Weather Monitoring System

Submitted in partial fulfillment of the requirements

of the degree of Bachelor of Engineering

by

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CERTIFICATE

This is to certify that Yajat Bhasin, Kaushik Kotian, Mohit Mandhyani, Swapnil Mulani of **D20B** semester **VII,** have successfully completed necessary experiments in the **IOE LAB** under my supervision in **VES Institute of Technology** during the academic year **2024-2025.**

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CERTIFICATE

This is to certify that the project entitled **" Weather Monitoring System"** is a bonafide work of **Yajat Bhasin(05), Kaushik Kotian(29), Mohit Mandhyani(33), Swapnil Mulani(67)** Submitted to the V.E.S. Institute of Technology in partial fulfillment of the requirement for the award of the Bachelor of Engineering in **Information Technology.**

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Project Report Approval for B.E.

This project report entitled **" Weather Monitoring System"** by **Yajat Bhasin(05), Kaushik Kotian(29), Mohit Mandhyani(33), Swapnil Mulani(67)** is approved for the degree of the Bachelor of Engineering in **Information Technology.**

Examiners

1. _____

2. _____

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Yajat Bhasin **Kaushik Kotian**

Mohit Mandhyani **Swapnil Mulani**

TABLE OF CONTENTS

Chapter 1: Introduction **1**
1.1. Introduction to the project 1
1.2. Motivation 1
1.3. Problem Definition 2
1.4 Applications 2

Chapter 2 : Literature Review **3**
2.1. IOT Based Weather Reporting System Using Arduino 3
2.2. Application Based Weather Monitoring System Using Internet of Things (IoT) 3
2.3. Our Proposed System 4

Chapter 3: Proposed Design /Block Diagram and Working **5**
3.1. System Design / Conceptual Design (Architectural) 5
3.2 Working 5

Chapter 4: Implementation of the Proposed System **6**
4.1. Hardware Required 6
4.2 Software Required 6
4.3 Architecture 6
4.4 Methodology 7
4.5 Flow Chart 8
4.6 Output 9

Chapter 5: Results, Conclusion and Future Scope **10**
5.1. Results 10
5.2. Conclusion 10
5.3. Future Scope 11

Chapter 1:

1.1 Introduction to the project

Weather plays a crucial role in our daily lives, influencing decisions related to agriculture, transportation, and outdoor activities. Accurate weather prediction is essential for effective planning and risk management. However, many existing weather forecasting methods often rely on limited data sources and can struggle to provide timely, localized predictions. This limitation can lead to inadequate preparation for adverse weather conditions, resulting in economic losses and safety hazards.

To address this challenge, the Weather Prediction System project, built using NodeMCU ESP8266, offers a comprehensive tutorial on developing a real-time weather data collection and forecasting solution. This system is designed to monitor environmental conditions and provide predictive insights for users. With detailed step-by-step instructions, the project is accessible to both beginners and tech enthusiasts, fostering a deeper understanding of home automation and environmental tracking. By utilizing NodeMCU ESP8266 for Wi-Fi connectivity, it showcases how to create an efficient weather prediction tool that enhances situational awareness and supports proactive decision-making. Ultimately, this project aims to empower individuals and communities with the information they need to respond effectively to changing weather patterns.

1.2 Motivation

The motivation behind the Weather Prediction System project stems from the increasing unpredictability of weather patterns due to climate change and urbanization. Accurate weather predictions are vital for a range of sectors, including agriculture, disaster management, and everyday life. Farmers rely on precise forecasts to make informed decisions about planting and harvesting, while businesses and individuals need to prepare for weather-related disruptions.

Traditional weather forecasting methods often lack the granularity and real-time updates necessary for localized predictions, leaving communities vulnerable to sudden changes in weather conditions. This highlights the necessity for a more innovative solution that harnesses modern technology to provide timely and accurate weather data.

By leveraging the capabilities of NodeMCU ESP8266, this project aims to create an accessible, efficient system that collects and analyzes real-time environmental data. The goal is to empower users with reliable forecasts that can enhance preparedness and reduce risks associated with extreme weather events. Ultimately, this project aspires to contribute to sustainable practices and informed decision-making, fostering a greater understanding of weather dynamics in our environment.

