Smart Farming Utilizing Blynk Server: Wireless Control for Irrigation, Water Lanes, and Security

Akash Badhan, Varsha, Abhishek Kumar Maddheshiya, Aditya Roy and Karan Singh

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Akash Badhan (11903598)

Computer Science and Engineering,
Lovely Professional University,
Punjab, India;
Email:
www.akashbadhan786@gmail.com

Dr. Varsha Sahni (28384)

Computer Science and Engineering,
Lovely Professional University,
Punjab, India;
Email: varsha.28384@lpu.co.in

Abhishek Maddheshiya (11904548)

Computer Science and Engineering,
Lovely Professional University,
Punjab, India;
Email: maddheshiyaa079@gmail.com

Aditya Roy (11909453)

Computer Science and Engineering,
Lovely Professional University,
Punjab, India;
Email: adityaroy2308@hotmail.com

Karan Singh (11903598)

Computer Science and Engineering,
Lovely Professional University,
Punjab, India;
Email: 7568680011karan@gmail.com

Abstract

Smart farming, also referred to as precision agriculture, has gained recognition for its potential to increase crop yields, optimize resource utilization, and promote environmental sustainability. This study explores the effectiveness of using the Blynk server, a prominent Internet of Things (IoT) platform, for implementing smart farming practices. A comprehensive smart farming system was developed, utilizing the Blynk server to manage various farm aspects, including irrigation, water lane adjustments, object/animal detection, and environmental monitoring. The impact of this system on crop yields, resource consumption, and sustainability was evaluated. The results highlight the efficiency and feasibility of Blynk server-based smart farming in transforming agricultural practices.

Keywords: Internet of Things (IoT), Precision Agriculture, Irrigation, NodeMCU (ESP8266), Temperature and Humidity Sensor (DHT11), Soil Moisture Sensor, Infrared (IR) Sensor, Servo Motor, Relay Module, Blynk Server.

Introduction

The significance of smart agriculture has grown due to the escalating global demand for food and the need to minimize the environmental impact of farming. By integrating Internet of Things (IoT) devices such as sensors, automation, and artificial intelligence, smart farming offers the potential to optimize resource usage, enhance crop yields, and reduce wastage. The Blynk server, a widely used IoT platform, enables the creation of tailored mobile and web applications for IoT devices. With its user-friendly interface and comprehensive features, the Blynk server is well-suited for developing intelligent farming solutions. This research delves into assessing the effectiveness of the Blynk server in the context of smart agriculture.

The agricultural landscape has undergone a transformative shift due to technologies like the Blynk server. As an open-source framework, the Blynk server empowers farmers to design custom IoT applications and dashboards, facilitating the monitoring and management of diverse farming operations.

The utilization of the Blynk server for smart farming dates back to the early 2010s, a time when IoT gained prominence across industries, including agriculture. IoT sensors were employed to gather data on soil moisture, temperature, and other environmental factors. However, the challenge of accessing and interpreting this data persisted.

In 2015, the Blynk server emerged as a solution. It allows users to create personalized IoT applications accessible worldwide, simplifying remote farm monitoring and control. Known for its adaptability and customization capabilities, the platform empowers users to design dashboards and applications tailored to their specific needs.

Since its introduction, the Blynk server has been widely adopted in agriculture, enabling farmers to streamline operations, increase yields, and reduce waste.

Implementing smart farming through the Blynk server offers several advantages for farmers and the agriculture industry. Real-time data collection involving parameters like soil moisture, temperature, and humidity equips farmers with tools to optimize practices and minimize inefficiencies. Additionally, the platform enables the setup of alerts, notifying farmers of deviations from optimal conditions and allowing preemptive action to prevent crop damage.

The Blynk server also facilitates the automation of various farming tasks. Farmers can use the platform to control irrigation systems, activate or deactivate pumps, and even remotely manage drones for crop monitoring and spraying.

The benefits of Blynk server-driven smart farming extend to researchers and the broader agriculture sector. The platform provides researchers with substantial data on crop growth and environmental dynamics, enhancing insights and promoting efficient farming practices.

However, the adoption of Blynk server-based smart farming comes with challenges. Swift and reliable internet connectivity is crucial, given the platform's dependence on it. High-speed internet access is essential for farmers to harness the platform's potential effectively.

Additionally, the costs associated with integrating smart farming technologies pose a challenge. Sensors, drones, and similar innovations come with expenses that might deter smaller-scale farmers from their adoption. Nevertheless, the gradual decline in technology costs over time promises increased affordability and accessibility for farmers of all scales.

In conclusion, integrating the Blynk server into smart agriculture has ushered in a paradigm shift, enhancing efficiency, sustainability, and profitability. By leveraging IoT capabilities and real-time data, farmers can optimize operations, minimize waste, and boost yields while conserving resources.

