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SMART AGRICULTURE USING INTERNET OF THINGS

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Abstract:
A Raspberry Pi 4 Model B, a water pump, an Android app, a rain sensor, a soil moisture sensor, a relay,and other components are used in this paper to demonstrate a smart agriculture system. By tracking soil moisture and rainfall and turning on the water pump as necessary, the device automates irrigation. Once the Raspberry Pi has digested the sensor data, it may control the relay to turn on or off the water pump. Farmers can manually operate the pump and examine sensor data from a distance using an Android app. This technique lowers labor costs, increases crop productivity, and optimizes water use. Using IoT technology, it is a workable way to update farming operations.

Keywords:Smart agriculture, Internet of Things, Raspberry Pi, water pump, relay, rain sensor, soil moisture sensor, water pump, Android app, automatic irrigation, and remote monitoring.

1. Introduction

Modern technology is revolutionizing agriculture, which is a fundamental aspect of human civilization. Agriculture now has more opportunities to improve sustainability, productivity, and efficiency thanks to the Internet of Things (IoT). This paper describes a smart agriculture system that automates irrigation procedures using a Raspberry Pi 4 Model B, a water pump, a relay, a rain sensor, soil moisture sensor, and an Android application. The system automatically maintains ideal water levels for crops by gathering real-time data on rainfall and soil moisture. The Android app enables farmers to remotely monitor sensor data and manage the pump, while the Raspberry Pi processes data from the sensors and operates the relay to activate the water pump as necessary. This method minimizes waste and maximizes water use. This paper aims to automate and optimize irrigation through the development of a smart farm system utilizing IoT technologies. Using real-time data from rain and soil moisture sensors, the system regulates a water pump to provide crops with the right amount of water without the need for human involvement. The system's objectives are to maximize agricultural yields, decrease water waste, and lower labor costs through precise irrigation management. More convenience and flexibility in farm management are made possible by the integration of an Android application, which enables farmers to remotely monitor sensor data and control the irrigation system. This promotes sustainable agricultural practices.

2. Proposed System

The suggested system is a complete smart agriculture solution created to improve crop management and expedite irrigation procedures by incorporating Internet of Things technologies. The Raspberry Pi 4 Model B, soil moisture sensor, rain sensor, relay, water pump, and Android application are the essential parts of the system that make it function. Through the constant collection and analysis of rainfall and soil moisture levels, the system guarantees accurate irrigation control that is customized to the individual requirements of crops. The Raspberry Pi functions as the main processor, controlling when to turn on and off the water pump in accordance with preset thresholds. This automation reduces the need for labor while also optimizing the use of water.

Additionally, the addition of an Android app gives farmers remote access to manually modify irrigation schedules based on sensor readings. Through the seamless integration of IoT technologies, the suggested system essentially aspires to change agricultural operations by encouraging efficiency, sustainability, and higher crop yields.