1.3 Problem Statement

As climate change leads to increasingly unpredictable weather patterns, traditional weather monitoring systems often fail to provide localized, real-time data, hindering effective preparation for extreme weather events. Existing solutions can be costly and complex, particularly in developing regions where access to advanced equipment is limited.

The proposed Weather Prediction System aims to create an affordable, user-friendly solution using the NodeMCU ESP8266 and various environmental sensors (LDR, BMP180, DHT11, rain sensor) to enable real-time monitoring of weather conditions. By integrating IoT capabilities, this system will allow users to access vital weather data remotely and make informed decisions based on accurate, timely information, ultimately enhancing preparedness and promoting sustainability.

1.4 Applications:

The Weather Monitoring System using NodeMCU ESP8266 offers a wide range of applications for both personal and professional use, enabling real-time data monitoring for enhanced decision-making and environmental awareness. Here are some key applications:

1. Real-Time Weather Monitoring :

The system provides accurate, real-time monitoring of weather parameters such as temperature, humidity, and pressure, enabling users to stay informed about current weather conditions.

2. Environmental Data Analysis :

Collected data can be analyzed to track weather patterns, climate changes, and environmental conditions over time. This is especially useful for weather enthusiasts, researchers, and environmental monitoring agencies.

3. Home Automation Integration :

The system can be integrated with home automation devices to adjust HVAC systems based on environmental conditions, optimizing indoor comfort while conserving energy.

4. Agriculture and Farming :

Farmers can use the system to monitor microclimate conditions in their fields, helping them make data-driven decisions about irrigation, planting, and harvesting, leading to more efficient crop management.

5. Smart City Applications :

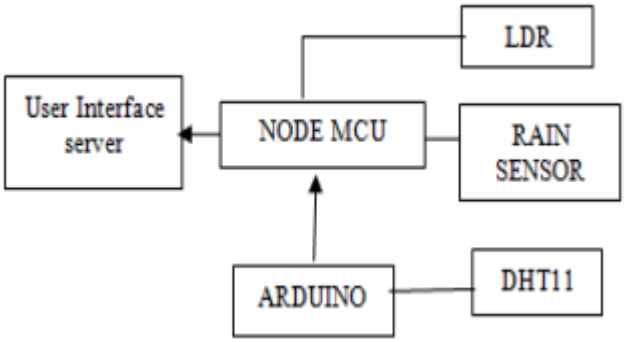
In smart cities, the system can be deployed to monitor local weather conditions, providing valuable data for traffic management, public safety, and infrastructure maintenance.

Chapter 2: Literature Review

The concept of real-time weather monitoring systems has evolved significantly, enabling smarter home environments and enhanced agricultural practices. These systems rely on various technologies to collect, transmit, and analyze weather data, providing users with actionable insights.

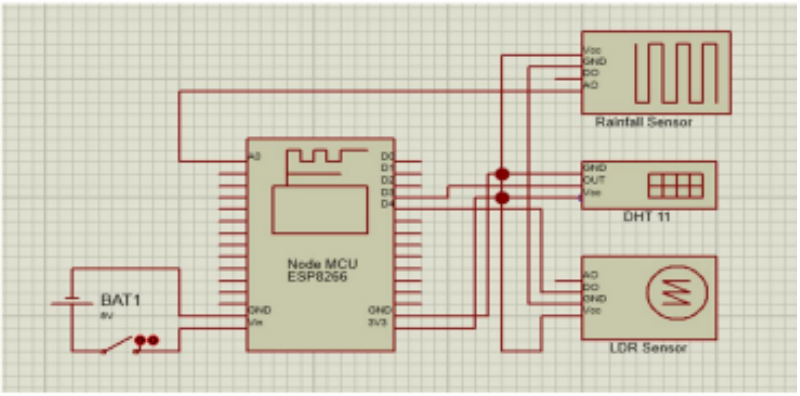
2.1 IOT Based Weather Reporting System Using Arduino

A Subhadra, R Ganesh, K Maheshbabu(2021) : These authors have published research on using IoT devices, such as Arduino, for weather monitoring and prediction. Their work might have focused on sensor selection, data processing, and machine learning techniques.



