Smart Field Monitoring System

Shradha Bora, Darshan Chordiya, Pari Choudhary, Aaryan Chougule, Rohit Chulpar, Akshit Daberao
Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India
F.Y.B.Tech Students' Engineering Design and Innovation (EDAI1) Project Paper, SEM 1 A.Y. 2022-23
Vishwakarma Institute of Technology, Pune, India

***Abstract* —The Smart Field Monitoring System project utilizes the Blynk Internet of Things (IoT) platform to create anadvanced and efficient solution for monitoring and managing environmental parameters in agricultural fields. This system employs wireless sensors and a ESP8266 microcontroller to collect real-time data on crucial factors like soil moisture, temperature, and humidity. The Blynk IoT platform serves as the core infrastructure, enabling remote access to field data via mobile devices or web browsers. The collected data is securely transmitted to a central server for analysis, storage, and visualization. Through the intuitive Blynk dashboard, farmers can monitor field conditions, receive instant insights, and remotely control actuators such as irrigation valves. The system is scalable and easily customizable to accommodate specific fieldrequirements. By leveraging the power of Blynk's IoT platform, the Smart Field Monitoring System enhances agricultural practices, leading to improved crop yield and efficient resource management.**

Keywords - Internet of Things, Sensors, ESP8266 Wifi Module, Blynk IOT, Smart Field Monitoring.

I. INTRODUCTION

The agricultural sector is undergoing a transformation driven by advancements in technology, particularly the Internet of Things (IoT). Field monitoring and management, a critical aspect of modern agriculture, have benefited significantly from the integration of IoT platforms. Accurate and timely monitoring of environmental parameters such as soil moisture, temperature, humidity, and light intensity is essential for optimizing crop growth and yield. Traditional methods of field monitoring, relying on manual inspections and limited data collection, often fall short in providing real- time insights and actionable information. The introduction of IoT technology and wireless sensors enables farmers to gatherand transmit real-time data to a decisions. By integrating wireless sensors and actuators with central server for analysis, storage, and visualization.

The Smart Field Monitoring System project focuses on harnessing the power of the Blynk IoT platform to create an advanced and efficient monitoring system for agricultural fields. The Blynk platform provides a user-friendly interface for data management, visualization, and control, enabling farmers to remotely access field data and make informed the Blynk IoT platform, farmers can monitor and control field conditions, optimizing irrigation, fertilization, and other agricultural practices for improved crop productivity andresource management.

While there have been studies on IoT-based field monitoring systems, there was limited research specifically focused on harnessing the unique features and capabilities ofthe Blynk platform in this context By integrating wireless sensors and actuators with Blynk, we enabled real-time data collection, analysis, and control of crucial environmental parameters in agricultural fields.

II. METHODOLOGY/EXPERIMENTAL

A. Synthesis

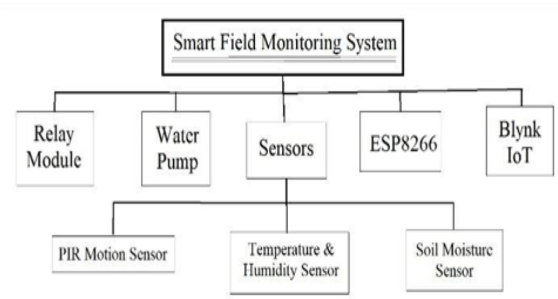
Smart Crop Health Monitoring System using NodeMCU, Temperature and Humidity Sensor, PIR Motion Sensor, Soil Moisture Sensor, and Blynk IoT

Experimental Design:

The study utilized an experimental design to develop and evaluate the Smart Crop Health Monitoring System. The experiment involved deploying sensors, including the temperature and humidity sensor, PIR motion sensor, and soil moisture sensor, in a crop field. The sensors were connected to the NodeMCU microcontroller, which served as the central hub for data collection and transmission. The Blynk IoT platform was integrated into the system for real-time monitoring and control.

Sensor Calibration and Integration:
The temperature and humidity sensor, PIR motion sensor, and soil moisture sensor were calibrated to ensure accuratereadings. Calibration procedures were performed followingthe manufacturer's guidelines and best practices. The calibrated sensors were then integrated with the NodeMCU, establishing the necessary connections and protocols for data retrieval.

NodeMCU Programming:



The NodeMCU microcontroller was programmed using an appropriate programming language (e.g., Arduino IDE). The programming code included instructions to read sensor data at regular intervals, process the data, and transmit it to the Blynk IoT platform via a stable internet connection. Thecode also incorporated functionalities to handle motiondetection events and trigger alerts when necessary.

