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AgreSense – Smart Sensing for Agriculture

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Abstract: The AgreSense system is an intelligent agricultural solution that leverages a combination of the Internet of Things (IoT), artificial intelligence (AI), and advanced sensors for real-time monitoring of soil and crop health. It gathers critical data points, including soil moisture, temperature, pH, and electrical conductivity (EC). This information is then processed to deliver automated recommendations for optimizing irrigation schedules and nutrient management.

Architecturally, the system is built using cost-effective sensors and ESP32 microcontrollers. It employs LoRa (Long Range) communication technology for efficient, long-distance data transmission. At its core, data analytics and machine learning models are used to process the incoming data, enabling predictive insights for irrigation needs and strategies to maximize crop yield. This paper outlines the design, practical implementation, and performance evaluation of AgreSense, focusing on its affordability, scalability, and overall contribution to the advancement of precision farming.

Keywords: - Smart Agriculture, IoT, LoRa, ESP32, AI, Machine Learning, Precision Farming, Soil Monitoring.

INTRODUCTION

Agriculture is the backbone of many economies and a critical component of global food security. However, with the rapid growth of the global population, the demand for food production continues to rise, placing immense pressure on agricultural systems to produce more with fewer resources. Traditional farming practices often rely on manual labor and conventional methods of monitoring crop and soil conditions, which can lead to inefficiencies, increased production costs, and inconsistent yields. Moreover, unpredictable weather patterns and climate change further exacerbate the challenges faced by farmers, making it difficult to achieve sustainable and efficient agricultural practices.

Software architecture has significantly changed, shifting from closely integrated monolithic systems to distributed, service-oriented, and eventually, microservices-based approaches. Although easy to begin with, conventional monolithic applications pose considerable difficulties related to scalability, maintainability, and deployment flexibility. With the increasing number of organizations utilizing cloud computing, there is an escalating demand for architectures that can take advantage of cloud elasticity, automate deployments, and sustain resilience amid fluctuating operational loads.

OBJECTIVES

Sensors are used in agriculture for real-time data collection to improve crop yields, optimize resource use, and enhance farm management. They monitor soil conditions like moisture, pH, and nutrient levels, track environmental factors such as weather and humidity, and analyze crop health and equipment performance. This data enables automated actions, like smart irrigation, and informs critical decisions about fertilization and pest control.

Soil sensors: Measure soil moisture, temperature, pH, salinity, and nutrient levels (like NPK) to ensure crops get the right amount of water and fertilizer

Nutrient sensors: Provide data on the exact nutrient concentrations in the soil, which helps farmers apply fertilizers precisely, reducing waste and environmental runoff.

LITERATURE REVIEW

Several IoT-based agricultural systems have been proposed for soil and crop monitoring. Systems like Smart Farm Net, CropX, and Kisan IoT focus on automation and remote data collection, but often have high implementation costs. Research by Kim et al. (2021) explored LoRa-based precision irrigation systems, while Sharma et al. (2022) demonstrated soil nutrient prediction using AI. AgreSense builds on these studies by providing a modular, low-cost platform integrating sensing, communication, and analytics suitable for Indian farming conditions.

Sensors and sensing platforms

A core component of any AgriSense device set is the physical sensor suite. The literature documents a wide set of sensors commonly used in smart-farming nodes: soil moisture, temperature, electrical conductivity (EC) / salinity, pH, leaf

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wetness, ambient temperature & humidity, PAR (photosynthetically active radiation), and sometimes NPK (nutrient) sensors or simple spectrometers for plant stress. Modern reviews emphasize increasingly “smart” sensors — devices that preprocess data locally, support calibration, and provide richer metadata (timestamp, GPS, status) to improve downstream analytics. Field studies repeatedly show soil moisture and temperature to be the highest-value, high-frequency measurements for irrigation management and early stress detection

Network architectures and communication

AgriSense-class systems are typically organized as distributed edge nodes (sensor nodes) connected to gateways which forward data to cloud services or local servers. Communication technologies vary by scale and requirement: short-range (Zigbee, BLE, Wi-Fi) for small plots; long-range, low-power networks (LoRaWAN, Sigfox) for wide-area farms; and cellular (NB-IoT / LTE-M / 2G/3G) when coverage and bandwidth are required. Several surveys outline that LoRaWAN and NB-IoT are popular choices for low-power, battery-operated sensor deployments because they balance range, power consumption, and cost. Power management (duty-cycling, sleep modes, energy harvesting) is a recurring design concern.

