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IOT BASED WEATHER MONITORING SYSTEM

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ABSTRACT

Weather monitoring plays a vital role in agriculture, transportation, disaster management, and daily human activities. Traditional weather monitoring systems are often limited by high costs, manual data collection, and the lack of real-time updates. The emergence of the Internet of Things (IoT) provides a cost-effective and efficient solution to monitor environmental conditions continuously. The proposed **IoT-Based Weather Monitoring System** utilizes various sensors, including temperature, humidity, pressure, and gas sensors, interfaced with a microcontroller and connected to a cloud platform. The collected data is transmitted wirelessly using Wi-Fi or GSM modules and displayed in real time on mobile and web applications. This system provides accurate, low-cost, and remote access to weather data, helping users make informed decisions in various domains.

Keywords: IOT, Weather monitoring, temperature sensor, gas sensors, pressure sensor

I. INTRODUCTION

With the rapid advancement of IoT technologies, environmental monitoring has become more intelligent, automated, and user-friendly. The weather plays a critical role in sectors such as agriculture, aviation, marine, and energy. Accurate monitoring of weather parameters such as temperature, humidity, atmospheric pressure, rainfall, and wind speed is essential for efficient resource management and disaster preparedness. Conventional meteorological systems are often expensive and not easily accessible for localized weather tracking.

An IoT-based approach integrates sensors, microcontrollers, and wireless communication technologies to collect and transmit environmental data in real time. The use of low-cost devices like Arduino or NodeMCU, combined with cloud services like ThingSpeak, Blynk, or Firebase, enables scalable and flexible weather monitoring solutions. Through this system, users can remotely monitor weather conditions from anywhere using a smartphone or computer, thereby enhancing accuracy, convenience, and decision-making.

The objective of this system is to automate the weather monitoring process using IoT-enabled sensors, eliminate manual intervention, and provide reliable, real-time weather data for smart applications. This system not only aids individuals but also contributes to smart city development and environmental sustainability initiatives.

II. LITERATURE SURVEY

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[1] Mysuru Andreanna and Grace Shires Girija C — "Internet of Things (IoT) Based Weather Monitoring System"

Mysuru Andreanna and Grace Shires Girija proposed an IoT-based weather monitoring system that collects and transmits real-time environmental data such as temperature, humidity, and atmospheric pressure. The system utilizes a microcontroller, DHT sensors, and Wi-Fi modules to send sensor data to a cloud platform for visualization and analysis. Their design emphasizes a cost-effective, scalable, and user-friendly system suitable for rural and urban applications alike.

The authors highlighted the integration of IoT technology with environmental monitoring for improving accuracy and accessibility. They implemented cloud services to store and display live weather data, accessible through mobile or web dashboards. This eliminated the need for manual observation and enhanced the ability to analyze long-term weather trends.

Their research also demonstrated how such IoT systems could contribute to smart city applications, enabling automated climate control, disaster preparedness, and agricultural management. The project's modularity and affordability make it ideal for educational and practical deployments in real-world conditions.

[2] B. Vongsagon, J. Ekchamanonta, K. Bumrungkhet, and S. Kittipiyakul — "XBee Wireless Sensor Networks for Temperature Monitoring"

Vongsagon et al. developed a wireless sensor network (WSN) for temperature monitoring using XBee modules for communication between sensor nodes and a base station. Their research explored the reliability, range, and power efficiency of XBee in transmitting sensor data across multiple nodes in a distributed network. The system was designed to continuously monitor temperature variations in industrial or environmental settings and transmit the data wirelessly to a monitoring center.

The authors analyzed network performance in terms of data transmission delay, packet loss, and node scalability. They demonstrated that XBee-based WSNs are suitable for short- to medium-range environmental monitoring applications due to their low energy consumption and simple configuration. This made them effective for IoT systems where real-time data transmission is essential.