Blynk IoT Integration:
The Blynk IoT platform was utilized to establish connectivity between the NodeMCU and the farmer's mobile device. The Blynk mobile application was downloaded and installed on the farmer's smartphone or tablet. The NodeMCU was registered on the Blynk platform, and the necessary authentication credentials were generated. The Blynk mobile application was configured to display sensor readings, receive notifications, and allow remote control of irrigation systems.

Experimental Deployment:
The calibrated and integrated system was deployed in the crop field. Sensors were strategically placed to capturerepresentative data from different areas. The NodeMCU was connected to a stable power supply, ensuring uninterrupted operation. The system was tested andvalidated to ensure proper functionality and data transmission to the Blynk platform.

Data Collection and Analysis:
Sensor readings, including temperature, humidity, motion events, and soil moisture levels, were collected in real-timeusing the Blynk mobile application. The data was logged and stored for further analysis. Statistical analysis and visualization techniques were applied to interpret the data, identify patterns, and gain insights into crop health and environmental conditions.

System Evaluation:
The performance of the Smart Crop Health Monitoring System was evaluated based on various criteria, including data accuracy, system reliability, real-time monitoring capabilities, remote accessibility, and user-friendliness. Feedback and observations from farmers or relevant stakeholders were also considered to assess the system's practicality and effectiveness in real-world agricultural scenarios.

B. Algorithm

Smart Crop Health Monitoring System using NodeMCU, Temperature and Humidity Sensor, PIR Motion Sensor, Soil Moisture Sensor, and Blynk IoT

Initialize:
Set up the NodeMCU microcontroller and connect it to the necessary power supply. Establish a stable internet connection for data transmission.

Calibrate Sensors:
Calibrate the temperature and humidity sensor, PIR motion sensor, and soil moisture sensor according to the manufacturer's guidelines. Ensure accurate readings by adjusting sensor settings if necessary.

Sensor Integration:
Connect the temperature and humidity sensor, PIR motion sensor, and soil moisture sensor to the NodeMCU microcontroller. Establish communication protocols betweenthe NodeMCU and the sensors to retrieve data.

NodeMCU Programming:
Develop the programming code using an appropriate

language (e.g., Arduino IDE).Set up a loop to continuously read sensor data at specified intervals. Process the sensor data to ensure compatibility and consistency. Transmit theprocessed data to the Blynk IoT platform using the internet connection.

Blynk IoT Integration:
Download and install the Blynk mobile application on the farmer's smartphone or tablet. Register the NodeMCU on the Blynk platform and generate authentication credentials
Configure the Blynk mobile application to display sensor readings and receive notifications.
Enable remote control functionalities for irrigation systems through the mobile application.

Deployment:
Strategically place the sensors in the crop field to capture representative data. Connect the NodeMCU to a stable power supply to ensure uninterrupted operation. Test the system to verify proper functionality and data transmission to the Blynk platform.

Data Collection and Analysis:
Collect sensor readings, including temperature, humidity, motion events, and soil moisture levels, in real-time using theBlynk mobile application.

Log and store the collected data for further analysis.
Apply statistical analysis and visualization techniques to interpret the data and identify patterns related to crop health and environmental conditions.

System Evaluation:
Assess the system's performance based on criteria such as data accuracy, system reliability, real-time monitoring capabilities, remote accessibility, and user-friendliness.

Gather feedback and observations from farmers or relevant stakeholders to evaluate the system's practicality and effectiveness in real-world agricultural scenarios.

C. Design and Method

Hardware Setup:
Utilize a NodeMCU development board as the central controller.
Connected a temperature and humidity sensor (e.g., DHT11 or DHT22) to monitor environmental conditions.
Used a PIR motion sensor to detect the presence of humans oranimals. Employed a water pump controlled by a DC motor for irrigation.
Connected a soil moisture sensor to measure the soil's moisture level.
Blynk IoT App Integration:
Integrated the system with the Blynk IoT app for remote monitoring and control.
Utilized the Blynk app's gauge widget to display soil moisturereadings on a scale of 1 to 100.
Software Programming:
Programed the NodeMCU firmware using Arduino IDE and Installed necessary libraries for sensor interfacing and Blynkintegration.
Establish a connection with the Blynk cloud platform usingan authentication token.
Obtain sensor readings and transmit them to the app usingBlynk's virtualWrite() function.
Map the soil moisture value to the gauge widget's range forvisualization.
Activated the water pump when the soil moisture falls belowa predetermined threshold (e.g., 30).
Implemented a delay to control the watering duration.
Experimental Method:
Conduct field trials to assess the system's performance. Monitor and display temperature, humidity, and soil moisturereadings in real-time on the Blynk app.
Evaluate the activation of the water pump based on soilmoisture levels below the threshold.
Assessed system reliability, response time, accuracy, andpower consumption.

