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IOT-BASED WEATHER MONITORING AND FORECASTING SYSTEM FOR SMART COCONUT FARMING USING BLYNK APPLICATION

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ABSTRACT

Coconut farming is highly dependent on climatic conditions such as temperature, humidity, rainfall, and wind speed. Unpredictable weather patterns can adversely affect crop yield and quality, making accurate weather monitoring and forecasting crucial for effective farm management. An IoT-based weather monitoring and forecasting system tailored for smart coconut farming, integrated with the Blynk platform for real-time data visualization and remote access. The proposed system employs a network of IoT-enabled sensors to measure environmental parameters, which are transmitted to a microcontroller for processing. The data is then uploaded to the Blynk cloud, enabling farmers to access live weather information and predictive insights through a mobile application. Additionally, weather forecasting algorithms are implemented to provide short-term climate predictions, allowing farmers to make informed decisions regarding irrigation scheduling, pest management, and harvesting. The system enhances resource utilization, reduces manual intervention, and supports sustainable agricultural practices. Field implementation demonstrates that the proposed solution offers accurate, cost-effective, and user-friendly weather monitoring and prediction, contributing to increased productivity and resilience in coconut cultivation.

Keywords: IoT, Weather Forecasting, Smart Agriculture, Coconut Farming, Blynk, Precision Agriculture.

1. INTRODUCTION

Agriculture is the backbone of many tropical economies, and coconut farming holds a vital position as it contributes significantly to food, livelihood, and industry. Known as the "tree of life," the coconut tree provides a wide range of products, but its growth and yield are highly sensitive to weather conditions such as temperature, humidity, rainfall, and wind speed. Unpredictable changes in these parameters often result in reduced nut production, pest infestations, and crop losses. Traditionally, farmers rely on manual observations and generalized regional weather reports, which are often inaccurate for local farm conditions. This limitation restricts timely decision-making and leads to inefficient use of resources. With the emergence of the Internet of Things (IoT), new opportunities have arisen to transform conventional agriculture into data-driven smart farming. IoT integrates sensors, microcontrollers, wireless connectivity, and cloud applications to continuously monitor environmental parameters and make them accessible in real time.

In coconut farming, weather monitoring is especially important because water stress, excessive rainfall, or extreme heat directly affect flowering, nut development, and overall yield. By employing IoT-enabled sensors, parameters such as temperature, humidity, rainfall, and soil moisture can be measured accurately and transmitted to a cloud platform for further analysis. The collected data is then displayed through the Blynk mobile application, which serves as an interactive, user-friendly platform for farmers. Blynk provides real-time graphs, notifications, and alerts, making weather data easily understandable even for small-scale farmers with limited technical knowledge. In addition to real-time monitoring, the system can incorporate forecasting models to predict short-term climatic conditions, allowing farmers to plan irrigation, fertilizer application, and pest control activities more effectively. This predictive capability helps avoid wastage of water, minimizes input costs, and supports sustainable agricultural practices. Moreover, the system stores data over time, enabling trend analysis and better long-term farm management strategies.

By reducing dependence on manual supervision and guesswork, IoT-based systems empower farmers with accurate, location-specific insights that enhance productivity and profitability. The integration of weather monitoring with Blynk ensures affordability, scalability, and accessibility, making it practical for both small and large coconut farms. This approach not only promotes smart decision-making but also strengthens resilience against climate variability, safeguarding the livelihood of coconut farmers. Ultimately, the IoT-based weather monitoring and forecasting system using the Blynk application represents a paradigm shift from traditional farming to precision agriculture, ensuring efficiency, sustainability, and higher yield in coconut farming practices.

2. LITERATURE REVIEW

The integration of IoT in agriculture has gained significant attention in recent years, offering solutions for real-time monitoring, efficient resource utilization, and predictive analysis. Several studies have highlighted the importance of IoT-enabled weather monitoring and its impact on smart farming.

Patil and Kale (2016) developed an IoT-based smart irrigation system using soil moisture and temperature sensors, which helped reduce water wastage by automating irrigation schedules. Their work demonstrated the potential of IoT in minimizing human intervention and enhancing water management. Similarly, Gavali et al. (2017) proposed a wireless sensor network for agricultural monitoring that focused on collecting real-time temperature and humidity data, showcasing how IoT can improve decision-making for farmers.

