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IoT Based Smart Agriculture Monitoring and Irrigation System

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Smart Agriculture, Monitoring System, Warning Notification

Abstract

The demand for effective agricultural methods has been heightened due to the rapid increase in population and the impact of climate change. This study focuses on the task of maximising water efficiency and monitoring crop conditions in agricultural fields. The primary objectives of this research are to develop a system that integrates sensors, microcontrollers, and cloud applications to monitor and control critical environmental factors affecting plant growth. This study employs IoT sensors, data analytics, and machine learning algorithms to conduct extensive field experiments to gather and analyse data on soil moisture, temperature, humidity, and plant physiological parameters. Conventional procedures for sensor calibration, data collection, and analysis are utilised to guarantee precision and dependability. The key findings demonstrate connections among various environmental conditions, soil moisture levels, and indicators of crop health. The data trends show how different irrigation schedules affect both crop yield and water consumption. The importance of real-time monitoring in agriculture can improve crop yield. Suggested actions involve conducting additional research on adaptive irrigation algorithms and incorporating predictive models to enhance resource efficiency in agriculture.

1. Introduction

Here, Agriculture has been practised since ancient times in all countries, and the cultivation of crops is the basis of this science. Agriculture was the innovation that brought about the sedentary human civilization. The convergence of technology and agriculture has brought unprecedented developments in recent years. The traditional method of growing plants, checking and watering them regularly, is one of the oldest. With the advent of innovative farming systems and crop monitoring using IoT technology, farmers can now grow their crops themselves [1].

The application of IoT in the manufacturing, processing, and marketing of food and agricultural products is widespread [2]. As the world moves toward new technologies, it is essential to consider advances in agriculture. IoT technology is integral to intelligent agriculture, providing information about the agricultural sector. Developing IoT-based applications can achieve great results using this latest technology. Thanks to the growth and modernization of current technology, farmers can now monitor and control their crops from anywhere [3].

The system aims to make agriculture intelligent by combining smart sensors and IoT technology with cloud computing services to observe field data and collect data accurately over the network [4]. Intelligent farming systems are used to maintain optimal temperature and humidity conditions, ensure constant light efficiency, and collect data [5]. The project developed and implemented an smart farming system to minimize human labour while significantly improving product quality. The system aims to monitor temperature and humidity, soil moisture, and water levels using the Blynk mobile app. This system includes cloud computing, storing and collecting data via ThingSpeak. different irrigation schedules affect both crop yield and water consumption. The importance of real-time monitoring in agriculture can improve crop yield. Suggested actions involve conducting additional research on adaptive irrigation algorithms and incorporating predictive models to enhance resource efficiency in agriculture.

2. Materials and Methods

This component has three steps that contribute to the achievement of the project by identifying the specific functions of both software and hardware.

2.1 Block Diagram

A block diagram is shown to facilitate a fundamental comprehension of the system's software and hardware implementation. The block and arrow symbolise the link between input, process, and output. Fig. 1 depicts the block diagram of the smart agriculture system, which includes an alarm system. The project employs a DHT11 sensor for measuring temperature and humidity, along with a soil moisture sensor and a water level sensor. The microcontroller used is the NodeMCU ESP32, which utilises Blynk for monitoring and sending alarm notifications, as well as ThingSpeak for collecting sensor data.

