IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, December 2023

# Insights into Tomorrow's Weather: An In-Depth Survey of Cloud-Integrated IoT Weather Monitoring Solutions with Flutter for Environmental Data Analysis

**Dr. Umesh B. Pawar[1], Prof. Daund Ramesh P.[2], Prof. Ravindra Pandit B.[3], Mr. Habib Adnan A.[4]**

Professor and Head Department of Computer Engineering [1]

PG Coordinator & System Admin Department of Computer Engineering[2]

Asst. Professor, Department of Computer Engineering[3]

PG - Computer engineering Student, Department of Computer Engineering[4]

SND College of Engineering & Research Center, Yeola, Nashik, MS, India

**Abstract***: The device is a cutting-edge method of keeping an eye on the local weather and disseminating the data anywhere in the globe. This is made possible by Internet of Things (IoT) technology, which is a sophisticated way to connect everything to the Internet and to connect the entire globe. elements within a network The data recovered from the finished system can be viewed online from any location on the planet. It will be very challenging to monitor and check the environmental limit in the cultivating zone using cables. and simple devices during a couple of environmental bets. To overcome this problem, sensors are used here the farTo monitor and screen the environmental restrictions. We'll discuss DHT11 Humidity and Rain, FC37, and Temperature Sensor*

**Keywords:** Temperature Sensor, Humidity Sensor, IOT, Raindrop Sensor, NodeMCU, Gas Sensor, Soil Moisture Sensor.

## I. INTRODUCTION

Fluttering into the world of Things (IoT) marks a pivotal evolution and economic surge in the global information landscape, post-Internet. IoT stands as an intelligent framework interconnecting everything with the Internet, with the overarching goal of facilitating data exchange and transmission through agreed-upon protocols. It successfully achieves the objective of astutely perceiving, discovering, tracking, understanding, and coordinating various entities. As an augmentation and expansion of the Internet-based structure, IoT nurtures communication from human to human, human to things, and even things to things.In the IoT realm, numerous entities, including everyday objects, will seamlessly integrate into structures of various forms. It envisions an ongoing communication scenario where commonplace objects, equipped with microcontrollers, digital communication handsets, and smart display stacks, will converse with each other and users, becoming integral components of the Internet. The essence of the IoT concept is to render the Internet more immersive and ubiquitous. Furthermore, by enabling seamless access and connections with a diverse array of devices such as home appliances, surveillance cameras, sensors, actuators, displays, vehicles, and more, the IoT will catalyze the development of applications leveraging the potentially vast amount and diversity of data generated by such interconnected entities.

Contemporary advancements in technology predominantly focus on controlling and monitoring various activities, dynamically emerging to meet human needs. This technological progress centers on efficient sensing and control of diverse operations.An effective environmental monitoring system becomes crucial for overseeing and assessing conditions, particularly when they exceed recommended thresholds, such as noise, CO, and radiation levels. As objects in the environment become equipped with sensor devices, microcontrollers, and various software applications, they transform into self-aware and self-monitoring environments, often referred to as smart environments. In such environments, alerts or LED warnings are triggered automatically in response to events.

Smart environmental monitoring systems can effectively detect and mitigate the impacts of environmental changes on animals, plants, and humans. Integrating information into the environment enhances its intelligence for various purposes, exemplifying one of the applications of smart environments. Diverse monitoring systems are essential to fulfill human needs, and these systems vary based on the data collected by sensor devices. Applications are categorized into Custom Detection-based and Spatial Process Estimation to classify their functionalities. The main goal of this paper is to formulate and execute an effective monitoring system that remotely oversees crucial parameters through the Internet.The information gathered from sensors is stored in the cloud and displayed on a web browser. The proposed solution focuses on monitoring temperature, humidity, rain visibility, and atmospheric pressure levels. If any parameter exceeds its predefined threshold in a specific area, the system alerts the user. Furthermore, the system offers intelligent remote monitoring for a specific area of interest, presenting real-time outcomes of collected or detected data within predefined parameter ranges.The embedded system seamlessly combines sensor devices with remote communication, allowing users to access diverse parameters remotely and store data in the cloud.