This research paper, having addressed the foundational history and importance of smart agriculture, now turns to its primary objective: exploring and disseminating innovative ideas that empower farmers. The subsequent sections detail the techniques and methodologies behind the creation of our smart farming prototype.

Literature Review

Numerous research efforts have been dedicated to the field of smart farming to date. However, it is important to acknowledge that no research area can be deemed entirely exhaustive, and the idea that all research avenues within it have been explored is unrealistic. Research remains a dynamic process, continuously evolving with technological advancements and changing agricultural needs.

Our team, recognizing the potential for further exploration in smart farming, conducted a review of existing research papers in the domain of smart agriculture using IoT technology. This endeavor aimed not only to gain insights from previous studies but also to identify unexplored areas where our research could make a unique contribution. By analyzing various research papers, our goal was to synthesize existing knowledge and identify areas that had not been extensively addressed. We aimed to discover innovative concepts that had not been previously proposed in the literature.

Among the reviewed literature, we encountered foundational research studies in the realm of smart farming. For example, in 2015, Mr. Karan Kansara and his team introduced an irrigation system incorporating soil moisture, temperature, and humidity sensors, utilizing a microcontroller to regulate water flow based on sensor readings.[1]

Similarly, in 2016, Mr. G. Parameswaran and Mr. K. Sivaprasath presented a study on designing a smart drip irrigation system. This system incorporated an Arduino microcontroller and various sensors, including a PH sensor, humidity sensor (CLM53R), and Temperature Sensor (LM35), coupled with an LCD (16x2) for displaying output messages. Their irrigation system also integrated a solenoid valve and water pump for precise control.[2]

In 2016, Mr. Anand Nayyar and Er. Vikram Puri explored the integration of solar panels into the irrigation process to achieve energy-efficient farming. Their work utilized an Arduino board and ThingSpeak server for data management, with wireless connectivity provided by an ESP8266 (Wi-Fi Module). This enabled remote monitoring of data via ThingSpeak's dashboard on mobile devices and laptops.[3]

In 2017, Mrs. R. Nandhini and her team delved into smart irrigation systems, incorporating various sensors such as a PIR sensor for motion detection and a GSM module for transmitting live data and weather conditions. The collected data was visualized on an LCD display.[4]

Another noteworthy study from 2017 by Mr. Ravi Kishore Kodali and Mr. Borade Samar Sarjerao focused on creating a simple water pump controller. Their system utilized a soil moisture sensor and a NodeMCU (ESP8266) microcontroller, implementing the MQTT and TLS protocols to ensure accurate sensor data recording and reliable water pump control.[5]

In 2018, Mr. Prabhakar Srivastav, Mr. Mohit Bajaj, and Ankur Singh Rana aimed to develop a smart, autonomous, and efficient irrigation system that minimized manual intervention. Their system utilized sensors to monitor moisture and climate conditions, enhancing the automation of the irrigation process.[6]

Another 2018 study by Mr. Arijit Ghosh proposed a system to automate irrigation using an Arduino UNO, with a focus on regulating water usage based on crop-specific needs. This straightforward system aimed to improve crop yield compared to traditional farming practices.[7]

In 2019, Mr. Kalyan Kumar Jena and a team of five members designed a system focused on optimizing water usage in irrigation and tracking soil moisture. This system also monitored environmental parameters like temperature and humidity using an Arduino as the central controller.[8]

In 2020, Mrs. Ritika Srivastava and her team worked on an efficient decision support system for agriculture. Their wireless sensor network collected data on soil moisture, water levels, temperature, and humidity, providing valuable information for farm management.[9]

In 2021, Anmol Kawade's study emphasized the importance of sensors, such as soil moisture, temperature, and humidity sensors, in controlling water wastage and monitoring soil and fertilizer health, ultimately aiding farmers in increasing their crop yields.[10]

Mr. Arun Ukarande and his team's 2022 paper explored the integration of DHT11 sensors for temperature and humidity, along with soil moisture sensors, with Blynk server for monitoring small home gardens and lawns.[11]

In the same year, Mr. Stephen Sampath Kumar and Mercy Amrita proposed a system for estimating key water quality parameters in aquaculture ponds or farms, contributing to water quality monitoring in agriculture.[12]

Another 2022 study by Mr. Sayantan Goon and a team of five members focused on building a system for monitoring water usage in irrigation by tracking water levels in containers or tanks.[13]

Lastly, in 2022, Shalaka Pawar and Jyoti Devare, under the guidance of Professor M.P. Sardey, designed a system based on the Arduino UNO. This system incorporated various sensors and a GSM module for data communication, with output displayed on an LCD and data stored on the ThinkSpeak server.[14]

Overall, these reviewed research papers provided valuable insights into various aspects of smart farming and IoT-based agricultural solutions, laying the foundation for our innovative contributions in this dynamic field.