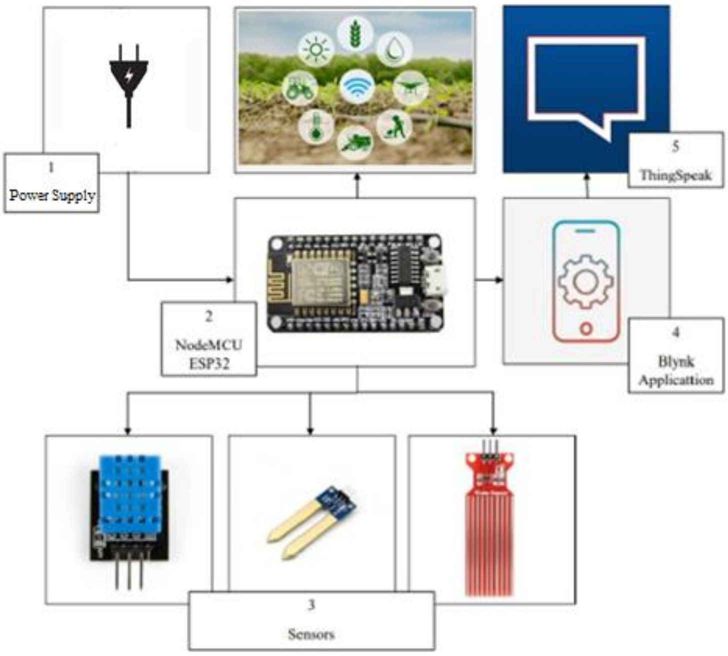

Fig. 1 *Block diagram of Smart Agriculture Monitoring and Irrigation System.*

2.2 Methods

Fig. 2 depicts the process flowchart for the automatic mode of the system. The entire process exhibits a precise sequence in accordance with the specified arrangement. The purpose of this flowchart is to offer an automated synopsis of the consecutive procedures entailed in this project.

2.3 Circuit Diagram

The graphic consolidates the connections of all the sensors. Fig. 3 depicts the schematic diagram of this project.

