IOT Based Agricultural Monitoring System

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Abstract: In the current scenario farmer doesn't have an idea of the exact requirement of particular environmental parameter for particular crop that leads to unhealthy growth of crop and degradation of soil. So we are designing a smart agriculture system using IOT. The IOT based drone agricultural monitoring system with LoRaWAN data receiver is a highly advanced technological solution designed to revolutionize agriculture farming. This system uses advanced sensors and drone cameras to collect real-time data on crop health and environmental conditions. The LoRaWAN data receiver system is used to receive, process, and store the data transmitted by drone for analysis. By taking advantage of Internet of Things and LoRaWAN technology, this system enables farmers to monitor their fields & crops identify areas that need attention, and make decisions to optimize crop production and quality. Drones fly over the fields, capturing high-resolution images and sensor data, which are then transmitted to the data receiver system via LoRaWAN for analysis. Overall, this system provides a cost-effective, skilled, and sustainable solution for precise agriculture. It empowers farmers by offering valuable insights into their crops, promoting resource-efficient farming practices, andultimately contributes to increased productivity and profitability in the farming sector.

Keywords: Iot, smart agricultural, real time monitoring, crop management, energy efficient.

INTRODUCTION

IoT could be a combination of knowledge, web associated items, which is an integral component of the long run Internet. IoT focuses on the automation of processes to cut back human intervention. IoT in agriculture focus is on automating the aspects of agricultural methods to form them more efficient and effective. Traditional approaches of farming don't include livestock management and have many inefficiencies like higher human interaction, labor cost, power consumption, water consumption, etc. The use of a wireless sensor network is finished during this project which collects the information from different sensors and sends it to the most server using wireless protocols. the info that's collected during the method provides the data about different environmental factors which is employed to watch the complete process. Monitoring environmental factors aren't the answer to boost yield, quality, and production of the crops. it's necessary to develop a combined and unique system that can make sure of all factors affecting productivity like cultivation, harvesting, and post-harvesting storage.

The Internet of Things (IOT) is a technology that can change how farming works. In agriculture, IOT systems use sensors, connections, and data analysis to monitor farms more effectively. They keep track of important things like soil moisture, temperature, humidity, and crop health in real-time. This introduction explains why IOT-based agriculture monitoring systems are important. They help farmers increase productivity, use resources better, and farm more sustainably. Traditional farming methods often rely on manual work and occasional checks, which can be slow and not very accurate. IOT systems improve this by constantly gathering data automatically. This lets farmers make quicker decisions, like when to water crops or apply fertilizers. It also helps them spot problems early, such as pests or diseases in crops.

IOT based system using drone also lets farmers monitor their fields from afar. They can keep an eye on several fields or even farms that are far apart from one central place. This makes farming more efficient and saves money on travel and labor costs. Using IOT in farming isn't just about efficiency—it's also about being more eco-friendly. By managing resources like water and fertilizers more precisely, IOT systems help farmers waste less. This is good for the environment because it reduces the impact farming has on nature. In conclusion, IOT-based agriculture monitoring systems are changing how farmers work. They use data to make farming smarter and more sustainable. This introduction sets the stage for exploring how these systems are designed, used, and why they're important for making agriculture more productive and

better for the environment. To improve the agricultural yield with fewer resources and labor efforts, substantial innovations have been made throughout human history. Nevertheless, the high population rate never let the demand and supply match during all these times. According to the forecasted figures, in 2050, the world population is expected to touch 9.8 billion, an increase of approximately 25% from the current figure.

1. Hardware Components Selection and Setup:

•ESP32 Microcontroller: Acts as the main controller for gathering sensor data.

Figure: 1.1.ESP32

•Sensors: Choose appropriate sensors

Rain Sensors: Rain Sensor as per the name, a rain sensor is a switching device which turn ON by sensing water. It has an important application which is a water storing device that is attached to the irrigation system, this results in turning OFF system when rainfall occurs.

Figure: 1.2.Rain Sensor

Light sensor: The light sensor is a sensor used to detect the intensity of light, referred to as illuminance, and works by converting the light intensity value into a voltage value, mainly used in agricultural greenhouses, flower culture greenhouses, agricultural fields, electronic equipment production lines and other applications that require light monitoring.

Figure: 1.3.Light Sensor

Gas sensor: Gas sensor is an air quality or air pollution measuring sensor device. It can detect various chemical contents in air and give appropriate voltage variation at the output pin depending on the chemical concentration in air. Gas sensors for the crop production section were used to anticipate and prevent damage from diseases and pests. Gas sensors were employed to elevate the quality of products to be safe from chemical contamination in the crop production process.

Figure: 1.4.Gas sensor

•LoRaWAN Module: Install a LoRaWAN module like SX1276 on both the ESP32 and Arduino Nano for long-range communication.

Figure: 1.5.LoRaWAN

LoRa Antenna: A LoRa antenna is a device that extends the range of low-power wide-area networks. It facilitates long-distance communications with minimal power consumption. The primary application of the antenna is in low-power wireless devices.