## II. BACKGROUND

The suggested system for weather monitoring utilizes IoT with Flutter, incorporating Internet of Things (IoT) principles into a Flutter-based application. This approach aims to develop a comprehensive and responsive solution for tracking weather conditions. Here are the key components and features of the proposed system:

- IoT-enabled Sensor Devices: Deploy IoT-based sensor devices equipped with sensors for monitoring weather parameters like temperature, humidity, rain visibility, and atmospheric pressure. Ensure the sensors are capable of real-time data acquisition and can communicate with the IoT platform.
- IoT Platform Integration: Employ a resilient IoT platform, such as AWS IoT, Google Cloud IoT, or Microsoft Azure IoT, to establish connections and manage sensor devices. Implement secure and scalable communication protocols between the sensor devices and the IoT platform.
- Data Processing and Analytics: Leverage the capabilities of the IoT platform to process and analyze real-time weather data.Implement data analytics to derive insights, detect patterns, and generate meaningful information.
- Flutter-based User Interface: Develop a cross-platform mobile application using Flutter to serve as the user interface for weather monitoring. Ensure seamless integration with the IoT platform to retrieve and display real-time weather data.
- Real-time Data Visualization: Implement interactive and real-time visualizations within the Flutter application to display current weather conditions. Utilize charts, graphs, and other graphical representations to enhance user comprehension.
- Customizable Alerts and Notifications: Enable users to set personalized thresholds for weather parameters and receive alerts when these thresholds are exceeded.Implement push notifications within the Flutter app to notify users of critical weather changes.
- Historical Data Storage: Store historical weather data in a secure and scalable cloud database connected to the IoT platform.Provide users with the ability to access and analyze past weather trends through the Flutter application.
- User Preferences and Settings: Incorporate user-friendly settings within the Flutter app to allow users to customize the display of weather information and set preferences.Enable users to configure the frequency of data updates and other relevant settings.
- Security Measures: Incorporate robust security measures to safeguard the confidentiality and integrity of data transmitted among IoT devices, the IoT platform, and the Flutter application. Utilize encryption protocols and secure authentication mechanisms.
- Cross-Platform Compatibility: Leverage Flutter's cross-platform capabilities to ensure the application is compatible with both Android and iOS devices.
- Scalability and Future Enhancements: Design the system architecture with scalability in mind to accommodate additional sensors or features. Plan for future enhancements by keeping the codebase modular and adaptable.

By combining the power of IoT for data acquisition and processing with the user-friendly interface provided by Flutter, this proposed weather monitoring system aims to deliver a seamless and efficient solution for users to monitor, analyze, and stay informed about current and historical weather conditions.

## III. LITERATURE SURVEY

The author of reference [1] established a robust and cost-effective weather station with automated operations. In this paper, the author elucidates how the weather forecast system is evolving into a significant challenge during extreme weather events, impacting both life and property. Therefore, weather data accuracy is one of the most important tasks to improve one's ability to forecast the weather and develop resilience to adverse weather report conditions. The writer explains that Uganda and several other Emerging nations have examined obstacles in providing fast and reliable meteorological data because of limited weather observation. The rare weather observation is a portion of the expensive price of creating automated weather scenarios. National organizations can get restricted money.

In reference [2], the author outlines an Internet of Things-based weather monitoring system. This study demonstrates the use of environmental sensors to collect various parameters. The author utilizes a specific sensor to measure different variables, including temperature, pressure, humidity, and rainfall, incorporating an LDR sensor in the process. The dew point is also computed by the system. the temperature prototype's value. The degree of heat sensor can be employed to determine the specific space, a room, or any location. With the LDR's assistance light intensity sensor, it can be utilized in the manner specified by the writer. The writer in this made use of an extra functioning of the SMS alert system for weather monitoring system depending on the sensor value exceeding variables including light, pressure, temperature, and humidity intensity as well as rainfall.

In reference [3], the author introduces an economical live weather monitoring system incorporating an OLED display. The system showcases diverse fields where IoT has introduced innovative applications. Described as a revolutionary solution, the system measures real-time weather conditions, proving beneficial for farmers, industries, daily commuters, and educational institutions. Through the creation of this live weather monitoring system featuring an OLED display, the author seeks to alleviate challenges for farmers and industries. The system employs an ESP8266-EX microcontroller-based WeMos D1 board, running on Arduino, to fetch data from the cloud. The WeMos D1, equipped with an ESP-8266EX microcontroller and 4MB flash memory, is programmed using NodeMCU and Arduino IDE. Weather data is showcased on both the OLED display and ThingSpeak cloud, providing real-time weather information on the OLED screen.