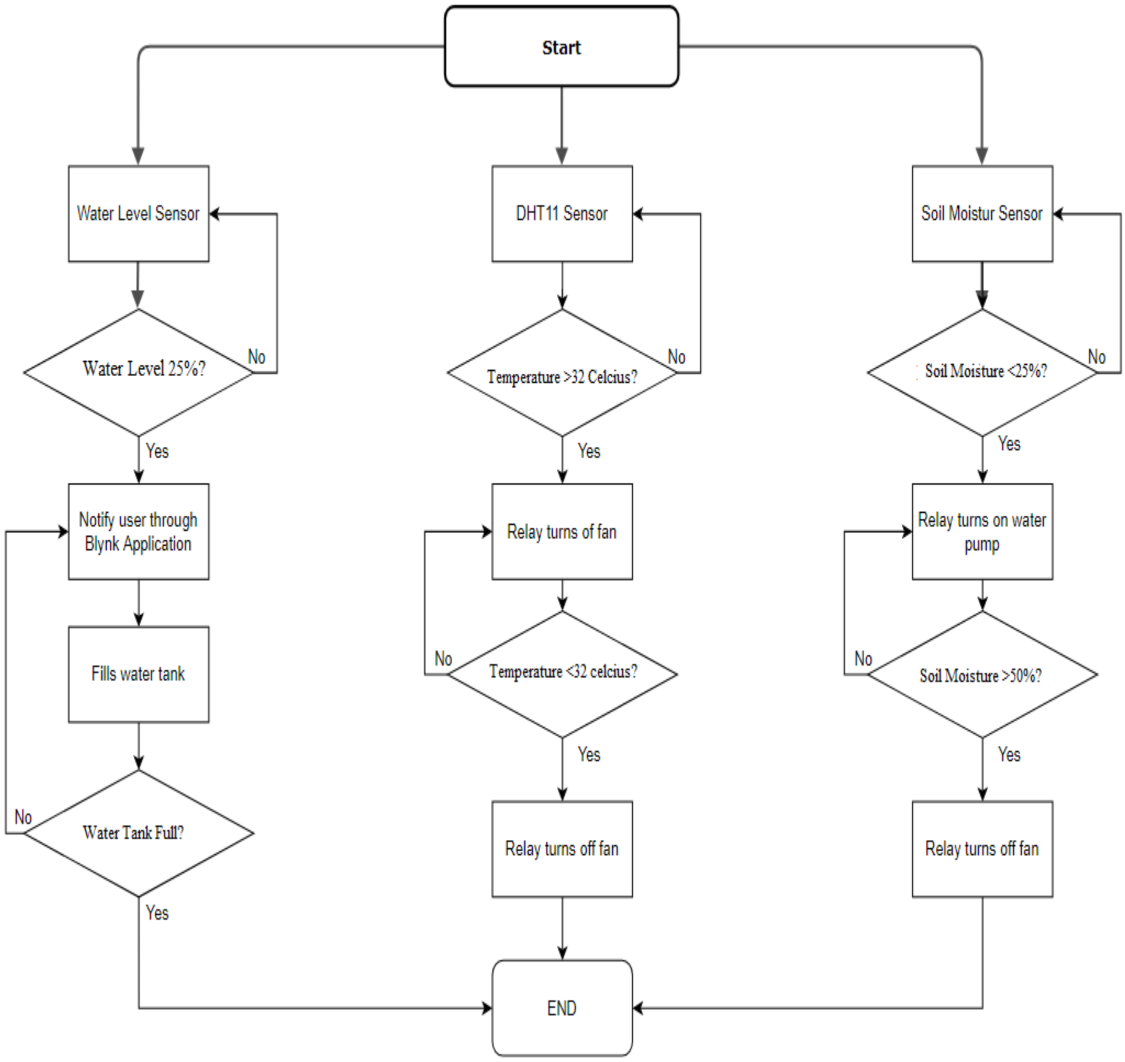

Fig. 2 *Flowchart of Smart Agriculture Monitoring and Irrigation System*

3. Result and Discussion

3.1 Prototype Setup

The output of this project is to enhance agricultural practices by closely monitoring critical environmental factors that are vital for crop growth. The DHT11 sensor will be utilized to gauge temperature and humidity levels, offering an understanding of the surrounding circumstances crucial for plant well-being. Furthermore, a soil moisture sensor will be employed to measure the moisture level in the soil, facilitating effective irrigation management to guarantee sufficient hydration for crops. Additionally, including a water level sensor will enable monitoring of water levels in irrigation systems or reservoirs, thereby facilitating accurate regulation of water distribution to the fields. If the data collected from these sensors exceeds pre-established threshold values, which indicate significant deviations in temperature, humidity, soil moisture, or water levels, instant alerts will be sent through a mobile application such as Blynk. Implementing this real-time alert system will empower farmers to promptly modify irrigation schedules or implement necessary interventions to achieve optimal crop growth.

3.2 Monitoring system on Blynk application

The Blynk Application presents essential measurements from the monitoring system, including temperature, humidity, water level, and soil moisture, through dedicated sensors. The application provides two modes: Auto and Manual. In Auto mode, the DC fan and water pump are automatically controlled, while in Manual mode, the user can manually activate the fan, pump, and growth light. A timer controls the growth light, usually programmed for nighttime use. A supplementary function enables the continuous monitoring of soil moisture in real time.