Data streams, remote sensing, and multi-modal fusion

Beyond in-situ sensors, the literature strongly recommends fusing ground sensors with remote sensing — satellite and UAV (drone) imagery — to achieve better spatial coverage and crop-condition insights. UAV multispectral and thermal imagery has become an effective complement to pointwise soil sensors, enabling rapid detection of spatial variability in water stress, canopy vigor, and nutrient deficiencies.

TOOLS AND TECHNOLOGY

1. Key hardware & sensing technologies

UAVs (drones) capturing multispectral imagery, possibly LiDAR or RGB-D, to estimate canopy size, tree counts, gaps, tree height, leaf density**.**

Satellite or high-altitude imagery also used for large-scale monitoring.

2. Software, analytics & algorithms

Agroview acts as a “digital twin” of the orchard/field: it ingests imagery + sensor data, processes & analyses it, and visualizes decision-ready maps (e.g., fertility maps, prescription maps).

Users can upload their boundary data, field metadata, import imagery, and view 2D/3D visualizations, per tree health metrics, full-field nutrient report.

3. Benefits & Technology Advantages

Higher precision: Moving from “whole-field uniform application” to zone → tree-specific application based on real data.

Efficiency: Reduced wastage of nutrients/fertilizers, better targeting, potentially lower environmental impact.

ACTIVITY DIAGRAM

The activity diagram of **AgreSense – Smart Sensing for Agriculture** illustrates the overall workflow of the system, starting from data collection to farmer decision-making. The process begins when the sensors placed in the agricultural field start collecting real-time environmental parameters such as soil moisture, temperature, humidity, and light intensity. These sensors are connected to the AgreSense smart sensing device, which acts as the main control unit. The collected sensor data is then transmitted to the microcontroller (for example, Arduino, ESP32, or Raspberry Pi), where preliminary processing and validation of the data take place.

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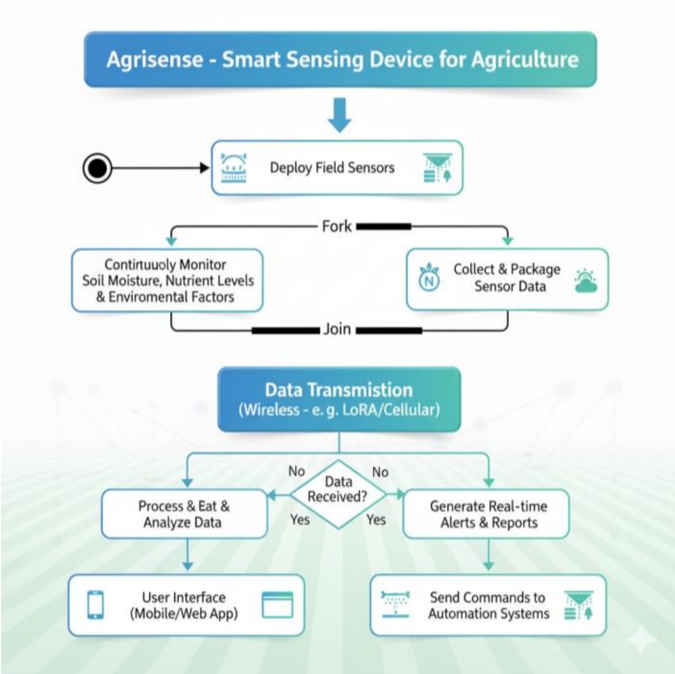

Fig 1 Activity Diagram

ADVANTAGES AND APPLICATIONS

The AgreSense system provides several advantages that make it an efficient and sustainable solution for modern agriculture. It integrates IoT, sensor networks, and AI-based analytics to help farmers make data-driven decisions for better crop management. The major advantages are as follows:

Real-Time Monitoring: AgreSense continuously collects real-time environmental data such as soil moisture, temperature, and humidity, enabling farmers to monitor crop health and field conditions remotely.