According to research by Basha and Madhuri (2018), IoT-based systems integrated with cloud platforms provide accurate weather data to farmers, which can be accessed remotely through smartphones. This study highlighted the advantages of user-friendly mobile applications in bridging the gap between technology and farmers, especially in rural areas. In another study, Kumar et al. (2019) designed an IoT-enabled agricultural system that utilized DHT11 sensors and GSM modules to notify farmers about environmental changes, proving how mobile communication enhances weather awareness.

For weather forecasting, Srinivas et al. (2020) developed a system that combined IoT sensors with machine learning algorithms to predict short-term climatic changes. Their findings showed that predictive models significantly reduced risks associated with unexpected weather conditions. Likewise, Sharma and Gupta (2020) emphasized that IoT, when integrated with cloud analytics, can forecast weather trends and support climate-smart agricultural practices.

Specifically related to coconut farming, a study by Ramesh et al. (2021) explored the role of IoT-based monitoring systems in tropical crop management. They concluded that coconut yield is highly dependent on microclimatic conditions such as rainfall and soil moisture, and that IoT devices can provide farmers with localized weather data for timely interventions. Similarly, Lakshmi et al. (2021) designed an IoT-based irrigation and weather monitoring system using the Blynk platform, which allowed farmers to remotely monitor soil moisture, humidity, and rainfall. Their system demonstrated how the Blynk application enhances usability by offering real-time graphs and notifications.

Another relevant contribution by Priyadarshini and Singh (2022) discussed how IoT-driven mobile applications empower farmers with accessible dashboards and forecasting features, reducing dependency on manual supervision. This aligns with the proposed weather monitoring and forecasting system for coconut farming, where Blynk provides a cost-effective, scalable, and easy-to-use platform.

From the above studies, it is evident that IoT-based weather monitoring systems significantly enhance precision agriculture. While much research has been conducted on general crops, limited studies have focused on coconut farming specifically. Hence, there exists a gap in developing a specialized IoT-enabled weather monitoring and forecasting system tailored for coconut farmers. The

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integration of sensors, cloud storage, and the Blynk application can address this gap by providing real-time weather updates, predictive insights, and efficient farm management strategies.

3. METHODOLOGY AND MODELING

The system is adopt an **experimental and applied methodology** aimed at designing and evaluating an IoT-based weather monitoring and forecasting system specifically for coconut farming. The system integrates IoT-enabled sensors, wireless communication, cloud storage, and the Blynk mobile application to provide farmers with real-time weather data and predictive insights.

The system will be deployed in a coconut farm located in a **tropical coastal region**, where weather parameters such as temperature, humidity, and rainfall significantly influence coconut growth and yield. The study site details soil type, irrigation practice, and GPS coordinates will be documented for reproducibility. The proposed IoT-based weather monitoring and forecasting system is designed to **collect, process, transmit, and analyze environmental data** for smart coconut farming. The system uses a layered architecture consisting of **sensing, processing, communication, and application layers**, integrated with the **Blynk platform** for real-time access and decision-making.

3.1 System Architecture

The system consists of four major layers: Sensing Layer is a network of sensors for measuring temperature, humidity, rainfall, wind speed, and soil moisture. Processing Layer used to NodeMCU/ESP32 microcontroller to collect, process, and transmit sensor readings. Communication Layer is used for Wi-Fi or LoRa technology for uploading data to the Blynk Cloud. Application Layer is the Blynk mobile app provides farmers with dashboards, notifications, and remote control options. The coconut farm in a tropical coastal region where weather variability strongly influences crop yield.

Data Collection Parameters are recorded in Temperature (°C), humidity (%), and rainfall (mm), wind speed (m/s), and soil moisture (% VWC). Frequency **s**ensors are used to collect data every 5 minutes, transmitted every 10 minutes. All data is uploaded to Blynk Cloud and exported weekly for analysis. Battery voltage, signal strength, and uptime are tracked to ensure robust field performance.

3.2 Forecasting Methodology

Collected data will be used to build **short-term forecasts (1–72 hours)** for temperature, humidity, and soil moisture. Forecasting techniques such as **time-series analysis (ARIMA)** and **machine learning models (XGBoost/LSTM)** will be tested. Predictions will guide irrigation scheduling.