2.2 Application Based Weather Monitoring System Using Internet of Things (IoT):

Nurima Majumdar1 , Souvik Mondal2 , Janhabi Das3 , Purbasa Basu4 , Prafulla Kumar Sahani5 , Diyanka Chakraborty6 1Assistant Professor(2023): The paper proposes a real-time weather monitoring system that uses IoT technology to collect data from sensors (temperature/humidity, rainfall, light intensity) and make it accessible globally. This system provides valuable insights into local weather conditions.



2.3 Real Time Data Transmission for weather Monitoring System:

Ms.Poonam Khetmalis, Ms Sanika Doke, Ms. Varsha Dherange(2016): The proposed system is a weather monitoring system that uses real-time data transmission. It employs a weather transmitter sensor to collect data on various weather parameters, including wind speed, wind direction, precipitation, atmospheric pressure, temperature, and relative humidity. This data is then transmitted wirelessly over long distances using GSM technology

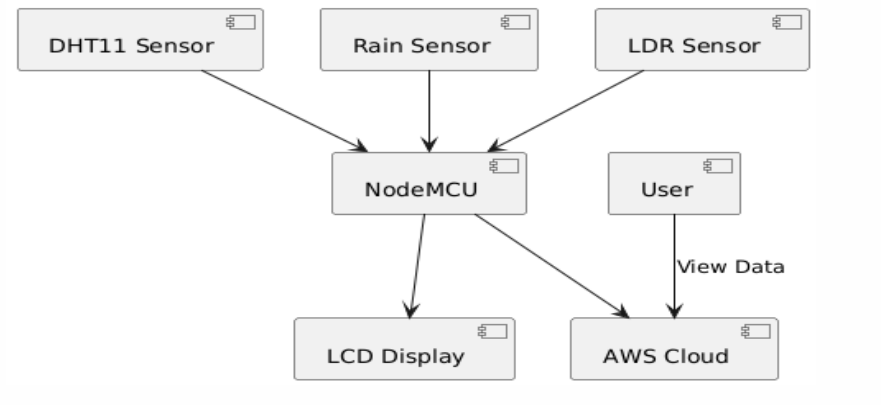
2.4 OUR PROPOSED SYSTEM

The hardware components used in weather monitoring systems vary widely, allowing developers to choose based on their project requirements and budget. Key components include:

- **NodeMCU**: This low-cost open-source IoT platform is based on the ESP8266 Wi-Fi module. It is popular among developers for its ease of use and compatibility with various sensors, making it an excellent choice for building weather stations.
- **Microcontrollers**: Devices like Arduino are widely used for their versatility and ease of programming. They can be paired with various sensors to create custom weather stations that meet specific needs.
- **Single-board Computers**: Low-cost computers, such as the NodeMCU, offer greater processing power and flexibility. They can run more complex applications and manage multiple sensors, making them suitable for advanced weather monitoring systems.

Chapter 3: Block Diagram and Working

3.1 Block Diagram



3.2 Working

1. Sensing Environmental Parameters

- **DHT11 Sensor**: Measures temperature and humidity.
- **Raindrop Sensor (YL-83)**: Detects the presence of rain.
- **LDR Sensor**: Measures light intensity to monitor ambient light conditions.

2. Data Collection by NodeMCU

- The NodeMCU ESP8266 collects input data from all sensors:
    - DHT11 communicates temperature and humidity data.
    - Raindrop sensor sends an analog/digital signal indicating the presence of rain.
    - LDR sensor sends data to detect that how much is light intensity.

3. Processing of Data

- The NodeMCU processes all the sensor inputs, converting analog or digital signals into meaningful values.
- It decides what information needs to be displayed, like temperature, humidity, or weather conditions based on the sensor data.

4. Displaying Data on LCD

- The 16x2 LCD connected via the **I2C module** displays key information such as:
    - Temperature (°C)
    - Humidity (%)
    - Rain status (e.g., "Rain detected" or "No Rain")
    - Light intensity (e.g., "The value of intensity").

5. IoT Data Transmission to AWS Cloud

- The NodeMCU ESP8266 connects to Wi-Fi and sends sensor data to **AWS Cloud**.
- The data (temperature, humidity, rain status, and light intensity) is transmitted in real-time to the cloud, where it can be viewed and monitored through dashboards or applications hosted on AWS (e.g., AWS IoT Core or DynamoDB).