Figure: 1.6.LoRa Antenna

•OLED Display: Connect an OLED to the ESP32 for local data visualization.

Figure: 1.7.OLED Display

•Arduino Nano: Setup the Arduino Nano as the receiver to display the data on an LED display.

Figure: 1.8.Arduino Nano

•LED Display: Use a suitable LED display for remote data visualization.
•Power Supply: Ensure that ESP32 and Arduino Nano have reliable power sources, such as battery packs.

2. Sensor Integration with ESP32:
•Connect all sensors to ESP32's GPIO pins according to their respective pinouts.
•Write code to initialize the sensors and read data.

3. OLED Display Integration:
•Connect the OLED to ESP32 via I2C protocol.
•Display key parameters such as temperature, humidity, light intensity, gas levels, and rain status in a user-friendly format.

4. LoRaWAN Communication Setup:
•Install the LoRaWAN modules on both the ESP32 and Arduino Nano.

5. Arduino Nano and OLED Display:
•Connect the OLED display to the Arduino Nano.
•Write code to display the received sensor data on the LED display.

6. Power Management:
•Ensure both the ESP32 and Arduino Nano have proper power supplies.
•For remote agricultural fields, consider using a solar-powered system with battery backup.

7. Code Development:
•ESP32 Code: Write the firmware that reads sensor data, displays it on the OLED, and transmits it via LoRaWAN. •Arduino Nano Code: Write the code to receive data via LoRaWAN and display it on the LED.

8. Testing and Calibration:
•Test each component individually to ensure proper functioning.

9. Final Integration:
•Once each component is working individually, integrate the system as per the block diagram.
•Deploy the system in the field and ensure that the LoRaWAN communication range meets your agricultural area's requirements.

10. Deployment and Monitoring:
•Deploy the ESP32 and sensors in the field, making sure they are well protected from environmental factors.
•Place the Arduino Nano with its LED display at a monitoring station.

LITERATURE REVIEW

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Mansour, and El-hadi M . Aggoune IEEE open access journal Publication date :1 August , 2019. IoT devices and communication techniques associated with wireless sensors encountered in agriculture applications are analyzed in detail.
• IOT based monitoring system and smart agriculture using

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• Smart Agriculture Monitoring System using IOT Prof. V.
A. Aher1 , Miss. Kadam Rutuja , Miss. Kadu Gauri , Miss. Yadav Shital International journal of advanced research in science , communication and technology (IJARSCT) Publication date:4 may, 2022. Using iot the system can predict the soil moisture level and humidity so that the irrigation system can be monitored and controlled.

• Iot Based Smart Agricultural Monitoring System
Dr.G.Rajakumar, M.SarojaSankari, D.Shunmugapriya and S.P.Uma Maheswari Asian Journal of Applied Science and Technology (AJAST) (Open Access Quarterly International Journal) Volume 2 , Issue 2 , Pages 474-480 , April-June 2018. Sensors capable of providing farmers with information about crop yields, pest infestation and soil nutrition are invaluable to production and offer the precise data.

PROPOSED SYSTEM:

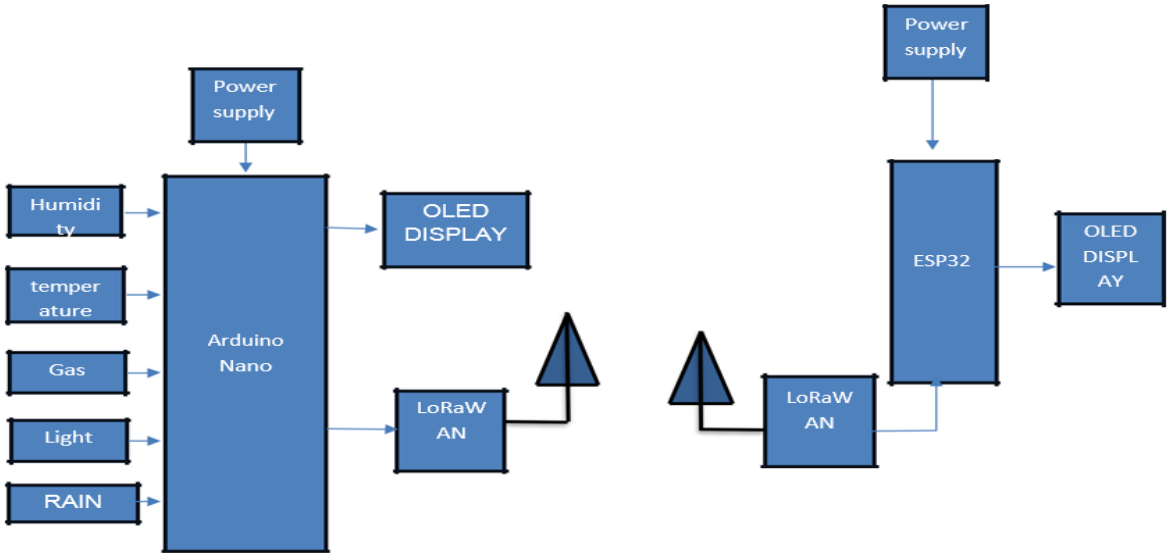

Figure. Block Diagram

OBJECTIVES OF THE STUDY

1. To decrease the amount of manual labor.

2. To Developing an integrated system of sensors that can collect and transmit real-time data about temperature, light intensity, air quality, and other relevant factors.