The study's relevance to IoT-based weather systems lies in its demonstration of wireless data communication reliability, which is crucial for multi-node sensor deployments. The findings contribute to the design of robust weather monitoring systems capable of transmitting accurate environmental data without the need for wired infrastructure.

[3] S. Gangopadhyay and M. K. Mondal — "A Wireless Framework for Environmental Monitoring and Instant Response Alert"

Gangopadhyay and Mondal proposed a wireless framework that integrates sensors, microcontrollers, and communication modules to monitor environmental parameters and generate instant alerts in case of abnormal readings. The system architecture focused on low-cost deployment, real-time data collection, and immediate response to hazardous environmental conditions such as temperature spikes or humidity anomalies.

The authors used a combination of sensor nodes and a central monitoring unit connected via wireless modules. The framework incorporated alert mechanisms using GSM or email notifications to warn users of critical environmental changes. This ensured proactive response and increased situational awareness in weather-critical applications.

Their contribution to IoT research lies in creating an alert-driven monitoring system that improves safety and efficiency in environmental observation. The paper's methodology aligns well with IoT-based weather monitoring systems that need real-time notification features for disaster prevention and adaptive climate response.

[4] Prof. Satyashil Nagrale, Ms. Poonam Khetmalis, Ms. Sanika Doke, and Ms. Varsha Dherange — "Real-Time Data Transmission for Weather Monitoring System"

Nagrale and colleagues developed a real-time data transmission model for weather monitoring, focusing on continuous collection and cloud-based communication of environmental data. Their system architecture employed a microcontroller and wireless communication modules to sense parameters such as temperature, humidity, and light intensity. The collected data was transmitted to a remote server for online monitoring and visualization.

The authors emphasized the importance of real-time communication in weather applications, ensuring instant access to live data. They also analyzed system performance based on response time, accuracy, and data transmission stability. The experimental results demonstrated that cloud-based IoT frameworks are efficient for large-scale weather monitoring operations.

Their work contributed to improving the connectivity and reliability of environmental monitoring systems by using affordable components and accessible data platforms. This research serves as a reference model for developing mobile-accessible IoT weather stations with low latency and high accuracy.

[5] ResearchGate Publication — "Microcontroller-Based Real-Time Weather Monitoring Device with GSM"

This research focused on developing a GSM-based weather monitoring system that transmits weather parameters such as temperature, humidity, and rainfall through SMS or GSM networks. The microcontroller acts as the central processing unit that reads data from multiple sensors and communicates it to users via mobile communication. The system is ideal for remote locations with limited internet access.

The study detailed the design of the hardware interface and software logic that enables periodic updates of weather conditions. GSM modules were integrated to send SMS alerts when parameters exceeded predefined thresholds. This ensured that users remained informed of environmental changes without needing continuous internet connectivity.

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The work's importance lies in providing an offline communication alternative to IoT weather systems. It demonstrated that GSM-based communication remains relevant for real-time weather updates in regions lacking Wi-Fi infrastructure, thus broadening the scope of IoT deployment in rural or developing areas.

III. EXISTING SYSTEM

Traditional weather monitoring systems depend on manual observation and conventional meteorological instruments. These systems are generally maintained by weather departments and research organizations using high-cost infrastructure and complex setups. Data collection is often periodic rather than continuous, resulting in time delays in data analysis. In rural or remote areas, access to such weather information is limited due to inadequate communication systems and equipment.

IV. PROPOSED SYSTEM

The proposed **IoT-Based Weather Monitoring System** overcomes the limitations of traditional systems by using sensors and IoT modules to monitor environmental parameters automatically. Sensors such as DHT11 (temperature and humidity), BMP180 (pressure), and MQ135 (air quality) are connected to a microcontroller (like NodeMCU or Arduino UNO). The microcontroller processes the data and uploads it to a cloud server via Wi-Fi or GSM. The information is then displayed on a mobile application or web dashboard in real time.