Chapter 4: Hardware/Software Overview:

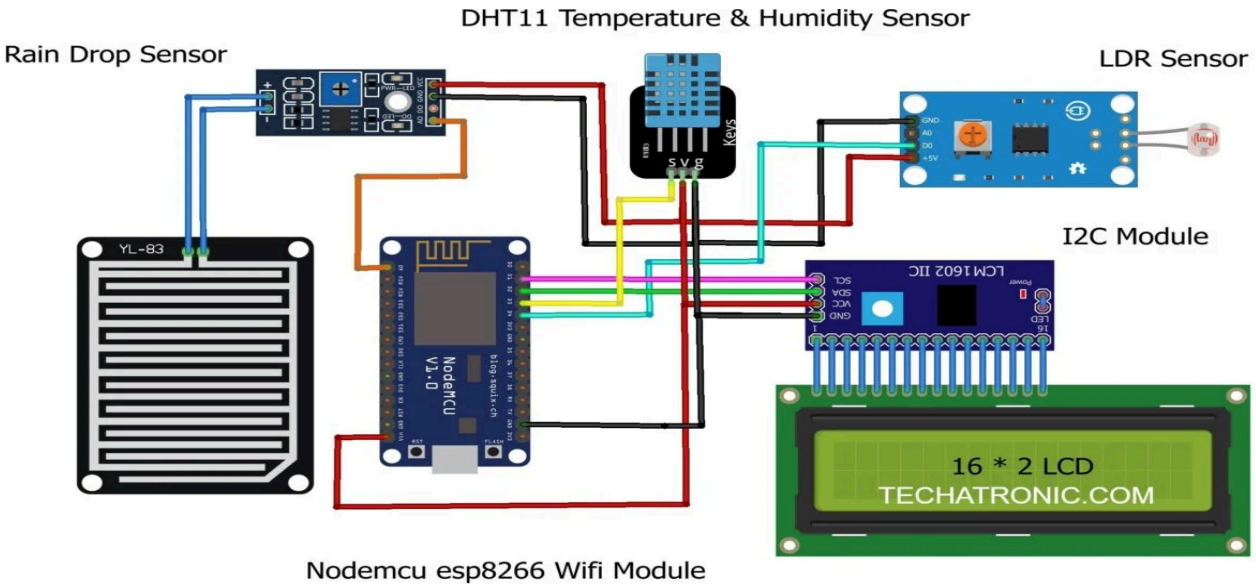
4.1 HARDWARE REQUIRED:

- **Microcontroller/Development Board:** ESP8266.
- **Sensors:**
  - Rain Sensor
  - DHT 11 Sensor
  - Light Sensor (e.g., LDR or Photoresistor)
- **Actuators:**
  - LCD Display
  - LED
- **Power Supply:** Suitable for powering the heating element and other devices.

4.2 SOFTWARE REQUIRED:

- **Cloud Platform:** AWS(Amazon Web Services)
- **Programming Languages:** Python, C/C++ for microcontroller coding, and JavaScript for the web interface.
- **User Interface:** Web or mobile app developed using React, Angular.

4.3 Architecture



4.4. Methodology applied

STEP 1: Study About the Topic Thoroughly

To begin the project, we referred to the following resources to gain an understanding of weather monitoring systems:

- **YouTube Videos**: We watched various tutorials and technical explanations on IoT-based weather monitoring systems, which helped us understand the practical aspects of the project.
- **Documentation**: We thoroughly studied available documentation related to NodeMCU ESP8266, sensor integration, and cloud platforms to guide our development process.

STEP 2: Data Collection

Data collection for this project was an essential and time-consuming task, as we needed to gather relevant materials, sensor details, and reference documents:

- **Sensors**: We collected accurate information about the sensors required for weather monitoring, such as the DHT11 (temperature and humidity sensor), Rain Sensor, and Light Sensor (LDR).
- **Microcontroller**: We chose the NodeMCU ESP8266 for Wi-Fi connectivity and real-time data transmission.
- **Cloud Platform**: After careful consideration, we selected AWS for cloud integration and remote monitoring.

