MINI PROJECT REPORT

on

Smart Irrigation System

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CB 352 Mini Project

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By

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BONAFIDE CERTIFICATE

This is to Certify that this Mini Project work entitled **"Smart Irrigation System"** is the bonafide work of **Rayidi Meghana(Y21CB046), Vajja SivaSai (Y21CB060)** of **III/IV B.Tech** who carried the work under my supervision, and submitted in the partial fulfillment of the requirements to **CB352 - MINI PROJECT LAB REPORT** during the year 2023-2024.

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From the idea to the act, from the conception to reality, from the emotion to the response, from the desire to the spasm, we are led by those about whom to write all words seem meek.

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ABSTRACT

Smart Irrigation using Internet of Things (IoT) technology have emerged as a promising solution to optimize water usage in agriculture. The system integrates sensors to gather data on soil moisture levels, weather conditions, and plant requirements. Through a centralized IoT platform, this data is processed in real- time to make informed decisions about irrigation scheduling. The goal is to create an intelligent and automated irrigation system that not only conserves water at the right time. The proposed solution aims to contribute to sustainable agriculture practices by leveraging IoT for efficient water management in irrigation.

Keywords:

Smart Irrigation, Internet of Things (IoT), Water Conservation, Soil moisture sensors, Humidity and Temperature sensor, Automated Irrigation.

.

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1. Introduction

Internet of Things (IoT) stands as a transformative force, seamlessly interweaving the physical and digital realms to redefine how we interact with the world. At its core, IoT is a network of interconnected devices, sensors, and systems, each equipped with the ability to collect, exchange, and act upon data. This vast ecosystem encompasses everything from everyday objects like household appliances and wearables to complex industrial machinery and smart cities. With the power to gather real-time information and communicate autonomously, IoT not only enhances efficiency in various sectors but also opens the door to unprecedented innovations. As we navigate the era of connectivity, IoT emerges as a catalyst for innovation, offering boundless possibilities to create smarter, more responsive, and interconnected environments that have the potential to revolutionize the way we live, work, and interact with our surroundings.

smart irrigation systems represents a significant leap towards sustainable and efficient agriculture. Gone are the days of indiscriminate watering schedules and wasteful water consumption. Enter the realm of intelligent and connected irrigation, where soil moisture sensors, weather data integration, and automated controllers converge to form a sophisticated network aimed at optimizing water usage. This revolutionary approach not only ensures the vitality of crops but also addresses the growing concerns of water scarcity. With real-time monitoring, remote access, and the integration of environmental factors, the smart irrigation system emerges as a beacon of precision agriculture, promising not only increased yields but also a conscientious and eco-friendly approach to farming practices.

1.1. Purpose:

Smart irrigation serves the purpose of revolutionizing traditional farming practices by integrating technology to enhance efficiency and sustainability.Through real-time monitoring of soil moisture levels, weather conditions, and crop requirements using sensors and IoT connectivity, smart irrigation systems enable precise and optimized water delivery.

1.2. Scope:

The scope of smart irrigation is broad, aiming to revolutionize traditional farming by integrating technology. It involves precise water management tailored to specific crops and soil conditions, with real-time data from sensors and IoT technologies.

1.3. Definitions,Acronyms & Abbreviations

DHT:

DHT (Digital Humidity and Temperature) sensor, commonly used to measure ambient humidity and temperature in smart irrigation systems.

NodeMCU:

A low-cost open-source IoT platform based on the ESP8266 Wi-Fi module, frequently employed as a microcontroller in smart irrigation systems.

IoT :

IoT (Internet of Things) A network of interconnected devices embedded with sensors, software, and other technologies, enabling them to exchange data and communicate in the context of a smart irrigation system.

2. Literature Survey

In the context of a literature survey for a smart irrigation system,the objective is to explore and address issues related to smart irrigation by observing, recording, and analyzing farm and related information. The problem at hand could range from optimizing the entire smart irrigation system to comparing the profitability of different irrigation levels.

While the processes of data collection and analysis may seem straightforward, conducting a literature survey for smart irrigation is inherently challenging and time-consuming. Key areas of difficulty include understanding sampling theory, its practical implementation, extracting accurate data, and effectively analyzing and interpreting the gathered information. Depending on the specific focus, some surveys concentrate on collecting quantitative facts and figures, while others emphasize opinions and ideas in a qualitative manner. Many surveys integrate both approaches to provide a comprehensive understanding of the topic.

In the case of a literature survey for a smart irrigation system, the focus is likely to be on quantitative aspects, exploring technological advancements, performance metrics, and empirical findings. Defining the problem to be addressed is the initial step, followed by identifying the target population of studies or farmers relevant to smart irrigation. Subsequently, the selection of literature sources that contribute to understanding and solving the identified problem is crucial. The collection of information involves reviewing academic papers, articles, and reports that provide insights into various aspects of smart irrigation systems. This may include the evaluation of sensor technologies, communication protocols, microcontroller platforms, energy efficiency strategies, and real-world implementations.

3. Existing vs Proposed

Existing Smart Irrigation System :

The existing smart irrigation system is designed around the Blynk platform, incorporating a variety of sensors and actuators to create an intelligent and automated irrigation setup. The system utilizes a soil moisture sensor, DHT11 temperature and humidity sensor, and a relay connected to a water pump. The Blynk app serves as the user interface, allowing real-time monitoring and control of the system. The soil moisture data, along with temperature and humidity readings, are sent to the Blynk app, providing users with insights into the environmental conditions of the agricultural field. Additionally, the system incorporates a threshold-based mechanism; when the soil moisture falls below a predefined threshold, the relay activates the water pump to initiate irrigation. Users have the option to manually control the irrigation system through the app, providing flexibility and customization.