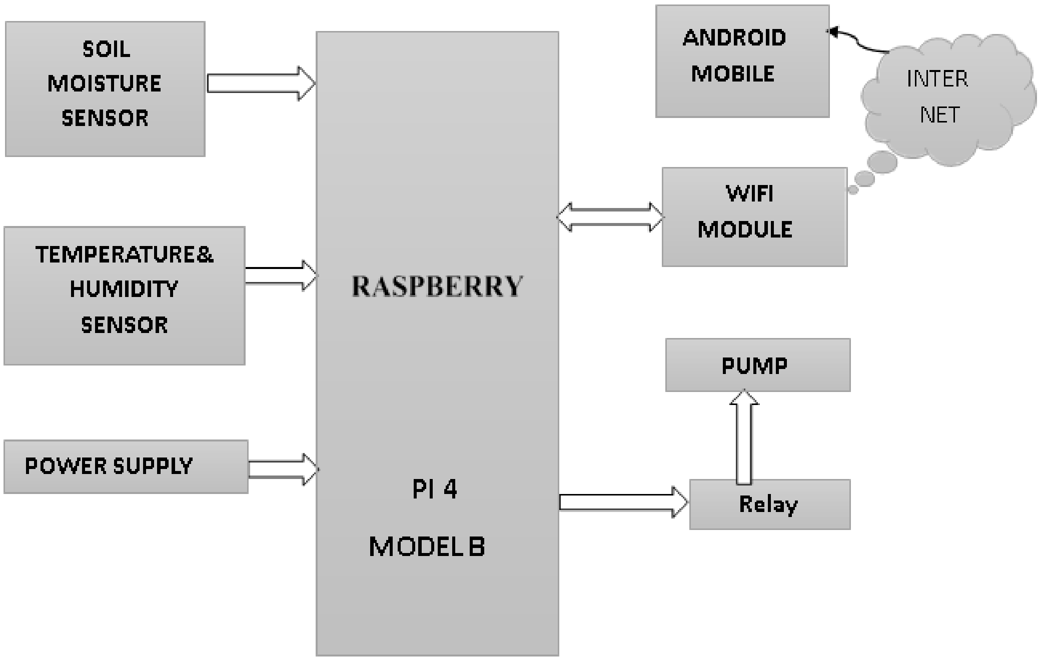


Fig 1. Smart Agriculture Using Raspberry Pi

The block diagram of Smart Agriculture Using Raspberry Pi is shown in fig 1. In order to optimize irrigation procedures and improve crop growth, the smart agricultural system functions on the principles of precise management and ongoing monitoring. The Raspberry Pi, which serves as the system's central processor, processes the real-time data on soil moisture levels and rainfall that is collected by sensors placed across the field. By comparing this data with preset criteria and algorithms, the Raspberry Pi calculates how much irrigation the crops require. The system activates the water pump through a relay module to irrigate the crops if soil moisture levels drop below a certain threshold and no rainfall is observed. Conversely, the relay turns off the water pump to save water if sufficient moisture levels are attained or rainfall is noticed.Additionally, farmers may monitor sensor data remotely, view irrigation activities, and manually regulate the system if needed, all with the help of an Android application. In a sustainable and effective manner, this integrated approach seeks to maximize crop yields while minimizing labor costs.

3. Implementation and Results

Step 1: Connect the Raspberry Pi to the laptop via a cable in order to turn on the equipment.

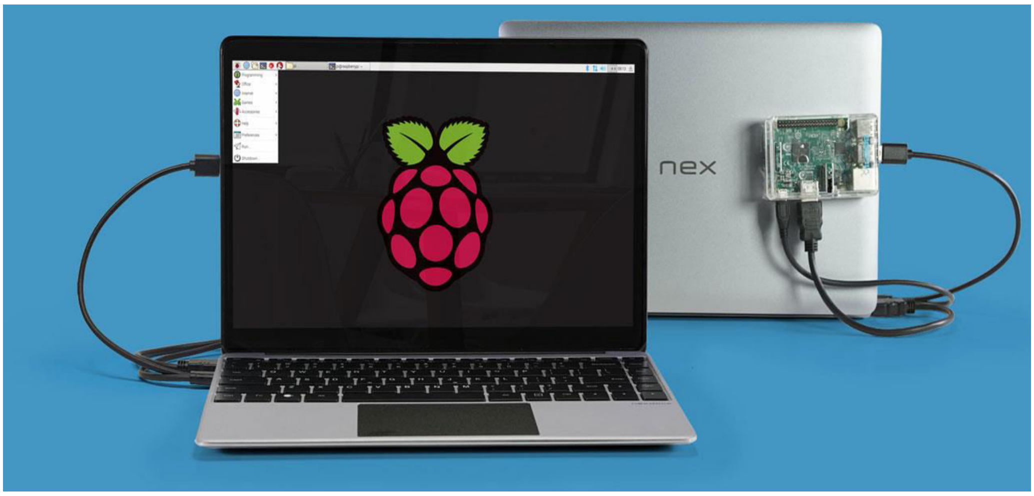


Fig 2. Setting up the raspberry pi with laptop

Step 2: Verify that the Raspberry Pi and laptop are both connected to the WiFi.