In reference [4], the author suggests a weather monitoring and prediction system designed for day-to-day planning. This system, beneficial in agriculture and industry, integrates sensor data, bus mobility, and deep learning technology. It utilizes a two-stage weather management system that integrates sensor data and deep learning to deliver real-time weather reports for stations and buses. The system predicts weather by employing a friction model and local information processing, ensuring precise forecasts through the utilization of multilayer perception models and long-term memory. The proposed system showcases dependable performance in weather monitoring and forecasting, featuring four essential components: information management, interactive bus stops, a machine learning predictive model, and a weather information platform.

In reference [5], the author implements an IoT-based weather monitoring system, highlighting the incorporation of IoT technology for the observation of climate-changing conditions. The project aims to create awareness by providing accurate and efficient weather information. Utilizing a swarm algorithm to enhance accuracy, the system collects climate data from various sensors, stores it in the cloud using www.thingspeak.com, and transmits the data to an Android mobile application through an API key. The project's hardware and software components render it easily deployable, providing a holistic solution for weather monitoring incorporating IoT technology.

[6] Pawar, U.B., Bhirud, S.G., Kolhe, S.R. (2020). Light Scattering Study on Protocols and Simulators Used in Automotive Application(s). In: Iyer, B., Deshpande, P., Sharma, S., Shiurkar, U. (eds) Computing in Engineering and Technology. Advances in Intelligent Systems and Computing, vol 1025. Springer, Singapore. https://doi.org/10.1007/978-981-32-9515-5_16

Industry demands rapid application prototyping and simulations of the protocols to save time, money and energy. Use of intelligent systems with high speed communication, the sector is moving towards the standardizations.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, December 2023

## IV. PROPOSED METHODOLOGY

The proposed weather monitoring system integrates IoT devices, cloud computing, and mobile application development to create a comprehensive solution for environmental data analysis.

Hardware Components: The system incorporates the following sensors for data collection:

1. Raindrop Sensor
2. NodeMCU
3. DHT11 Sensor
4. MQ-136 Sensor
5. Soil Moisture Sensor
6. BMP180 Sensor

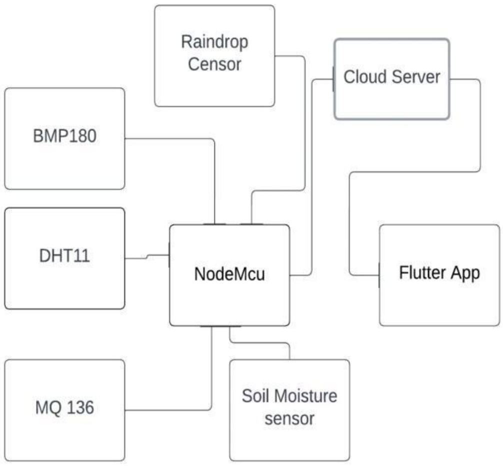
- Data Transmission: Data transmission is facilitated through the MQTT (Message Queuing Telemetry Transport) protocol, ensuring efficient and lightweight communication between the IoT devices and the cloud-based server. Cloud-Based Server: A cloud server, hosted on a reputable cloud service such as AWS or Google Cloud, serves as the central hub for data processing and storage. An MQTT broker is implemented on the server to receive real-time data from the IoT devices. The received data is stored in a database (e.g., MongoDB, MySQL) for further analysis.
- Mobile Application: The user interface is developed using the Flutter framework to create a cross-platform mobile application. The application provides
- Real-time data visualization: Users can monitor current weather conditions through charts and graphs.
- Historical data analysis: The system stores data for retrospective analysis, enabling users to observe trends over time.
- User authentication: To ensure secure access to the weather monitoring system.