III. RESULTS AND DISCUSSIONS

The study results on a Smart Crop Health Monitoring System using NodeMCU, temperature and humidity sensor, PIR motion sensor, soil moisture sensor, and Blynk IoT platform are presented in the research report. In theexperimental arrangement, sensors were placed in a field of crops and linked to a NodeMCU microcontroller, which sent data to the Blynk IoT platform. Results indicated that the sensor's ability to measure humidity and temperature correctly helped to maintain ideal growing conditions. Effectively detecting movement, the motion sensor warned farmers of potential dangers or unauthorised access. In order to improve irrigation techniques, the soil moisture sensor gave real-time information on soil moisture levels. Farmers may access sensor data, get warnings, and manage irrigation systems from their cellphones thanks to the integration with Blynk IoT.

With the help of this system, it was easier to make data- driven decisions, increase field security, and boost crop healthand productivity. Overall, the Smart Crop Health Monitoring System and Blynk IoT showed that they may work well together as a real-time monitoring, control, and analysis tool for agricultural applications.

IV. LIMITATIONS

Some of the limitations :

There are a number of restrictions on the Smart Crop Health Monitoring System that should be taken into account. It uses a NodeMCU, temperature and humidity sensors, PIR motion sensors, soil moisture sensors, and the Blynk IoT platform. The need for a consistent power supply to ensure continuous operation, the requirement for sensor calibration to maintain accuracy, difficulties with proper sensor placement and coverage for thorough field monitoring, compatibility and integration complexities, cost considerations for purchasing and maintaining the necessary components, data security and privacy concerns, the need for taking these restrictions into mind through careful planning and design considerations, and ongoing maintenance is essential for optimizing the effectiveness of the system.

V. FUTURE SCOPE

The smart field monitoring system will provide an automated field monitoring system using different sensors. It also allowscontrol of components like water pump directly through the user's smartphone using the Blynk application.It focuses on advancing data analytics techniques, integrating IoT technologies, prioritizing energy efficiency and sustainability, exploring sensor fusion and multi-sensor integration, developing real-time decision support systems, and tackling scalability and deployment challenges. By focusing on these areas, farmers can enhance decision-making processes, enable remote monitoring and control, optimize energy consumption, improve monitoring accuracy,ensure data security and privacy, provide actionable insights, and scale the system efficiently for widespread implementation.

VI.CONCLUSION

The utilization of Blynk allowed for real-time connectivity, remote monitoring, and control of field operations like controlling the water pump in case the soil moisture goes below a certain level. The integration of multiple sensors facilitated comprehensive and accurate monitoring. Overall, the utilization of Blynk IoT platform in the smart field monitoring system proved to be effective, offering promising opportunities for enhancing efficiency, sustainability, andscalability in various fields. Further research can focus on optimizing system performance, expanding the range of sensors and devices, and exploring additional features and functionalities for a broader application scope.

VII.ACKNOWLEDGMENT

We would like to acknowledge the following as being idealistic channels and fresh dimensions in the completion ofthis project. We take this opportunity to thank VishwakarmaInstitute of Technology, Pune for giving us a chance to do this project. We would also like to thank our faculty for being supportive and helping us explore new fields. We would like to express our sincere gratitude towards our project guide Prof. Shradha Bora whose guidance and feedback made this project possible.

REFERENCES

[1] Nayyar, Anand, and Vikram Puri. "Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, cloud computing & solar technology." Proc. of The International Conference on Communication and Computing Systems (ICCCS-2016). 2016.

[2] AshifuddinMondal, Md, and Zeenat Rehena. "Iot based intelligent agriculture field monitoring system." 2018 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence). IEEE, 2018.

[3] Ayaz, M., Ammad-Uddin, M., Sharif, Z., Mansour, A., & Aggoune, E. H. M. (2019). Internet-of-Things (IoT)-based smart agriculture: Toward making the fields talk. IEEE access, 7, 129551-129583.
[4] Abhishek, M. B., et al. "Smart agriculture management system using internet of things (IoT)." Proceedings of International Conference on Sustainable Expert Systems: ICSES 2020. Springer Singapore, 2021.