Proposed Smart Irrigation System :

In the proposed smart irrigation system, the core architecture remains similar, leveraging the Blynk platform for real-time data visualization and user interaction. However, the system is enhanced with a few modifications for improved functionality. Firstly, a Blynk template with the ID "TMPL3ZqG77R8d" and the name "Smart Irrigation System" is introduced for better project organization and template-based deployment. The system still features a soil moisture sensor, DHT11 sensor, and a relay-connected water pump. Notably, the threshold for soil moisture triggering irrigation is set at 550 in the proposed system. Additionally, a Blynk widget is added to control the irrigation relay directly from the app. Users can manually toggle the relay to activate or deactivate the water pump, providing immediate control over the irrigation process. These enhancements aim to offer a more user-friendly and customizable smart irrigation experience through the Blynk platform.

4. Methodology

4.1. Circuit Diagram

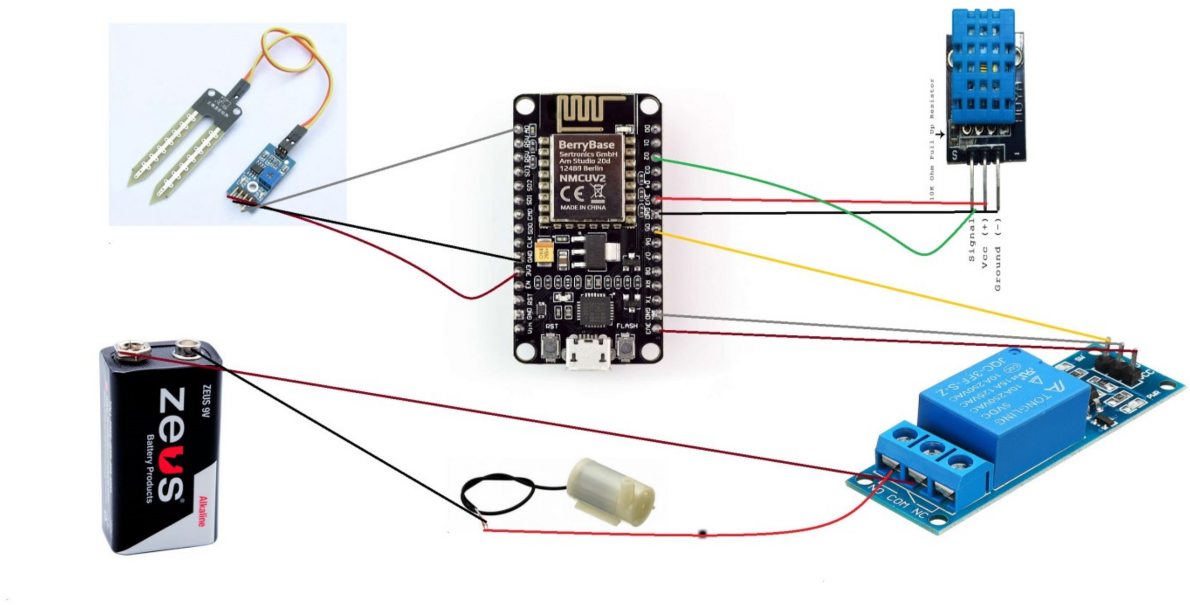

Fig 4.1. Circuit Diagram

Components Needed:

NodeMCU (ESP8266)

DHT11 Sensor (for temperature and humidity)

Soil Moisture Sensor

Relay Module (to control the water pump)

Water Pump

Blynk App

Power Supply

Jumper wires

Process:

Firstly, you need to set up the NodeMCU by connecting it to your computer, installing necessary drivers, and configuring the Arduino IDE for NodeMCU, including the installation of the ESP8266 board.

The next step is to connect the various sensors. Attach the DHT11 sensor to the NodeMCU for monitoring temperature and humidity, and connect the soil moisture sensor to measure soil moisture levels. Additionally, connect the relay module to the NodeMCU, which will control the water pump based on the soil moisture readings.

Following the hardware setup, install the Blynk library in the Arduino IDE to facilitate communication between the NodeMCU and the Blynk app. In the Blynk app, create a new project, adding widgets for temperature, humidity, and soil moisture display. Include a button widget to manually trigger the watering mechanism, and take note of the authentication token generated by the Blynk app.

Now, proceed to write the Arduino code. This involves programming the NodeMCU to read data from the DHT11 and soil moisture sensors, implement logic for controlling the relay based on soil moisture levels, and integrate the Blynk library using the authentication token to establish a connection to the Blynk app. Upload this code to the NodeMCU.

Testing the system is crucial. Power up the system and verify that the NodeMCU is successfully connected to the Blynk app. Use the Blynk app to monitor real-time sensor values and manually trigger the watering mechanism to ensure its proper functionality.

Refinement and optimization come next. Fine-tune the system parameters based on testing results, optimizing watering schedules and adjusting relay control logic as needed for better efficiency.

Finally, deploy the system in your garden or desired location. Continuously monitor its performance over time, making necessary adjustments to adapt to changing environmental conditions. This comprehensive methodology ensures the successful implementation and operation of a smart irriagtionsystem using NodeMCU, DHT11, soil moisture sensor, a relay to control the water pump, and real-time monitoring with the Blynk app.

4.2. Block Diagram:

A smart irrigation system, illustrated in a comprehensive block diagram, seamlessly integrates soil sensors, DHT sensors, relays, water pumps, and the Internet of Things (IoT) through the Blynk platform. The system begins with soil sensors strategically positioned in the agricultural field, continuously gauging soil moisture levels, while DHT sensors measure temperature and humidity. Both sets of data are transmitted to a microcontroller, acting as the central hub of the system.

The microcontroller, connected to the Blynk IoT platform, processes the incoming sensor data and communicates with the Blynk cloud server. Through the Blynk mobile app, users gain remote access to the system, enabling real-time monitoring and control. The Blynk platform not only facilitates user interaction but also allows for the customization of irrigation parameters and scheduling base5d on the received sensor data.