This system enables continuous data logging, remote monitoring, and analysis. The data stored in the cloud can also be used for long-term weather trend prediction and analysis. The design is low-cost, energy-efficient, and easy to maintain, making it suitable for both urban and rural deployment.

V. SYSTEM ARCHITECTURE

The system architecture comprises multiple components interconnected through IoT communication layers:

- **Sensors:** DHT11 (Temperature & Humidity), BMP180 (Pressure), Rain Sensor, MQ135 (Air Quality).
- **Microcontroller:** NodeMCU or Arduino UNO for data processing.
- **Connectivity Module:** Built-in Wi-Fi or GSM module for communication.
- **Cloud Platform:** ThingSpeak or Blynk for data storage and visualization.
- **User Interface:** Mobile application or web dashboard for displaying real-time data.

Working Principle:
Each sensor collects specific environmental data and sends it to the microcontroller. The data is formatted and transmitted to the IoT cloud server. The cloud platform visualizes the information using graphs and gauges. Users can access this data in real-time via smartphones or computers, allowing for continuous weather monitoring and alert notifications in case of abnormal conditions.

VI. IMPLEMENTATION

1. **Hardware Setup:**
   Sensors are connected to the microcontroller

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through analog/digital pins. The NodeMCU is powered through USB or a 9V adapter.

2. **Software Configuration:**
   Arduino IDE is used to program the NodeMCU. Libraries for DHT, BMP, and Wi-Fi modules are integrated to read sensor values and connect to the internet.
3. **Cloud Integration:**
   The system is linked to ThingSpeak or Blynk through an API key for real-time data transmission and visualization.
4. **Data Visualization:**
   The user can view weather data on a smartphone app or cloud dashboard in the form of charts and indicators.
5. **Alerts and Notifications:**
   Threshold-based alerts can be configured to notify users via SMS or email when parameters exceed preset limits (e.g., high temperature or poor air quality).

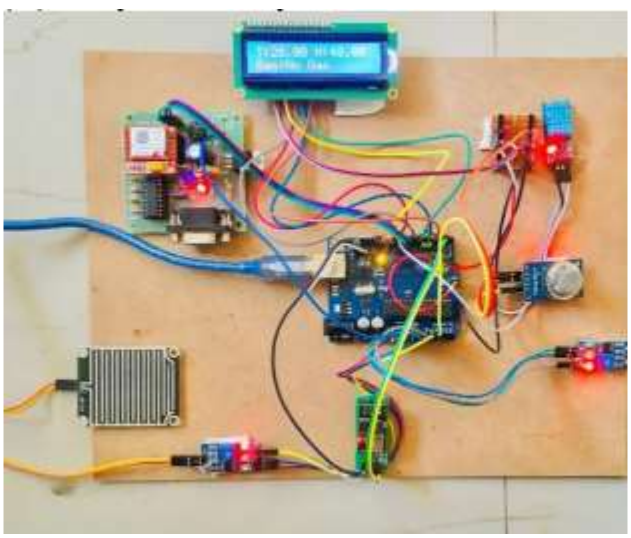

Fig.6.1 Implementation of proposed system

VII. CONSLUSION

The IoT-Based Weather Monitoring System provides an innovative, reliable, and cost-effective approach for real-time environmental data collection. It automates the monitoring process and enhances the accuracy of weather reporting using IoT sensors and cloud platforms. The system is beneficial for applications in agriculture, meteorology, and smart cities, allowing users to access continuous weather data remotely. By eliminating manual intervention, the system ensures accuracy, speed, and ease of use.

VIII. FUTURE SCOPE

In the future, the system can be expanded to include more advanced sensors such as wind speed, UV index, and rainfall sensors. Integration with AI and machine learning algorithms can enable weather prediction and pattern recognition. The system can also be connected to automated irrigation or disaster management systems for proactive response. Solar-powered modules and long-range communication protocols like LoRa or NB-IoT can further enhance its deployment in remote areas, contributing to sustainable and intelligent environmental monitoring.

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