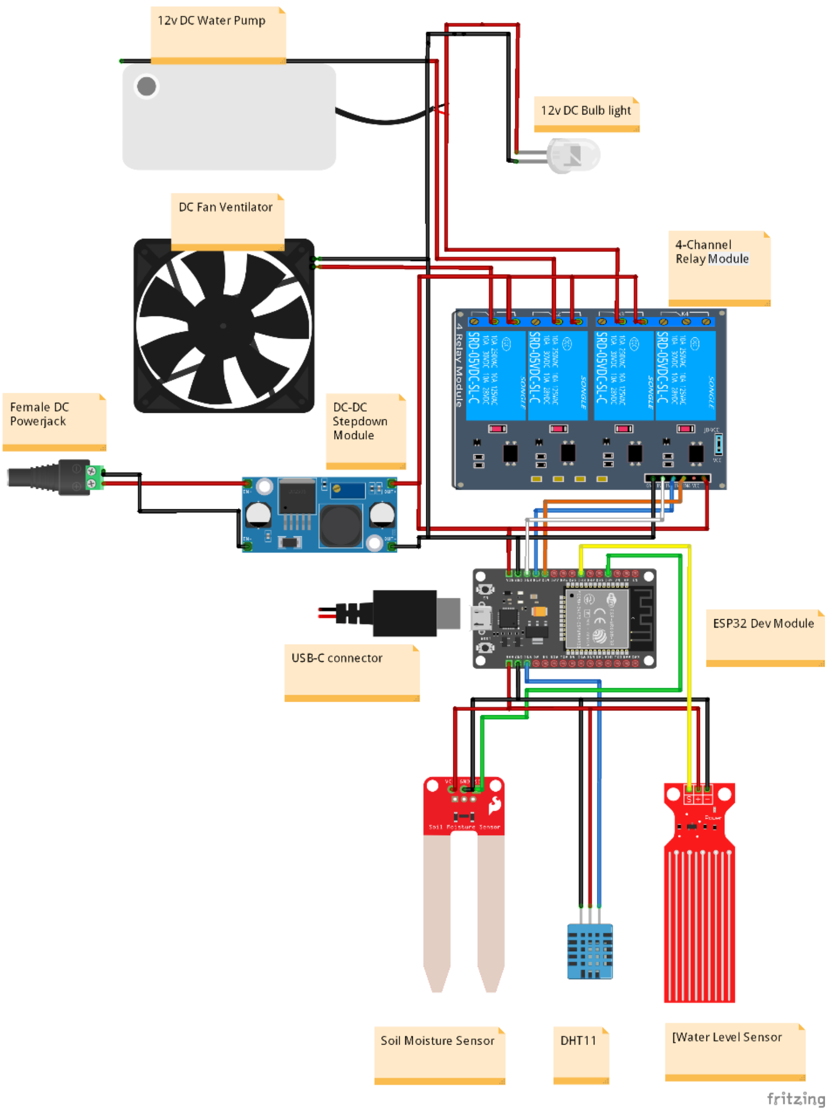

Fig. 3 *Circuit diagram of Smart Agriculture monitoring and Irrigation System.*

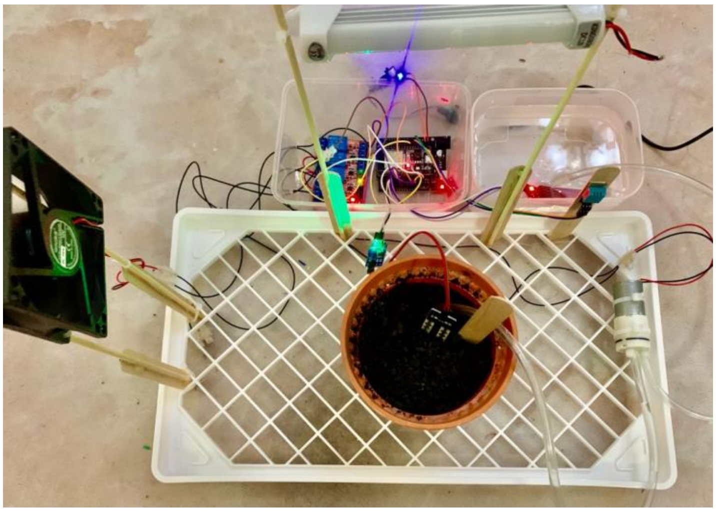

Fig. 4 *Prototype of the system*

Fig. 5 *Monitoring system on the Blynk App*

The Blynk notification is depicted, which serves to inform the user of a low water level in the tank, prompting them to refill it. It will trigger the notification when the water level drops below 30%. The system will persistently alert the user at one-minute intervals until the water tank is replenished by the user.