Proposed Methodology

We have extensively examined numerous research papers in the realm of smart agriculture and farming. After a thorough review, it has become evident that a significant portion of these studies has concentrated on the automation of irrigation processes through the integration of sensors such as those measuring soil moisture, temperature, and humidity. However, an unexplored avenue pertains to altering the direction of water flow. In our endeavor, we aim to introduce several innovative features aimed at simplifying farming practices, curtailing water wastage, and optimizing farmers' time. The subsequent section will elaborate comprehensively on the specifics of our work.

Components and Software requirements

Table 1: Components and Sensors used by us.

Sr. No.	Component	Sr. No.	Component
1	NodeMCU	6	RelayModule
2	Soil Sensor	7	Servo Motors
3	DHT11	8	Battery
4	IR Sensor	9	Breadboard
5	LED	10	Jumper Wire

Table 2: Software that we have used.

Sr. No.	Software	Usage
1	Arduino IDE	To write code
2	Blynk Cloud	To create web-dashboard
3	Blynk IoT	Mobile Application

Implementation

As previously mentioned, we have employed NodeMCU and integrated components such as DHT11, IR sensors, Soil Moisture Sensors, and two servo motors. The complete list of components is provided in above Table. The DHT11 sensor is

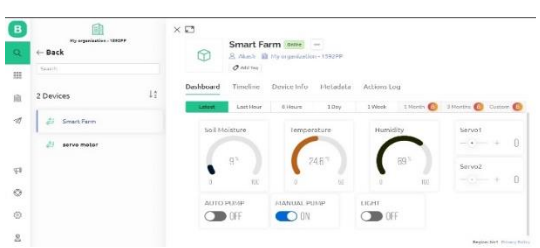

Figure 1: Web Dashboard of Our Implemented Work

utilized to monitor air temperature and humidity, with the data accessible via a mobile app and a web dashboard.

Additionally, a soil moisture sensor has been incorporated, with its probes inserted into the soil to measure moisture levels. The backend programming activates the water pumping system automatically when moisture falls below a predefined threshold, ensuring proper irrigation. This functionality is known as the automatic irrigation mode. Furthermore, we have implemented a manual irrigation mode, allowing manual control of the water pump based on specific

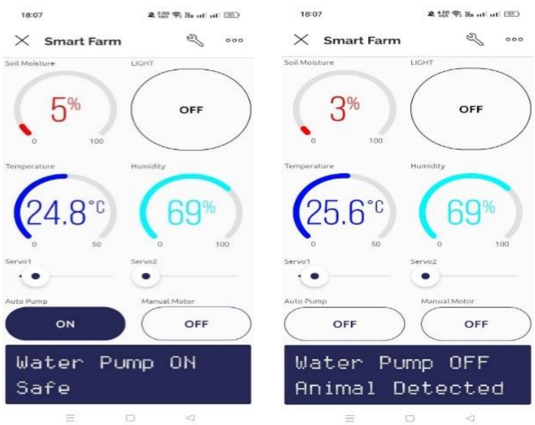

Figure 2: Our Designed App Interface

crop requirements.

To enhance security and object detection, an IR sensor has been integrated. This sensor triggers alerts whenever an object obstructs its path. For altering the direction of water flow, servo motors are employed. These servo motors enable the adjustment of water lanes, as depicted in the prototype images provided.

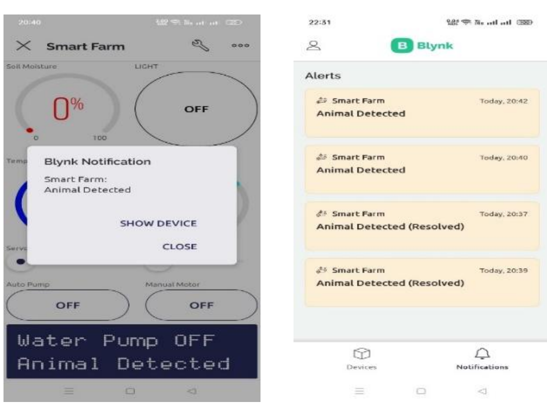

Figure 3: Our Project Output for Animal Detection

Centralized control of the entire system is achievable through a mobile device or laptop. To control the system via a mobile device, users need to install the "Blynk IoT" Android application connected to the Blynk cloud server. The application's interface has been thoughtfully designed to meet our system's requirements, emphasizing innovation, user-friendliness, and visual appeal.

Figure 4: Our Designed Project Prototype (Front View)

Above figure illustrates the front view of our smart farm prototype, highlighting the arrangement of components in their designated positions.

Figure 5: Our Designed Project Prototype (Top View)

In the above figure, the top view of the smart farm model is presented. Notably, the farm is enclosed on all sides except the entrance, which is equipped with an IR sensor. This sensor triggers notifications on our mobile application and activates a light when movement is detected at the entry point.