Login: iothome

Username: iothome01

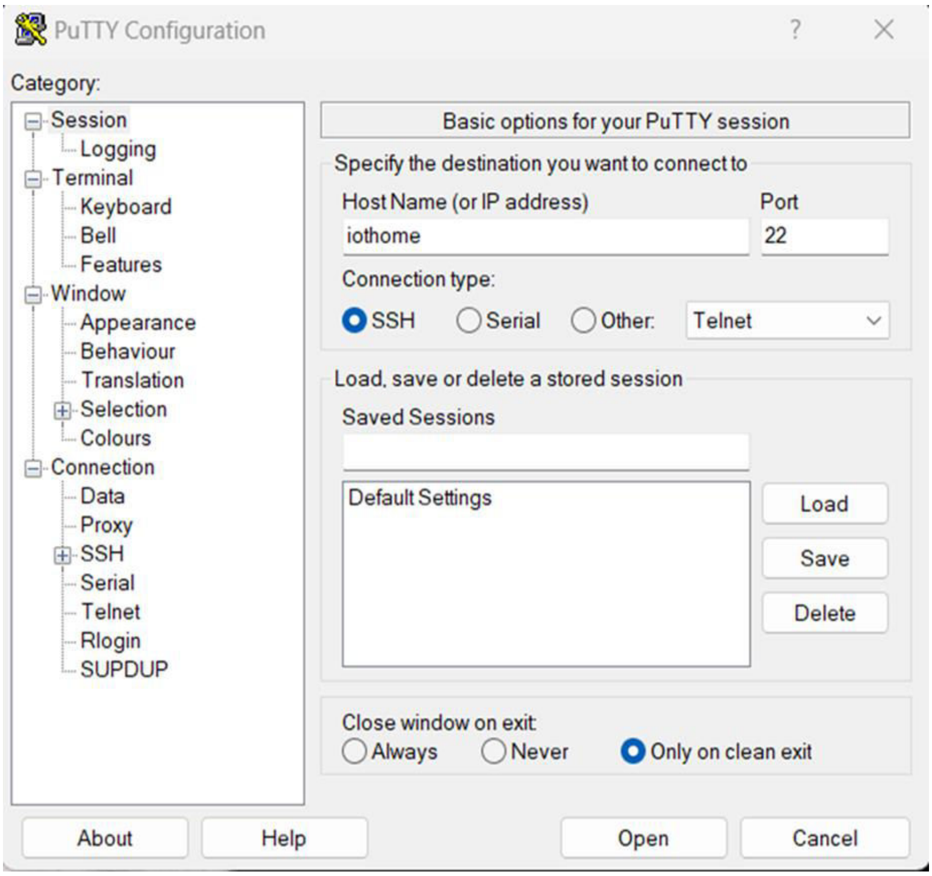


Fig 3. PuTTY configuration

Step 3: Use the Windows bar to search for the PuTTY application, which will open the PuTTY

Configuration as shown in fig 3.

Step 4: Click on open after entering the host name :iot home.

(The Terminal Window is then opened.)

Step 5. Put in your password and login ID as shown in fig 4.

ID for login: ras

12345678 is the password.

Step 6: After that, type the following commands step by step as shown in fig 4.

Command1: ls, then hit Enter to view the list of files.

Command 2: Press Enter after selecting "cd Downloads."

Command 3: type ls and hit Enter.

(Provide the downloads folder's file list.)

Command 4: type cd project_agri and hit the Enter key.

Command 5:ls: Provides the project_agri folder's list of file details.

Command 6: hit Enter to execute Python offtest1.py.

