform:** ThingSpeak for real-time data visualization
- **Software Tools:** Arduino IDE for programming, ThingSpeak dashboard for monitoring

8 References

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