3. To take the update about the crop behavior from anywhere when climate suddenly vary. 5.To monitor the Temperature and Humidity level of the crops in the field.

4. To Providing farmers with access to this data through a user-friendly interface, allowing them to monitor crop conditions, analyze data trends, and make informed decisions about crop management.

Applications

• Weather Monitoring: IoT-based weather stations provide real-time data on temperature, humidity, and rainfall, helping farmers plan activities like planting or harvesting.

• Crop Monitoring: IoT drones or sensors monitor crop growth, health, and yield, providing actionable insights on plant stress or nutrient deficiencies.

• Weather Monitoring: IoT devices can collect weather data (temperature, humidity, rainfall) to help farmers make informed decisions about planting and harvesting times.

• Precision Farming: Optimizes water usage, fertilizer, and pesticides by providing real-time data on soil and crop conditions.

EXPECTED RESULTS

1. The data is sensed by various sensors such as: Temperature and humidity sensor, Camera, gas sensor, Light sensor and rain sensor, etc.

2. Thus after the signal conditioning process the value of humidity and the temperature is transmitted through the cloud interface, then it is received and displayed on the user device.

3. By providing farmers with real-time data on their crops, the system can help them make informed decisions regarding water and fertilizer usage, pest control, and harvesting times. This, in turn, can lead to increased crop yields, reduced costs, and improved profitability.

4. The conclusion is that the system will help farmers monitor fields and activities to boost production through efficient water and input use.

CONCLUSION

The integration of IoTbased smart agriculture monitoring s ystems using LoRaWAN and drone technology represents a transformative approach to modern farming.

By using the longrange, lowpower capabilities of LoRaWA N, this system ensures reliable and efficient data transmissi on across vast agricultural fields.

Working of the System

The IoT-Based Smart Agriculture Monitoring System is designed to optimize agricultural practices through the integration of advanced technologies such as Internet of Things (IoT), sensor networks, long-range communication protocols, drones, and cloud computing. The system operates in a structured way, with data collection, transmission, real-time monitoring, and decision-making processes working together to ensure efficient farm management. Below is a detailed explanation of how the system works from data collection to user interaction.

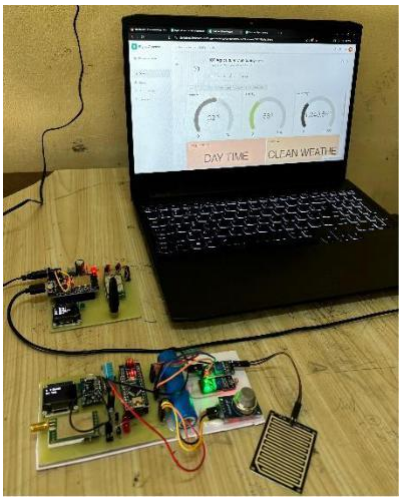

Figure: 2.1

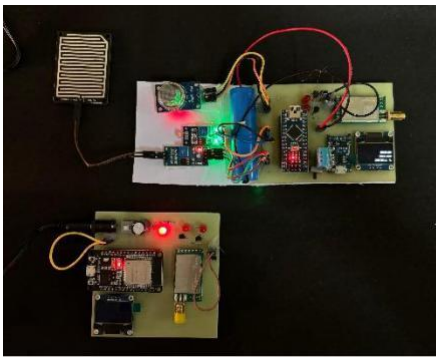

Figure: 2.2

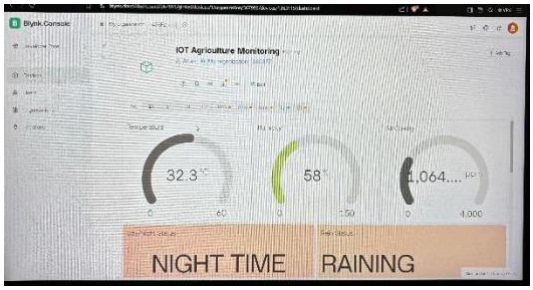

Figure: 2.3

Future Scope

1. Expanded Sensor Integration: Adding sensors for pest detection and nutrient monitoring.
2.AI and Machine Learning: Implementing predictive analytics for yield forecasting and optimization.
3.Automated Irrigation: Introducing smart irrigation systems for precise water management.
4.Blockchain Technology: Ensuring data security and traceability.

5.Enhanced User Interfaces: Developing mobile and web applications for better accessibility.

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