Result

Our findings illustrate that the utilization of the Blynk server for smart farming represents an efficient, intelligent, and sustainable approach to agriculture. The implemented system yielded significant improvements in crop yields while simultaneously reducing resource consumption. Users gained the ability to remotely monitor and control various farm aspects, resulting in time and labor savings. Moreover, the system effectively mitigated the environmental impact of agriculture by optimizing resource deployment and minimizing wastage. The "Smart Farming System using Blynk Server," which we conceptualized and developed, has been successfully deployed. After deployment, we conducted an in-depth analysis of the outcomes by monitoring the generated outputs. Remarkably, the system exhibited flawless functionality even when operating with low or DC power supplies. Our system's readings, when compared with live data from global-level weather stations, demonstrated a precision rate of approximately 99% or higher. This data holds great potential to benefit farmers in increasing their crop yields. An additional advantage lies in safeguarding crops against wandering animals, as the IR sensor promptly sends notifications to farmers' mobile devices upon detecting motion.

Importantly, no previous system has been designed with the ability to alter the direction or course of water flow during crop irrigation. This innovative feature not only saves farmers' time but also introduces a novel sense of engagement in farming, appealing even to younger generations. The widespread integration of such embedded agricultural systems on a global scale could potentially spark the interest of youth in agricultural pursuits. With arable land dwindling at an alarming rate, largely due to insufficient crop returns, the incorporation of weather monitoring through our system could significantly enhance crop yields, leading to increased profits for farmers.

Furthermore, the variety of modes we offer, such as automatic and manual irrigation, presents flexible options. During rice cultivation, the automatic mode can maintain a consistent moisture level for the crop, while the manual irrigation mode can be advantageous for cultivating other types of crops.

Discussion

Benefits and Innovations in Our System:

• The entire system operates on NodeMCU, demanding minimal power supply ranging from 3.3 to 5 Volts.

• Our system doesn't necessitate an external Wi-Fi module for connection to the Blynk server or cloud control. The built-in ESP8266 Wi-Fi module within the NodeMCU handles connectivity.

• We offer two irrigation modes: automatic and manual ON/OFF control for the water pumping system via our controller application.

• The automatic irrigation mode proves particularly advantageous for rice farming, ensuring consistent moisture levels throughout the season and thereby enhancing crop yields.

• The notification feature enhances farm security by promptly alerting us whenever the IR sensor detects movement, enabling timely intervention.

• The servo motors, employed to alter the water distribution, exemplify efficiency. Through mobile app control, the farmer can adjust the servo motor arms without the need for physical tools, contributing to a smarter farming approach.

• Environmental conditions can be consistently monitored.

• Our system can also be operated through a web dashboard using a laptop or computer, providing flexible control options.

• Mobile app operation is possible via a connected smartphone with internet access.

Limitations of Our "Smart Farming System":

• Internet connectivity is crucial for system functionality.

• Remote control is limited to a range of approximately 125 to 150 meters, contingent on the internet modem's capabilities.

• Potential water leakage through the servo motor arms should be considered.

• Ensuring levelled soil across the field is essential to facilitate uniform irrigation, as uneven surfaces could lead to uneven water distribution.

Conclusion

In conclusion, our devised system holds promise as an invaluable tool for augmenting agricultural endeavors, leading to amplified crop yields and subsequently bolstered profitability for farmers. The amalgamation of the soil moisture sensor, IR sensor, and DHT11 for temperature and humidity tracking consistently furnishes data of over 99% accuracy. This technological advancement stands poised to imbue farming practices with an unprecedented degree of intelligence. At the crux of this transformation lies the pivotal role of the Blynk server, serving as the linchpin for orchestrating smart farming operations. Through harnessing the potential of Blynk server, our research underscores the potency of smart farming as a sustainable and effective paradigm within agriculture. The evidence amassed underscores the marked enhancement in crop yields, curtailed resource consumption, and ameliorated environmental repercussions. As our study concludes, a prospective avenue for further exploration entails navigating the intricacies and potentials of Blynk server-driven smart farming in diverse geographic and climatic settings.

Future Scope

In terms of future prospects, it is pertinent to reiterate that our developed system can be managed solely via mobile phones or laptops, given the confines of NodeMCU's wireless connectivity range. To transcend the need for uninterrupted internet access, integrating a GSM module emerges as a viable avenue, enabling users to exercise control over the system through the mobile network. Furthermore, expansion could encompass incorporating a LoRa module, facilitating remote farm management and monitoring over extended distances. The augmentation of our system could involve the incorporation of supplementary sensors, including rain sensors, pH sensors, and solar panels, enhancing the system's comprehensiveness and utility.

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