Improved Resource Utilization: The system optimizes the use of water, fertilizers, and pesticides by applying them only when required, thus minimizing wastage and reducing operational costs.

Automation and Efficiency: Through automatic irrigation and intelligent decision-making, the system reduces human effort and time while increasing overall efficiency.

Applications:

AgreSense – Smart Sensing for Agriculture has a wide range of applications across various agricultural domains. The key applications include:

Precision Agriculture: Enables precise control over irrigation, fertilization, and pest management to improve crop yield and quality.

Soil and Crop Monitoring: Helps monitor soil health, detect moisture variations, and assess plant growth conditions throughout the crop cycle.

Smart Irrigation Systems: Automates irrigation scheduling based on real-time soil moisture and weather data to reduce water consumption.

Weather-Based Farming Decisions: Assists farmers in planning agricultural operations such as sowing, irrigation, and harvesting based on environmental data.

CONCLUSION AND FUTURE SCOPE

Conclusion:

The AgreSense – Smart Sensing for Agriculture system represents a modern technological advancement in the field of precision farming. By integrating IoT-based sensors, wireless communication, and AI-driven data analytics, the system

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effectively monitors key environmental factors such as soil moisture, temperature, humidity, and light intensity. The continuous monitoring and intelligent decision-making processes enable farmers to make informed choices regarding irrigation, fertilization, and pest management.

The implementation of AgreSense leads to improved resource efficiency, reduced operational costs, and enhanced crop productivity. It bridges the gap between traditional farming and digital agriculture by providing real-time insights through an interactive mobile or web-based dashboard. Thus, AgreSense not only helps in optimizing agricultural processes but also promotes sustainable and eco-friendly farming practices essential for meeting the growing global food demands.

Future Scope:

The future development of the **AgreSense** system can further enhance the effectiveness and usability of smart agriculture technologies. Integration of **Artificial Intelligence (AI)** and **Machine Learning (ML)** models can be expanded to include advanced prediction mechanisms for crop diseases, pest infestations, and yield forecasting. The system can also be enhanced with **drone-based remote sensing**, **satellite data integration**, and **image-based crop health monitoring** for larger agricultural areas.

In addition, the implementation of **blockchain technology** for secure data storage and transaction records can provide greater transparency in the agricultural supply chain. Integration with **automated irrigation controllers**, **voice-assistant interfaces**, and **predictive weather models** can make the system more interactive and user-friendly. Future work may also focus on developing a **low-power IoT architecture** to ensure long-term field operation using renewable energy sources such as solar panels.

REFERENCES

[1] Y. Ampatzidis, "Agroview and Agrosense for AI-enhanced Precision Nutrient Management," U.S. Department of Agriculture (USDA) Project Report, 2023.

[2] Agriculture Intelligence, Inc., "Agroview and Agrosense – AI-Based Crop Intelligence Platform," AgIntel Official Website, 2024.

[3] AgroSense, "Smart Agriculture Platform for Data-Driven Farming," *AgroSense Official Website*, 2024.

[4] Y. Ampatzidis and V. Partel, "Agroview: Cloud-based Application to Process, Analyze, and Visualize UAV-collected Data for Precision Agriculture Applications," *Computers and Electronics in Agriculture*, vol. 174, pp. 1–10, 2020.

5] S. Wolfert, L. Ge, C. Verdouw, and M. J. Bogaardt, "Big Data in Smart Farming – A Review," *Agricultural Systems*, vol. 153, pp. 69–80, May 2017.

[6] R. G. Smith, "IoT-Based Smart Agriculture Monitoring System Using Sensors and Cloud Computing," *International Journal of Advanced Research in Computer Science*, vol. 12, no. 5, pp. 45–50, 2021.

[7] M. D. Jain and R. Patil, "Precision Agriculture Using IoT and Machine Learning," *International Journal of Emerging Technologies in Engineering Research (IJETER)*, vol. 9, no. 7, pp. 1–6, 2021.

[8] K. A. Patidar, P. Verma, and R. Sharma, "IoT Based Smart Agriculture Monitoring System," *International Journal of Innovative Research in Computer and Communication Engineering*, vol. 8, no. 4, pp. 1012–1018, Apr. 2020