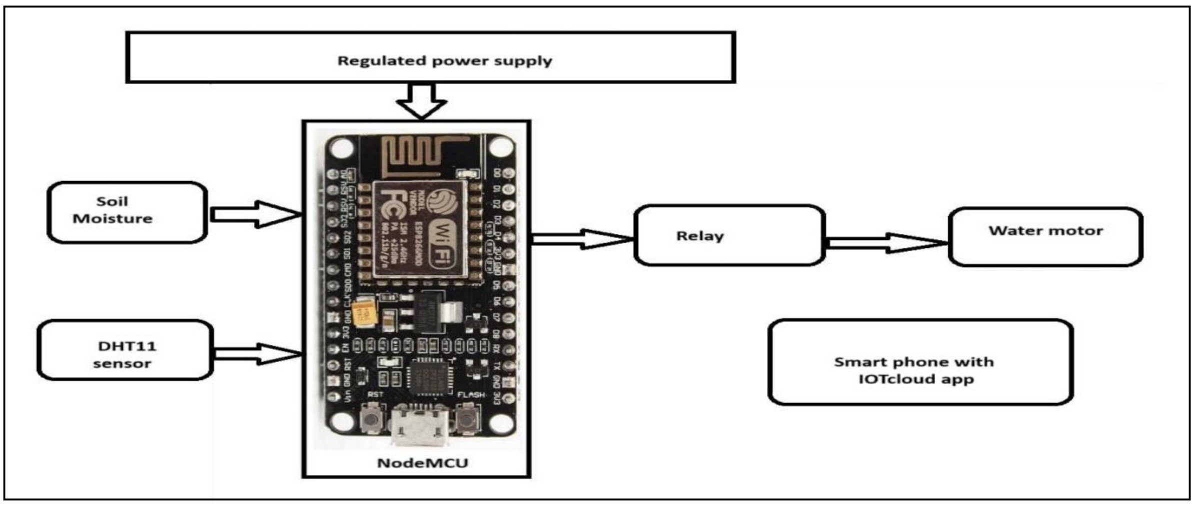

Fig 4.2. Block Diagram

The relay, serving as the intermediary between the digital and physical components, is triggered by the microcontroller. This activation controls the water pump, which draws water from a source and distributes it through pipes or a drip irrigation system across the field. The Blynk platform ensures that users receive alerts and notifications, providing insights into soil moisture levels, environmental conditions, and irrigation activities.

This smart irrigation system, depicted in the block diagram, exemplifies a sophisticated integration of sensors, relays, water pumps, and IoT technology through the Blynk platform. It not only automates the irrigation process based on real-time data but also empowers users with remote accessibility and control, fostering a sustainable and efficient approach to modern agriculture.

4.3. Flow Chart:

The flow chart for the smart irrigation system with soil sensor, DHT sensor, relay, and a condition to activate the water pump based on moisture levels depicts a systematic process to optimize irrigation in agricultural settings. The process begins with the reading of soil moisture levels through a dedicated sensor, simultaneously capturing temperature and humidity data from a DHT sensor. These parameters are crucial in assessing the need for irrigation. The system checks if the soil moisture is below the desired threshold and if environmental conditions warrant additional water.

If the moisture levels are insufficient, and conditions are favorable, the system proceeds to check the time or predefined schedule for irrigation. If the timing aligns with the schedule, the relay is activated, serving as a switch between the digital and physical components. This activation triggers the water pump to start, drawing water from a source and distributing it across the field through a network of pipes or a drip irrigation system.

To ensure efficient water usage, the system incorporates a duration control mechanism. The water pump operates for an optimal period, and after this duration, the relay is turned off, stopping the water pump and concluding the irrigation process. If the soil moisture levels are adequate or the timing is not suitable, the system continues monitoring without initiating irrigation.