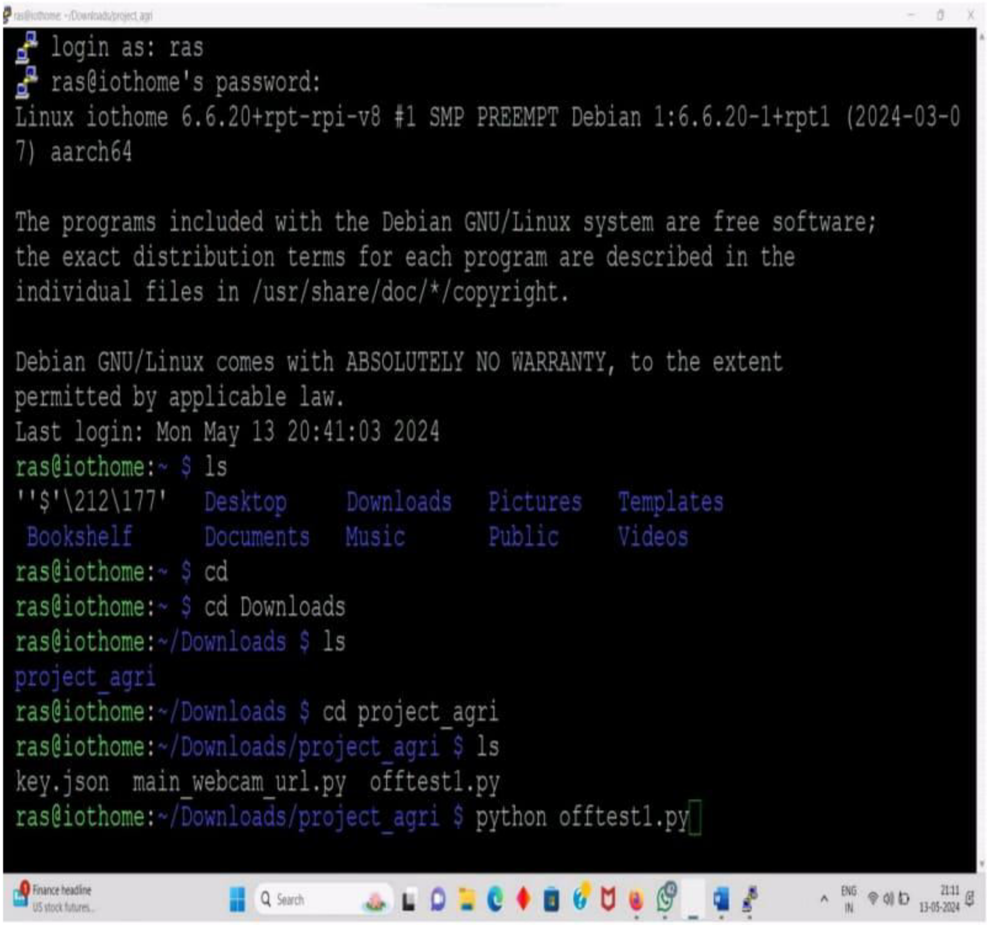


Fig 4. Terminal window

Step 7: Using the soil moisture sensor and rain sensor, we evaluate the kit's circumstances and present the output based

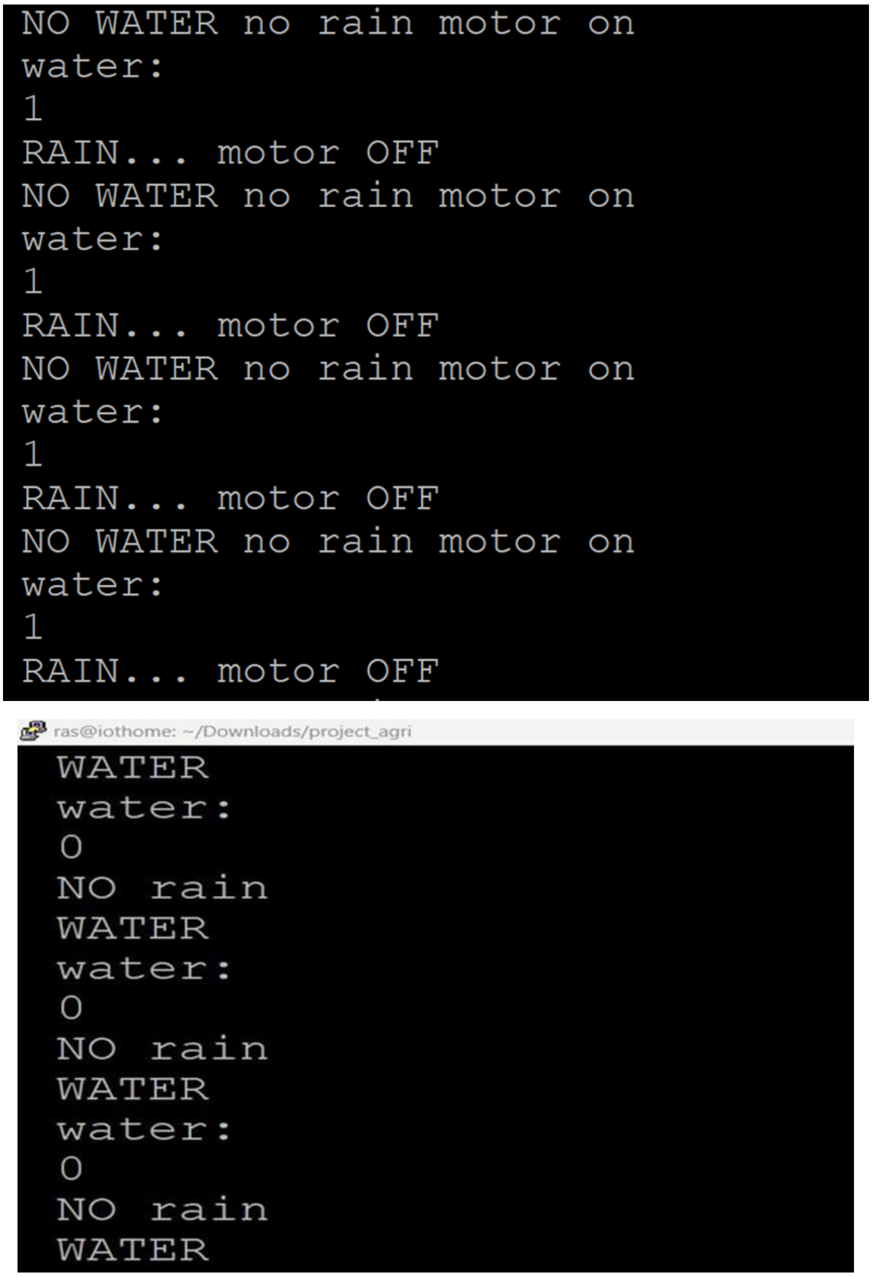
On those findings as shown in fig 5, fig 6 and fig 7.