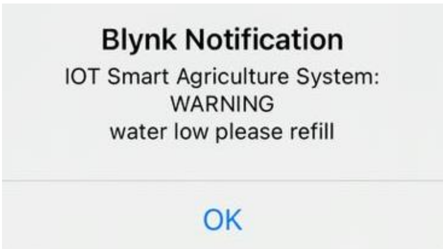

Fig. 6 *Blynk Notification*

3.3 Monitoring system on ThingSpeak

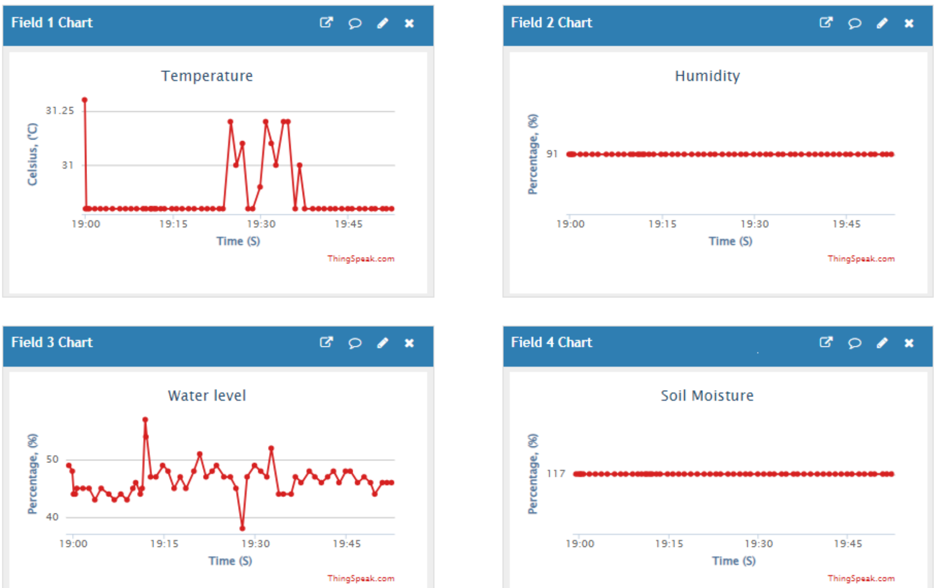

Fig. 7 *The Result of Water Level, DHT11, and Moisture sensor from ThingSpeak*

The ThingSpeak presents live data collected from the DHT11 sensor on December 11th, from 7:00 PM to 8:00 PM. The data includes temperature readings ranging from 31.2°C to 30.8°C and a consistent humidity level of 91%. The water level measurements in Field 3 vary between 54% and 38%, whereas the soil moisture in Field 4 remains constant at 100%. The readings demonstrate the sensors' sensitivity to environmental conditions, efficiently transmitting data to the ThingSpeak cloud via the system.

4. Conclusion

In conclusion, the IoT-based smart agriculture monitoring and irrigation system offers a practical and effective solution for farmers to supervise and improve the cultivation of their crops. The system enables the collection and analysis of data related to various environmental variables, such as temperature, humidity, soil moisture, and water level. As a result, farmers possess valuable knowledge about the health and growth of their crops. Through the utilization of sensors, the system can detect potential problems such as pests, diseases, and nutrient deficiencies. This allows farmers to address and prevent or mitigate these issues quickly. The system also enables the automation of various tasks for farmers, such as irrigation, leading to time and resource efficiency, as well as improved crop productivity. Upon contemplating the future, it becomes apparent that there is substantial potential for additional progress in the realm of intelligent agricultural technology. Integrating artificial intelligence and machine learning algorithms is a promising approach to improving the accuracy of data analysis and predicting crop growth and yield. Moreover, the incorporation of drone technology for aerial surveillance of agricultural fields has the potential to provide more extensive observations regarding the health and growth of crops.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the completing of the paper.

Author Contribution

The author attests to having sole responsibility for the following: planning and designing the study, data collection, analysis and interpretation of the outcomes, and paper writing.

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