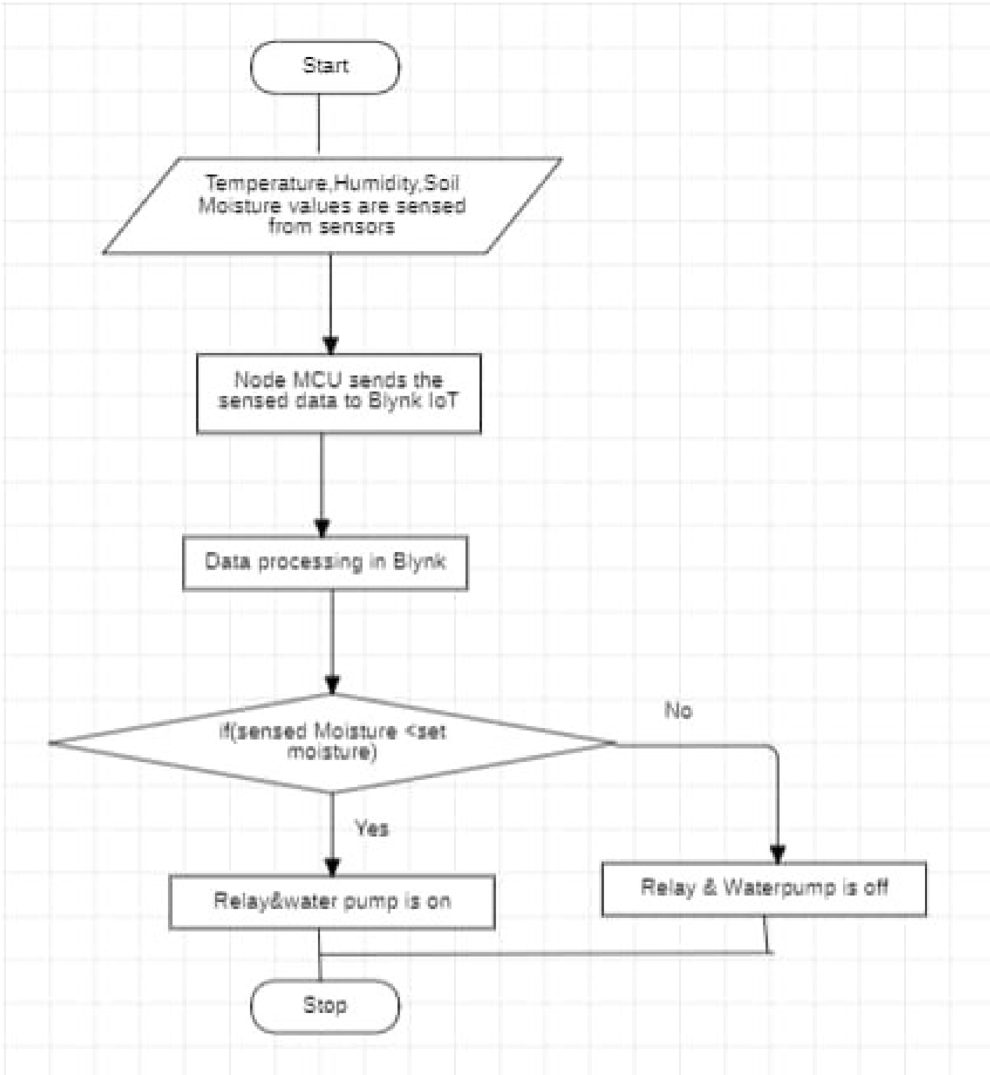

Fig 4.3. Flow Chart

In summary, this flow chart outlines a responsive and automated irrigation system that takes into account soil moisture, environmental conditions. By activating the water pump only when necessary, based on real-time data.

5. UML Diagrams

Class Diagram:

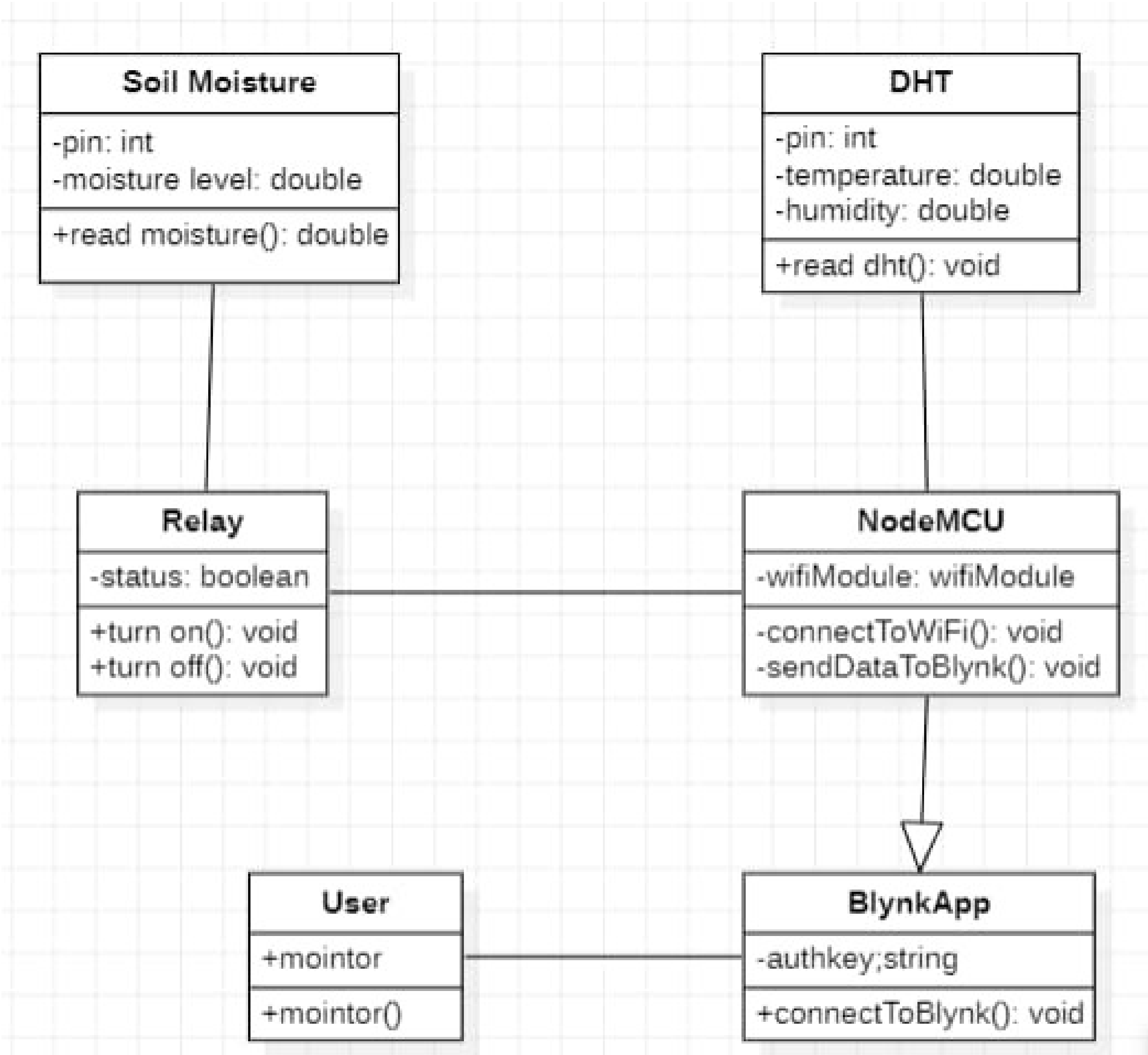

Fig 5.1. Class Diagram

Sequence Diagram:

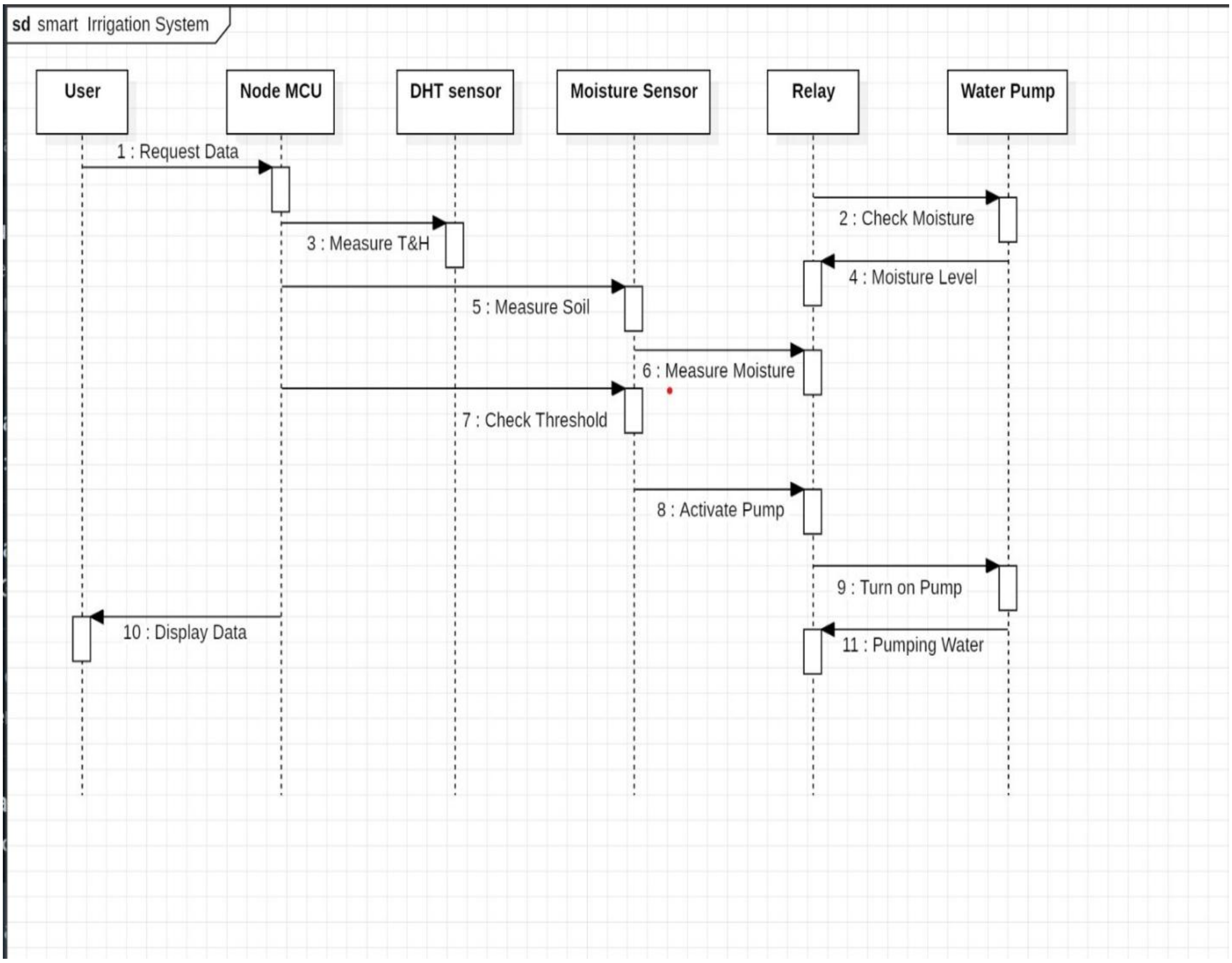

Fig 5.2. Sequence Diagram

Use Case Diagram:

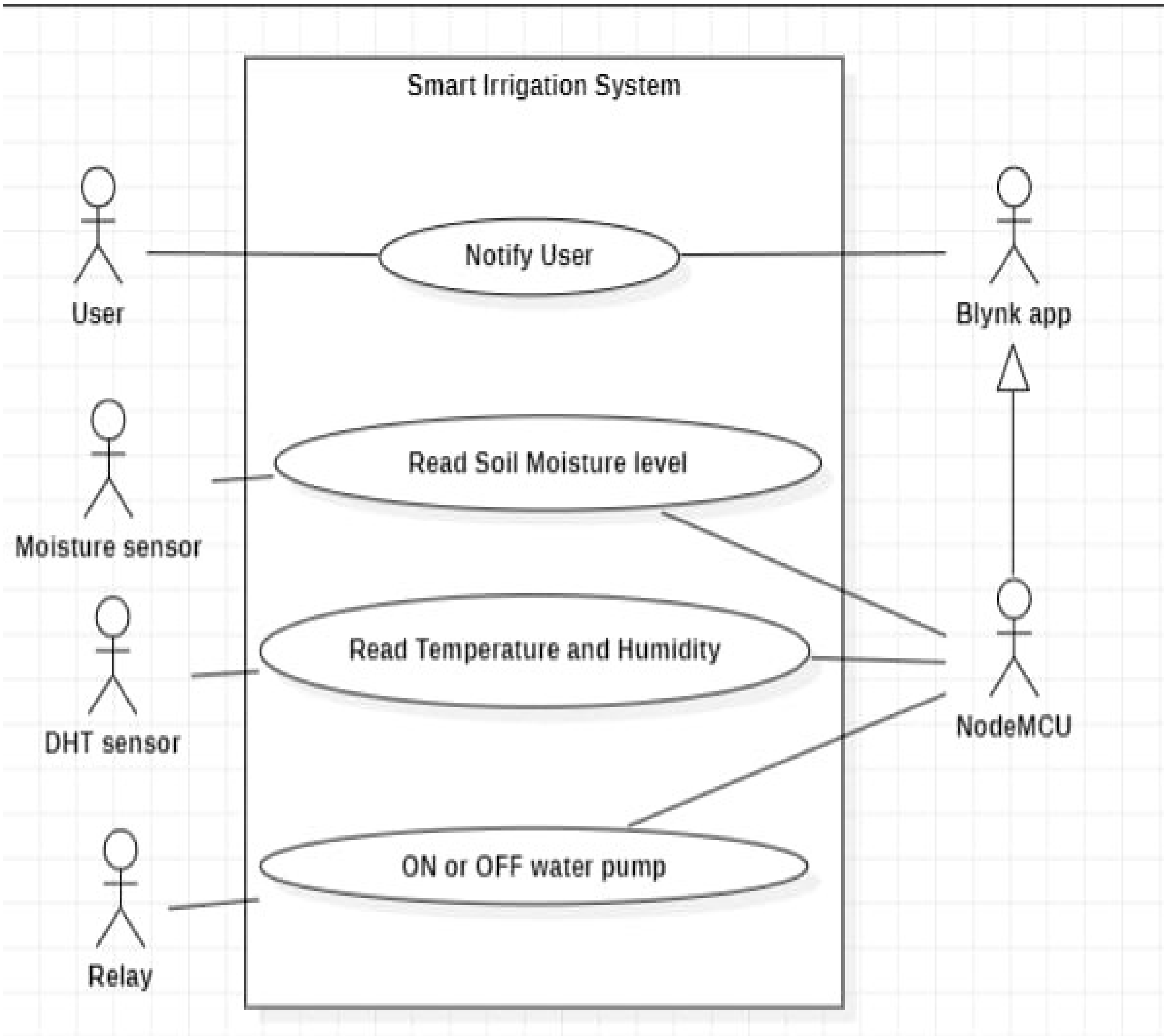

Fig 5.3. Use Case Diagram

6. Code Snippet

```
#define BLYNK_TEMPLATE_ID "TMPL3ZqG77R8d"
#define BLYNK_TEMPLATE_NAME "Smart irrigation system"
#define BLYNK_AUTH_TOKEN "9HZD6FxZxurZuQqw0tGWCKVEpguXZrOl"


#define BLYNK_PRINT Serial
#include<ESP8266WiFi.h>
#include<BlynkSimpleEsp8266.h>

#include <DHT.h>
#define DHTPIN D2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

#define soil_pin A0
#define motor D5
BlynkTimer timer;

char auth[]=BLYNK_AUTH_TOKEN;
char ssid[]="Esp8266";
char pass[]="88888888";

const int soil_moisture_threshold=550;

void sendSensor()
{
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
  int soil_feed = analogRead(soil_pin);
  Blynk.virtualWrite(V2, soil_feed);
  Blynk.virtualWrite(V1, h);
  Blynk.virtualWrite(V0, t);
```

```
  if (soil_feed < soil_moisture_threshold)
  {
    digitalWrite(motor, HIGH); // Turn on the relay
    Blynk.virtualWrite(V3, 1); // Update the app to show the relay is ON
  }
  else
  {
    digitalWrite(motor, LOW);  // Turn off the relay
    Blynk.virtualWrite(V3, 0); //Update the app to show the relay is off
  }
}
BLYNK_WRITE(V3){
  digitalWrite(motor, param.asInt());
}
void setup() {
  pinMode(motor, OUTPUT);
  Serial.begin(9600);
  Blynk.begin(auth,ssid,pass);
  dht.begin();
  timer.setInterval(1000L, sendSensor);
}
void loop() {
  Blynk.run();
  timer.run();
}
```

7. Results

7.1. Template :

Blynk's template simplifies IoT customization, letting users design tailored dashboards for seamless interaction with connected devices. With intuitive widgets and easy pin assignments, users can create personalized interfaces, enhancing monitoring and control for diverse IoT applications.

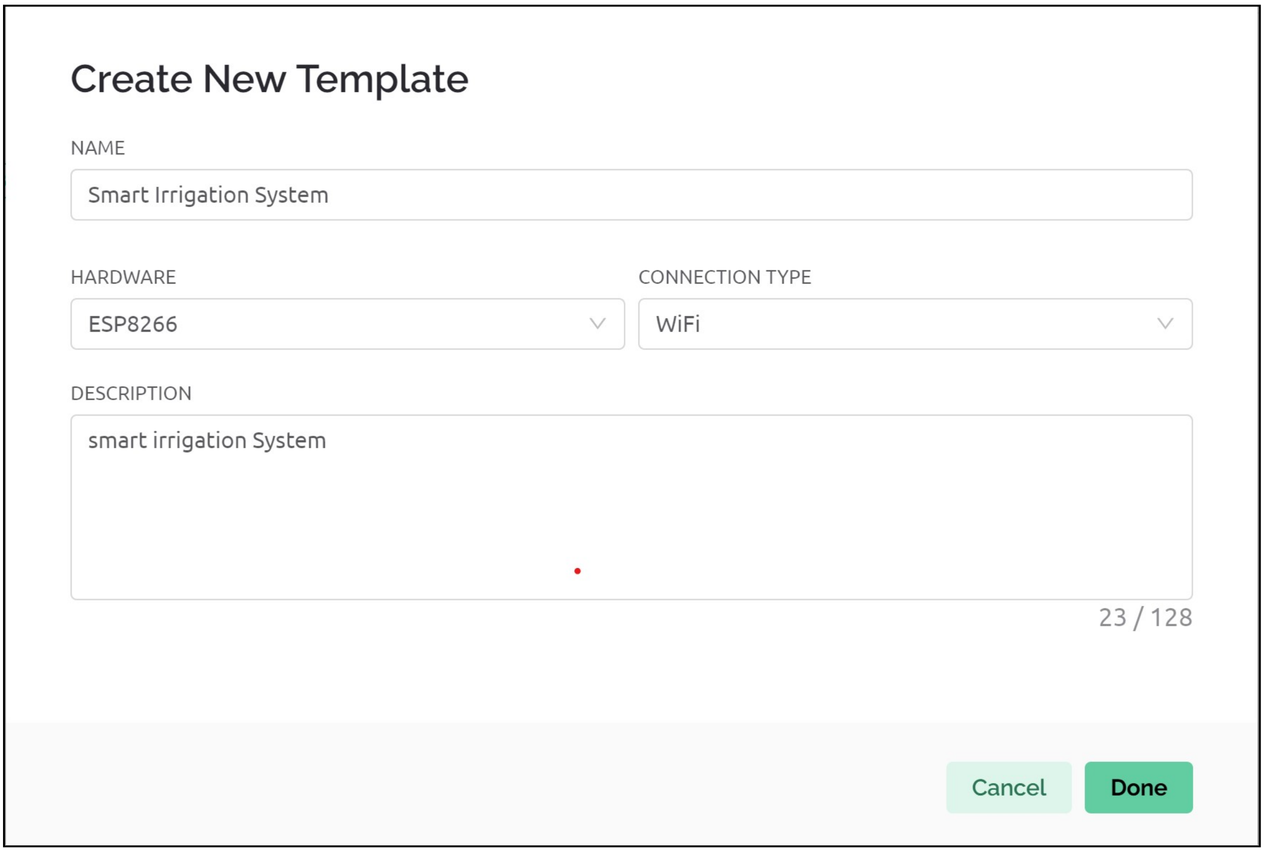

Fig 7.1. Template

7.2. Datastreams :

Blynk's datastreams streamline information flow, enabling seamless communication between devices and the Blynk app. Users can efficiently transmit and receive data, enhancing the versatility and responsiveness of their IoT projects.