STEP 3: Choosing Frontend and Database for the Application Did not use Blynk so change completely

For the project's backend and cloud service, we made the following choices:

- **Backend and Cloud Services**:
    - **AWS (Amazon Web Services)**: For backend services, we chose AWS to leverage its robust cloud storage and computing solutions, which are essential for managing our weather monitoring system's data efficiently.

STEP 4: Embedding the Content

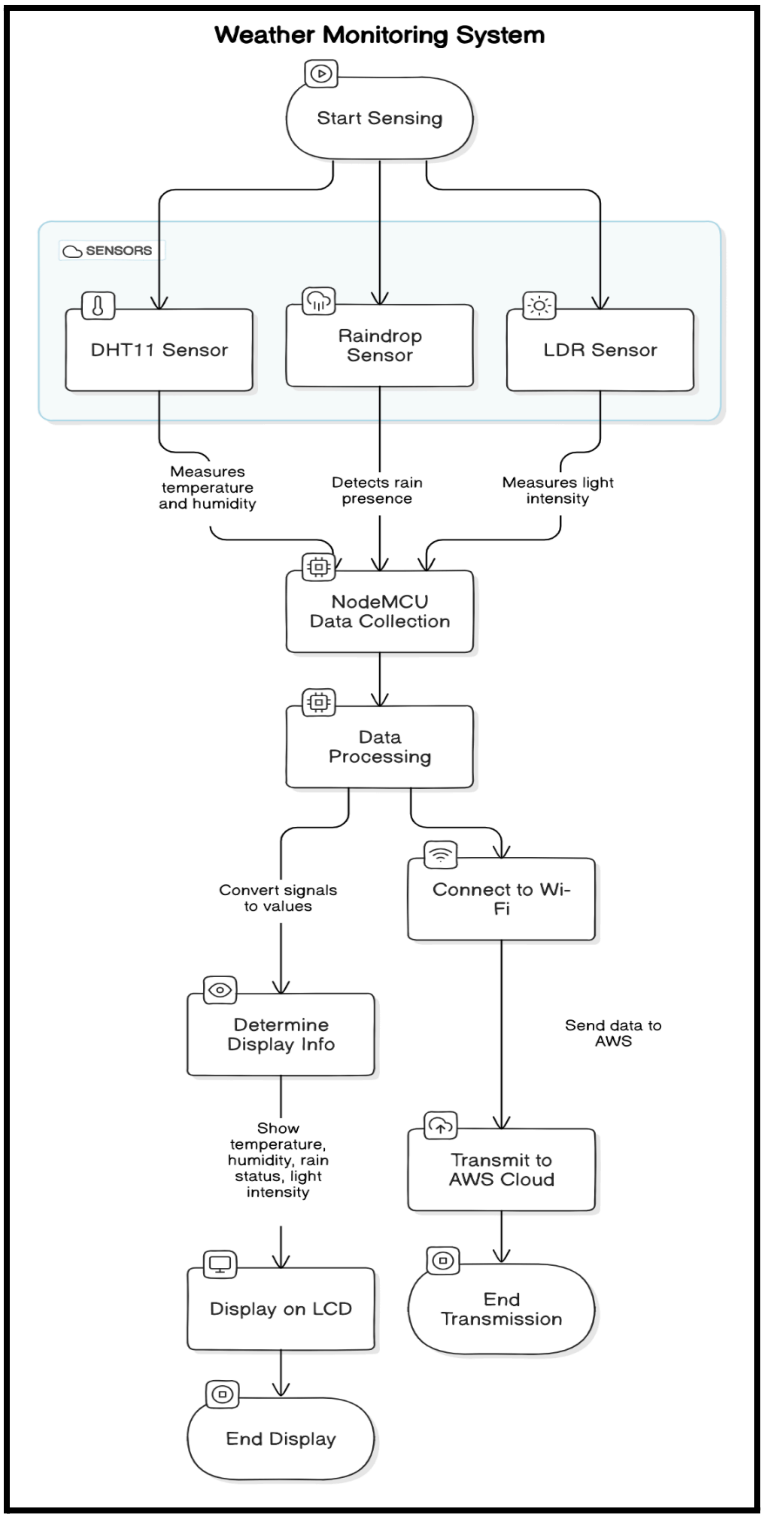
Embedding the weather data and connecting it to the cloud was a crucial part of the project:

- **Sensor Integration**: We integrated the DHT11, rain sensor, and LDR with NodeMCU and connected them to the AWS for real-time data monitoring.