The water pump is turned off - if moisture is found.

Water pump is activated - if no moisture is found.

If we are online, the rain detector notifies us via the Android app; if not, it notifies us viathe standard message

sent to the specific user's mobile number as shown in fig 8.



```
NO WATER no rain motor on
water:
1
RAIN... motor OFF
NO WATER no rain motor on
water:
1
RAIN... motor OFF
NO WATER no rain motor on
water:
1
RAIN... motor OFF
NO WATER no rain motor on
water:
1
RAIN... motor OFF
```

```
ras@iothome: ~/Downloads/project_agri
WATER
water:
0
NO rain
WATER
water:
0
NO rain
WATER
water:
0
NO rain
WATER
```

Fig 5. The laptop's output results are displayed.

Fig 6.Shows the output prior to the detection of rain and moisture.

Fig7. The output following the detection of rain and moisture.

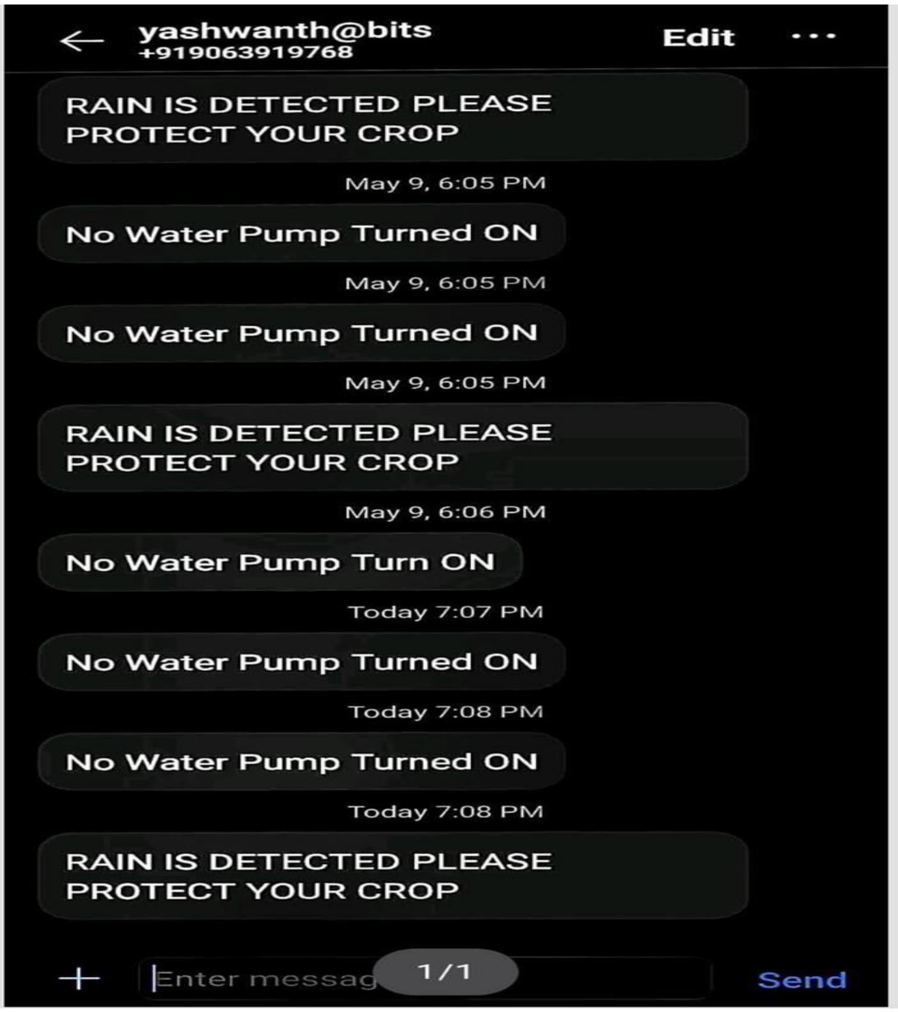


Fig 8.Notification alerting the user.

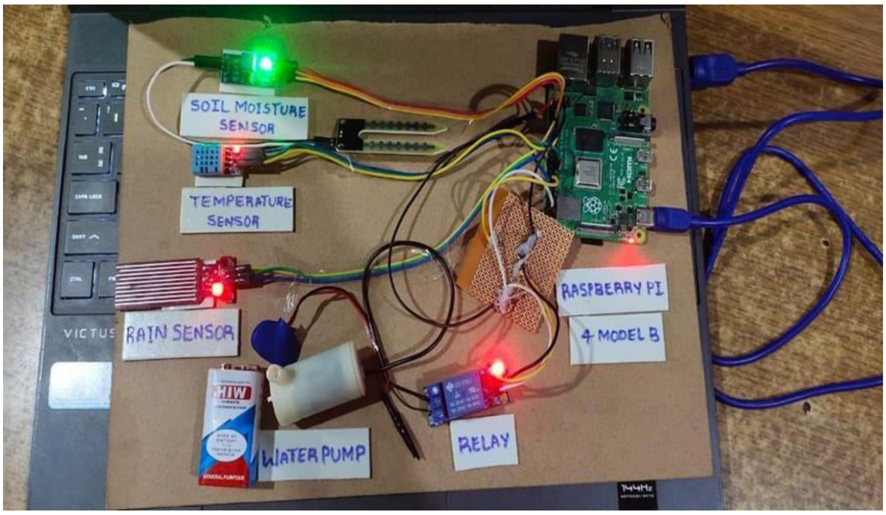


Fig 9. Intelligent farming.

4. Conclusion

To sum up, the smart agriculture system described in this study provides a workable and expandable answer to the problems associated with conventional farming. It shows how IoT technology may revolutionize agriculture by increasing resource efficiency, sustainability, and productivity. Such systems will probably get more advanced as technology develops, which will help the agriculture industry and contribute to the world's food security.

5. Future scope