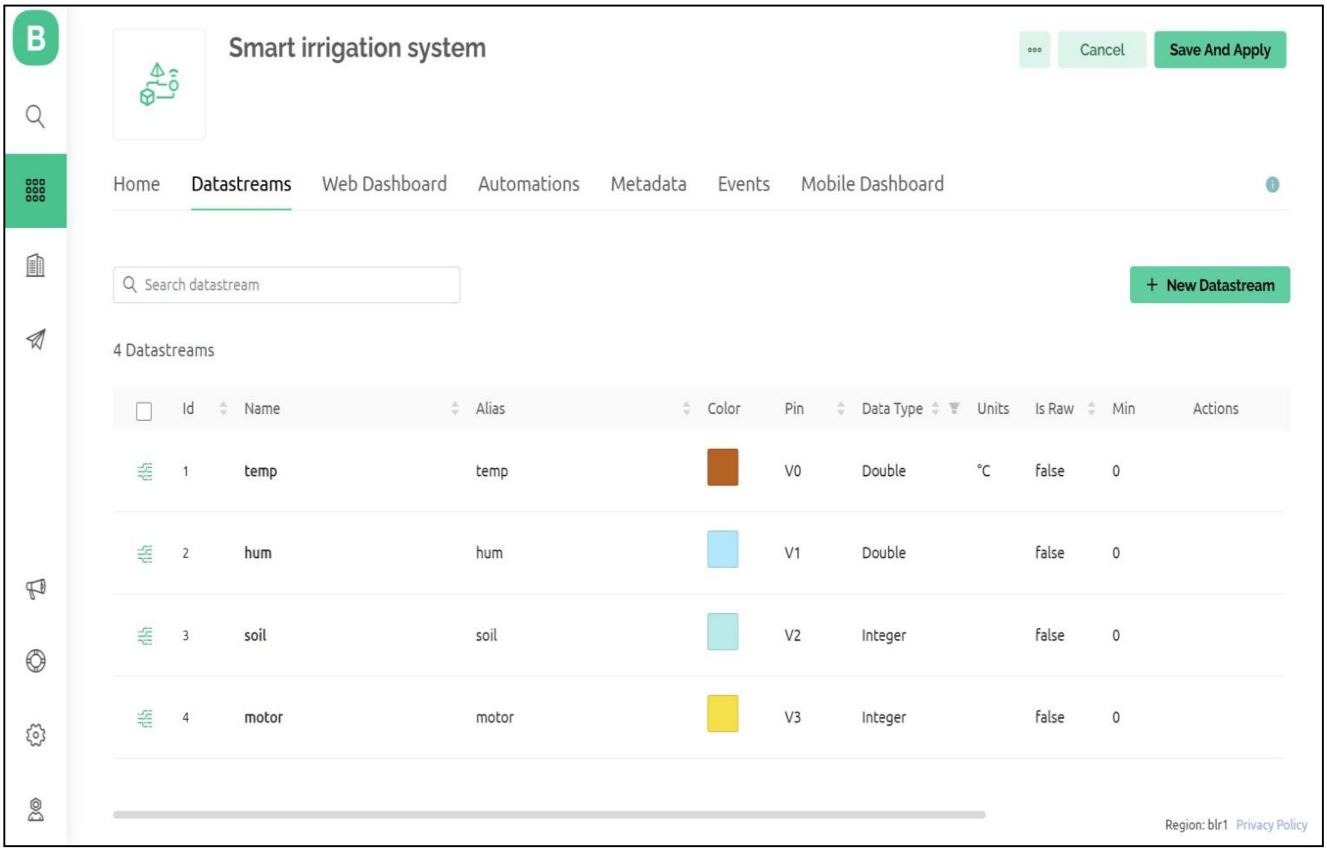

Fig 7.2. Datastreams

7.3. Web Dashboard:

A web dashboard refers to an online interface that displays and allows interaction with data and controls associated with a system or application. It is commonly used in the context of IoT (Internet of Things) and other web-based applications. Web dashboards provide a user-friendly and visual representation of real-time or historical data, offering insights and enabling users to monitor, analyze, and control various aspects of a connected system. These dashboards often include interactive elements such as charts, graphs, and control buttons, allowing users to manage devices, track performance, and make informed decisions through a web browser.