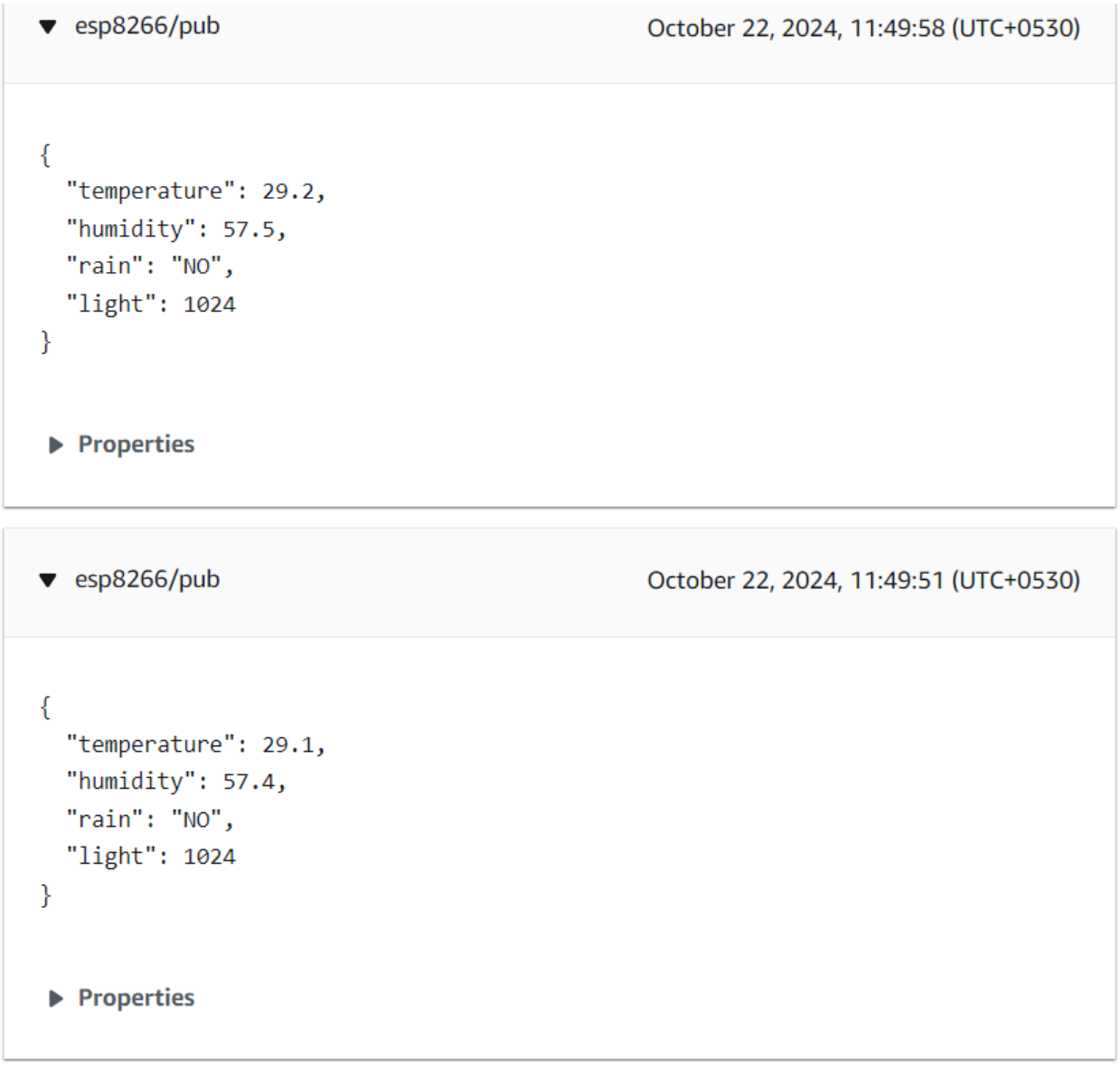
STEP 5: Integration, Testing, and Results:

- **Integration**: We successfully integrated the frontend, backend, sensors, and cloud platform to create a seamless weather monitoring system.
- **Testing**: Each team member tested the system by viewing live weather data, checking sensor accuracy, and verifying cloud connectivity. The system was calibrated in various environments to ensure the precision of the data.