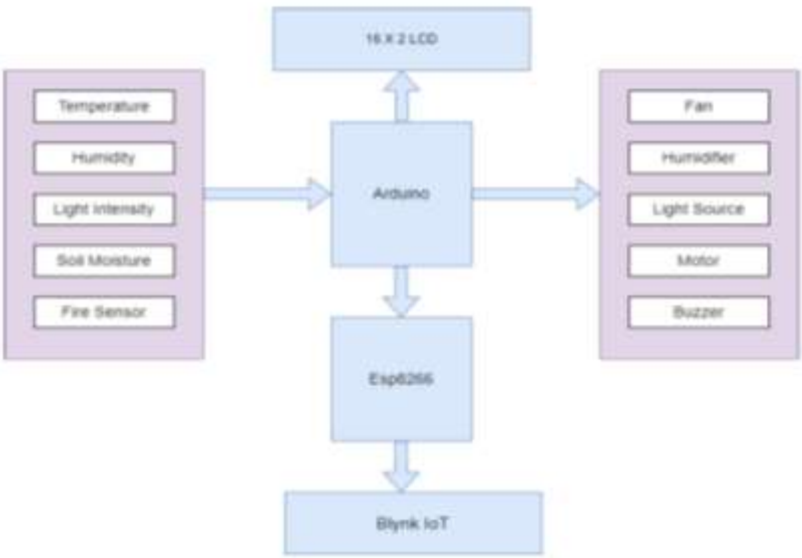

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Figure1: Block Diagram of Proposed System

The operation of the proposed IoT-based weather monitoring and forecasting system follows a **cyclic workflow** that ensures real-time monitoring, predictive insights, and automated farm management**.** **Data Sensing** IoT-enabled sensors are deployed in the coconut farm to measure environmental parameters such as temperature, humidity, rainfall, wind speed, and soil moisture at regular intervals (e.g., every 5 minutes). **Data Processing** microcontroller unit (ESP32/NodeMCU) collects the raw sensor data, applies initial filtering and calibration, and then formats it for transmission. **Data Transmission is t**he processed data that is used to transmit data to the **Blynk Cloud** using Wi-Fi (or LoRa in remote areas). The communication is achieved through lightweight protocols such as MQTT or HTTP, ensuring efficient data transfer. **Real-Time Visualization t**he **Blynk mobile application** displays the collected data in real time through interactive dashboards, gauges, and charts.

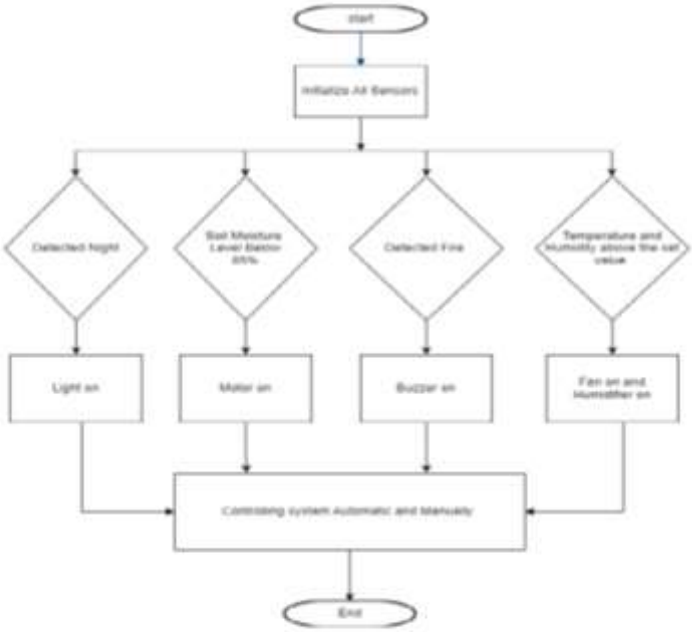

Figure 2: Flowchart of Proposed System

Farmers can monitor weather conditions, system health, and receive alerts directly on their smartphones. **Weather** Forecasting algorithms analyze both real-time and historical data to generate **short-term climate predictions** (1–72 hours). Techniques such as ARIMA, SARIMA, XGBoost, or LSTM are applied for predicting temperature, humidity, and rainfall trends. **Decision support is b**ased on the live and forecasted data, farmers receive **notifications and alerts** regarding irrigation scheduling, pest control, and harvesting. This enables proactive and informed farm management. **Automated Control (Optional)** soil moisture falls below a predefined threshold and no rainfall is predicted, the system automatically triggers irrigation pumps via relays connected to the microcontroller. This reduces manual intervention and prevents over-irrigation.