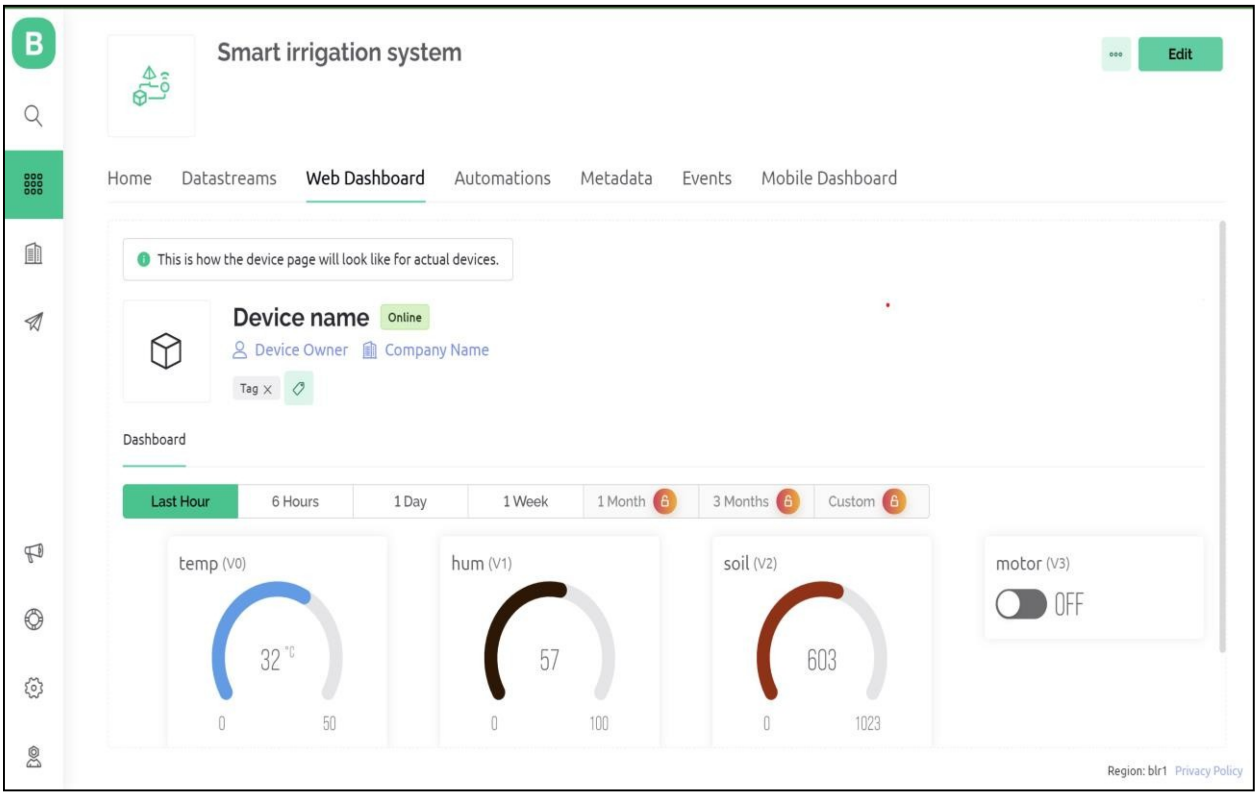

Fig 7.3. Web Dashboard

7.4. Mobile Dashboard:

The mobile dashboard provides real-time monitoring, control, and feedback for connected devices, offering a user-friendly experience that allows for on-the-go management of various IoT applications. Whether it's smart home automation, environmental monitoring, or industrial control, the Blynk Mobile Dashboard is a versatile tool for creating intuitive and visually appealing interfaces that enhance the functionality of IoT projects.

Fig 7.4. Mobile Dashboard

7.5. Real View of Project:

By constantly monitoring soil moisture levels, weather conditions, and plant requirements in real-time, smart irrigation systems ensure that crops receive the precise amount of water they need, preventing both under- and over-irrigation. This not only conserves water resources but also enhances crop yield and quality. The integration of automation and remote control features allows farmers to manage irrigation remotely, providing flexibility and convenience. Overall, the real view of a smart irrigation system reflects a significant advancement in agriculture, promoting resource efficiency, environmental sustainability, and increased productivity

Fig 7.5. Real View of Project

8. Social Impact

The adoption of smart irrigation systems leveraging IoT technologies has profound social implications, reshaping traditional agricultural practices and contributing to a more sustainable and resilient future. By optimizing water usage through real-time data analysis and sensor-driven precision, these systems foster water conservation, addressing critical concerns in regions facing scarcity. The environmental impact is significant, with minimized water wastage and improved soil health, preserving ecosystems and biodiversity. The financial benefits extend to farmers, promoting economic stability through reduced water bills and increased crop yields. Beyond economic gains, the technology facilitates adaptation to climate change, ensuring resilient agricultural practices. Smart irrigation's integration of advanced technologies not only fosters economic growth and job creation but also promotes education and technological literacy in communities. Ultimately, the widespread implementation of smart irrigation systems underscores their potential to enhance global food security and elevate the well-being of communities by harnessing the transformative power of IoT in agriculture.

9. Conclusion &Future Scope

Conclusion:

The smart irrigation system developed using the Blynk platform and IoT technology represents a significant milestone in modern agriculture. By seamlessly integrating soil moisture sensors, environmental monitors, and real- time control through the Blynk app, the system provides an effective and user- friendly solution for optimizing water usage in farming practices. The threshold- based irrigation mechanism ensures that water is applied precisely when needed, mitigating water wastage and promoting sustainability. This project underscores the transformative potential of technology in addressing crucial challenges faced by the agricultural sector.

Future Scope:

Looking forward, the project holds considerable promise for future expansion and refinement. The integration of advanced sensors, such as nutrient level detectors or advanced weather sensors, could provide more nuanced data for improved decision-making in crop management. Implementing machine learning algorithms could elevate the system's predictive capabilities, optimizing irrigation schedules based on evolving environmental conditions. Exploring energy-efficient irrigation methods, networked irrigation systems for collaborative decision-making, and incorporating data analytics for comprehensive insights are avenues that could further enhance the system's impact. As technology continues to evolve, this smart irrigation system serves as a foundational model for sustainable and technology-driven farming practices, paving the way for innovations that contribute to global agricultural efficiency and environmental stewardship.

10. Bibliography

Books:

"Internet of Things in Agriculture for Sustainable Rural Development" by Nilanjan Dey, Amira S. Ashour, et al.:

Explores the applications of IoT in agriculture, including smart farming practices and technologies that contribute to sustainable rural development.

“Smart Agriculture: Connecting Innovative Technologies with Farming Practises" by Francisco Javier Ferrández Pastor, et al.:

Discusses the integration of innovative technologies, including IoT, in agriculture to enhance productivity and sustainability.

"Smart Farming Technologies for Sustainable Agricultural Development" by Meenu Rani, et al.:

Examines various smart farming technologies, including precision agriculture and IoT applications, with a focus on sustainable development.

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