This smart agriculture system has a wide range of potential applications in the future, as well as many avenues for improvement and innovation. A more thorough understanding of agricultural conditions will be possible with the integration of sophisticated sensors to monitor a wider range of environmental characteristics, such as temperature, humidity, and light intensity. By using AI and machine learning, irrigation plans may be made more efficient. Crop requirements can be predicted using historical data and weather predictions, and anomalies like pest infestations and plant illnesses can be found early on. Increased connectivity via cloud platforms and 5G technologies will guarantee scalable solutions for managing big datasets across several farms as well as dependable, real-time data transmission.Additional automation, such as the use of robotic equipment and drones, can expedite processes like planting, fertilizing, and harvesting. Rainwater harvesting and recycling technologies, as well as the use of renewable energy sources like solar power, can all improve sustainability. Accessibility and user experience will be enhanced by adding cross-platform interoperability, real-time notifications, and comprehensive analytics to the Android application's user interface. The system's adaptability to several agricultural contexts can be attributed to its scalability and customisation, which can be modified to accommodate varying farm sizes and crop varieties. Furthermore, by combining the system with supply chain management and market data, farmers will be able to maximize their financial returns by making well-informed decisions. These developments will keep pushing the boundaries of smart agriculture forward, bringing more productivity, sustainability, and efficiency to farming methods.

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