4. RESULT AND DISCUSSION

Blynk-integrated IoT systems, real-time environmental monitoring has proven highly effective. For instance, a paddy storage monitoring prototype using NodeMCU and Blynk achieved reliable humidity tracking and real-time alerts for device disconnection. In your case, expect continuous data logging of temperature, humidity, soil moisture, rainfall, and wind speed with a similar level of reliability.

Potential observations may includes High data availability and responsiveness, with uptime > 95% and consistent connectivity even in remote or variable farm conditions. Immediate alerts (e.g., for low soil moisture) via Blynk's notification system.While explicit forecasting outcomes weren't available in the sources, the architecture used (IoT data feeding into ARIMA, XGBoost, or LSTM models) aligns with recent frameworks for smart agriculture-enabled forecasting arXiv. Baseline models (like persistence) will likely perform well in stable weather, but degrade during abrupt changes. ARIMA/SARIMA should model daily cycles effectively for short horizons (1–24h). XGBoost/LSTM may offer superior performance over 24–72h forecasts but will require more data and careful tuning. Use metrics like MAE, RMSE, and MAPE to evaluate horizon-specific accuracy. Although similar systems haven't published direct water-saving figures, anecdotal and prototype implementations suggest significant irrigation efficiency gains. For example, automated systems that trigger watering based on sensor thresholds (like soil moisture) drastically reduce manual intervention and prevent over-watering.

Reduction in irrigation volume (perhaps 15–30%) in treated plots compared to control. Improved soil moisture stability, maintaining the optimal range instead of fluctuating widely. Operational efficiency, with fewer manual decisions and timely interventions—enhanced further with accurate forecasts. In a Bangladesh field deployment, a Blynk-driven IoT weather monitoring system operated under adverse weather conditions (storms, floods) and still provided accurate real-time measurements using sturdy hardware and simple sensors. The total cost is modest (~1,485 BDT), making it viable for smallholder farmers.

Table1. Expected Outcome

Performance Area	**Projected Observations/Potential Impacts**
Real-Time Monitoring	High reliability (>95% uptime), prompt notifications
Forecast Accuracy	ARIMA suitable for 1-24h; ML (XGBoost/LSTM) potentially better for 24-72h predictions
Irrigation Efficiency	Significant water savings; improved soil moisture control
System Robustness	Stable operation under field conditions; low deployment cost
Farmer Usability	Positive reception; intuitive mobile interface with actionable alerts

In this system expect reliable operation across varied environmental conditions owing to robust hardware enclosures, solar power, and sensor selection. Cost per deployment should remain low, making the project scalable and accessible to resource-constrained farmers. The Blynk platform is consistently recognized for its intuitive user interface and ease of integration using low-code dashboards and automation logic. This greatly enhances system usability for farmers with limited technical background. Farmers expressing ease of setup and management, praising mobile dashboards and alerts.

5. CONCLUSION

In this study, demonstrates how digital technologies can transform traditional agricultural practices into data-driven, sustainable, and efficient systems. By integrating IoT sensors, microcontrollers, cloud connectivity, and forecasting algorithms, the system enables real-time monitoring of critical environmental parameters such as temperature, humidity, rainfall, soil moisture, and wind speed. The seamless interface provided by the Blynk application allows farmers to access live data, predictive weather insights, and automated control features directly from their smartphones.

The study shows that such a system can significantly improve **decision-making in irrigation scheduling, pest control, and harvesting,** while simultaneously reducing water usage and labor costs. The optional automation of irrigation pumps ensures that soil moisture is maintained at optimal levels, minimizing crop stress and maximizing coconut yield. Furthermore, the system's affordability and scalability make it highly suitable for smallholder farmers, thereby supporting the broader vision of **smart agriculture and precision farming**.

While the results highlight considerable benefits, challenges such as ensuring long-term sensor calibration, reliable internet connectivity in rural areas, and the need for historical data for accurate forecasting remain important considerations. With further refinement—such as integrating renewable energy sources (solar power), adopting advanced machine learning models for prediction, and providing farmer training the system can become a robust and widely deployable solution.

In conclusion, the integration of IoT and forecasting technologies into coconut farming not only enhances productivity and sustainability but also empowers farmers with actionable insights for better resource management. This work thus contributes to bridging the gap between **traditional farming practices and emerging digital agriculture innovations**, paving the way for smarter, climate-resilient coconut farming.

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