### A. System Workflow:

- Data Collection: The NodeMCU collects data from the connected sensors at regular intervals.
- Data Transmission: The collected data is transmitted to the cloud server using the MQTT protocol.
- Cloud-Based Processing: The cloud server receives and processes the incoming data, storing it in the database for historical analysis.
- Mobile Application Access: Users access the weather data through the Flutter mobile application, which communicates with the cloud server.
- User Interaction: The mobile app offers an intuitive interface for monitoring in real-time and analyzing historical data.
- System Benefits:
- Scalability: The system is designed to accommodate additional sensors or users, ensuring scalability for future expansion.
- Cross-Platform Accessibility: The Flutter mobile application allows users to access weather data seamlessly on both Android and iOS devices.
- Efficient Data Transmission: The use of MQTT ensures efficient and low-latency data transmission between IoT devices and the cloud server.The proposed system serves as an innovative and practical approach to weather monitoring, providing a reliable and scalable solution for environmental data analysis.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

## V. MODULE ARCHITECTURE




## VI. CONCLUSION

In conclusion, the proposed weather monitoring and prediction system employs a two-stage approach, integrating sensor data, bus mobility, and deep learning technology. This system provides real-time weather reports for stations and buses, contributing to efficient day-to-day planning. The author emphasizes the reliability of the system in monitoring and forecasting weather conditions.The IoT-based weather monitoring system discussed in focuses on creating awareness of climate-changing conditions. Using IoT technology, this project collects weather data through sensors, stores it in the cloud using www.thingspeak.com, and delivers real-time information to an Android mobile application. The implementation is designed for simplicity and efficiency.these projects collectively highlight advancements in weather monitoring, showcasing cost-effective solutions, predictive capabilities, and the integration of IoT technology. These efforts contribute to improving the accuracy, accessibility, and usability of weather monitoring systems for various users, including farmers, industries, and the general public.

## REFERENCES

[1] Mary Nsabagwaa, Maximus Byamukamab, Emmanuel Kondelaa, "Towards a robust and affordable Automatic Weather Station ", journal homepage: www.elsevier.com/locate/deveng.

[2] Ravi Kishore Kodali and Snehashish Mandal "IoT Based Weather Station" 2016 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT) 978-1-5090- 5240-0/16/$31.00, IEEE, (2016)

[3] Ravi Kishore Kodali and Archana Sahu "An IoT based Weather Information Prototype Using WeMos" 2016 2nd International Conference on Contemporary Computing and Informatics (ic3i), 978-1-5090-5256- 1/16/$31.00, IEEE, (2016)

[4] Zi-Qi Huang, Ying-Chih Chen and Chih-Yu Wen, "Real-Time Weather Monitoring and Prediction Using City Buses and Machine Learning", Vols. 3 to 21 Published 10 September (2020)

[5] Kavya Ladi, A V S N Manoj, G V N Deepak, "IOT Based Weather Reporting System to Find Dynamic Climatic Parameters", International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017)

[6] P. Susmitha, G. Sowmyabala "Design, and Implementation of Weather Monitoring and Controlling System", International Journal of Computer Applications (0975 – 8887) Volume 97– No.3, (July 2014)

[7] Tanmay Parashar1, Shobhit Gahlot2, Akash Godbole3, Y.B. Thakare4 "Weather Monitoring System Using Wi-Fi", (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96, 2015

[8] Nutant Sabharwal, Rajesh Kumar, Abhishek Thakur, Jitender Sharma "A LOW-COST ZIGBEE BASED AUTOMATIC WIRELESS WEATHER STATION WITH GUI AND WEB HOSTING FACILITY" e-ISSN: 1694-2310 | p-ISSN: 1694-2426, Vol. 1, Spl. Issue 2 (May 2014) [9] M. Prasanna, M. Iyapparaja, M. Vinothkumar, B

Ramamurthy, S.S. Manivannan," An Intelligent Weather Monitoring System using Internet of Things", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue4, November (2019)

[10] Mircea Popa and Catalin Iapa "Embedded Weather Station with Remote Wireless Control", 19th Telecommunications forum TELFOR 2011 Serbia, Belgrade, November 22-24, 2011, 978-1-4577-1500- 6/11/$26.00, IEEE, 2011

[11] Pawar, U.B., Bhirud, S.G., Kolhe, S.R. (2020). Light Scattering Study on Protocols and Simulators Used in Automotive Application(s). In: Iyer, B., Deshpande, P., Sharma, S., Shiurkar, U. (eds) Computing in Engineering and Technology. Advances in Intelligent Systems and Computing, vol 1025. Springer, Singapore. https://doi.org/10.1007/978-981-32-9515-5_16.