4.5 Flowchart



4.6 Output


esp8266/pub
October 22, 2024, 11:49:58 (UTC+0530)
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"temperature": 29.2,
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"rain": "NO",
"light": 1024
}
Properties
esp8266/pub
October 22, 2024, 11:49:51 (UTC+0530)
{
"temperature": 29.1,
"humidity": 57.4,
"rain": "NO",
"light": 1024
}
Properties

Chapter 5: Results, Conclusion and Future Scope

5.1 Results and Discussion

This chapter presents a comprehensive evaluation of the Weather Monitoring System, focusing on the outcomes of the investigation and the contributions of the study. The findings will lead to inferences, conclusions, and suggestions for future work.

Evaluation of the Investigation

The Weather Monitoring System, developed using the NodeMCU ESP8266 and the Blynk app, successfully achieved its primary objective of real-time environmental monitoring. The system was tested under various conditions, demonstrating its ability to accurately measure and display weather parameters such as temperature, humidity, and rainfall. Key findings from the investigation include:

- **Real-Time Data Accuracy**: The integration of sensors with the NodeMCU allowed for precise readings. The DHT11 sensor provided reliable temperature and humidity data, while the rain sensor effectively detected precipitation levels.
- **User Engagement and Accessibility**: Utilizing the Blynk app as the frontend interface facilitated user interaction. Users could easily monitor weather conditions from their mobile devices, enhancing accessibility and engagement with the data.
- **Cloud Connectivity**: Leveraging AWS for cloud services enabled efficient data storage and retrieval, ensuring that users could access historical weather data seamlessly.

5.2 Inferences and Conclusions

The Weather Monitoring System has proven to be an effective tool for real-time weather data collection and monitoring. The findings indicate that such systems can empower users to make informed decisions based on accurate and timely data. The intuitive design of the Blynk app further enhances user experience, making it easier for non-technical users to interact with complex data.

The **Weather Monitoring System** was successfully implemented using **NodeMCU ESP8266**, a variety of sensors, and the **Aws Cloud** for real-time data monitoring and analysis. The project demonstrated the practical applications of IoT in environmental monitoring and highlighted the potential of such systems in agriculture, smart homes, and smart city projects.

5.3 Scope for Future Work

While the project achieved its goals, there are several opportunities for further development:

- **Expanded Sensor Array**: Future iterations could include additional sensors for monitoring atmospheric pressure, air quality, and UV radiation, broadening the system's applications.
- **Data Analytics and Predictive Modeling**: Incorporating data analytics tools to analyze trends in the collected data could lead to predictive weather modeling, aiding users in planning and preparedness.
- **Enhanced Mobile Application**: Developing a dedicated mobile application could improve accessibility and provide users with push notifications for weather alerts.
- **Energy Efficiency Solutions**: Researching low-energy alternatives for sensor operation could contribute to the sustainability of the system, making it more suitable for long-term deployment.

References :

[1]IOT Based Weather Reporting System Using Arduino and Node MCU: (Meera.S, Sharmikha Sree.R, Kalpana R.A, S.R. Manasvinii, Haritha.V, K. Valarmathi): 10.3233/APC210038

[2] Application Based Weather Monitoring System Using Internet of Things (IoT) - (nurima Majumdar1 , Souvik Mondal2 , Janhabi Das3 , Purbasa Basu4 , Prafulla Kumar Sahani5 , Diyanka Chakraborty6 1Assistant Professor)

[3] Real Time Data Transmission for weather Monitoring System:

Ms.Poonam Khetmalis, Ms Sanika Doke, Ms. Varsha Dherange(2016): The proposed system is a weather monitoring system that uses real-time data transmission.

[4] Live Weather Monitoring System Using Iot - Puja Sharma and Shiva Prakash, Department of Information Technology and Computer Application from Madan Mohan Malaviya University of Technology, Gorakhpur

[4] Internet of Things (IOT) based Weather Monitoring System - Girija C, Harshalatha H, Andreanna Grace Shires, Pushpalatha H P from Department of Electronics and Communication, NIEIT, Mysur