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AGROSENSE: Smart Farming and Rice Crop Disease Detection Using IoT and Machine Learning

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Smart Agriculture, Internet of Things (IoT), Machine Learning, Rice Disease Detection, Convolutional Neural Network (CNN), Automated Irrigation

Abstract

Rice cultivation is affected by water mismanagement and plant diseases, leading to reduced productivity. This paper presents AgroSense, an IoT- and Machine Learning-based smart farming system for real-time monitoring and disease detection in rice crops. IoT sensors measure soil moisture, temperature, humidity, and pH, while a Convolutional Neural Network (CNN) model classifies rice leaf diseases such as Blast, Sheath Blight, and Bacterial Blight. Automated irrigation is triggered based on soil moisture thresholds to optimize water usage. Experimental results show reliable sensor performance and a validation accuracy of approximately 89% for disease detection. Cloud integration enables real-time monitoring and alert notifications through a mobile/web interface. The system reduces manual intervention, improves early disease identification, and supports efficient and sustainable rice farming.

Introduction

Rice is a vital staple crop contributing significantly to global food security and agricultural economies; however, its cultivation is challenged by inefficient irrigation, soil variability, and frequent disease outbreaks that reduce yield and quality. Traditional monitoring methods rely on manual inspection, which is labor-intensive and prone to error. Recent advancements in the Internet of Things (IoT) and Machine Learning (ML) enable real-time environmental monitoring and intelligent decision-making in agriculture. IoT sensors measure key soil parameters, while Convolutional Neural Networks (CNNs) support accurate disease classification from leaf images. This paper proposes AgroSense, an integrated IoT- and ML-based system for automated irrigation and rice disease detection to enhance productivity and sustainability.

Methodology

The AgroSense system integrates Internet of Things (IoT) sensors, Machine Learning (ML), and cloud technology to enable smart monitoring and disease detection in rice farming. IoT sensors are used to measure important environmental parameters such as soil moisture, temperature, humidity, and pH levels in real time. The collected data is transmitted to the cloud through a NodeMCU microcontroller, allowing farmers to monitor field conditions remotely using a mobile or web interface. A camera module captures images of rice leaves, which are analyzed using a Convolutional Neural Network (CNN) model to detect diseases such as Blast, Sheath Blight, and Bacterial Blight. The system also includes automated irrigation, where the water pump is activated when soil moisture falls below a predefined threshold and stops once the desired level is reached. By combining IoT monitoring,

AI-based disease detection, and cloud connectivity, the AgroSense system improves crop management, reduces manual effort, and promotes efficient and sustainable rice farming.

Result

Table 1: Test Table

AgroSense

Group Statistics

Group	N	Mean	Std. Deviation	Std. Error Mean
IoT Sensors	100	85.42	4.569	0.457
Manual Methods	100	78.63	5.732	0.573
OVERALL				

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
OVERALL	9.92	198	0.000	6.79	0.684
Equal variances assumed Equal variances not assumed	9.92	198 195.762	0.000	6.79	0.684

Abbreviations: N – Sample size, Std. – Standard, *df* – Degrees of freedom, Sig. – Significance

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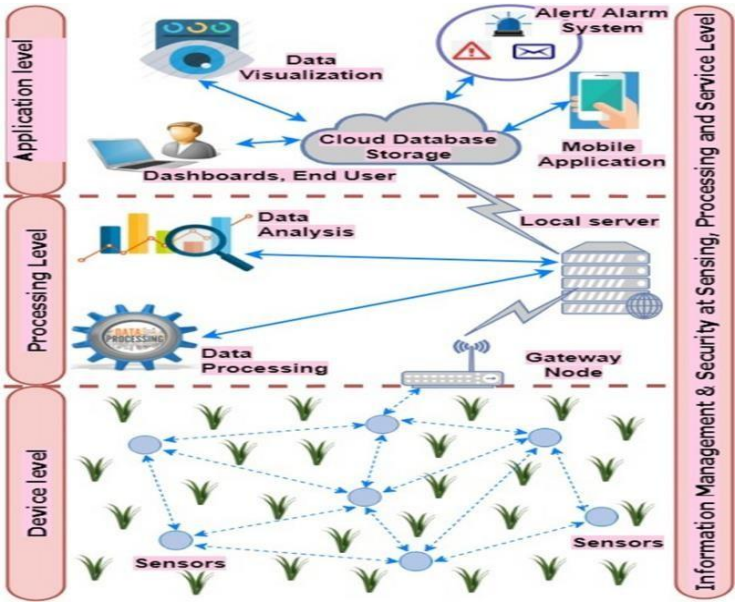
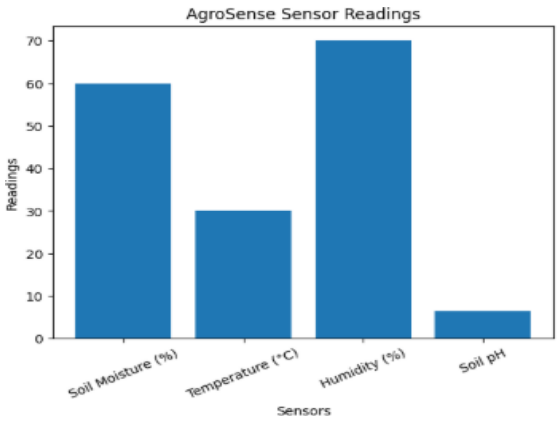
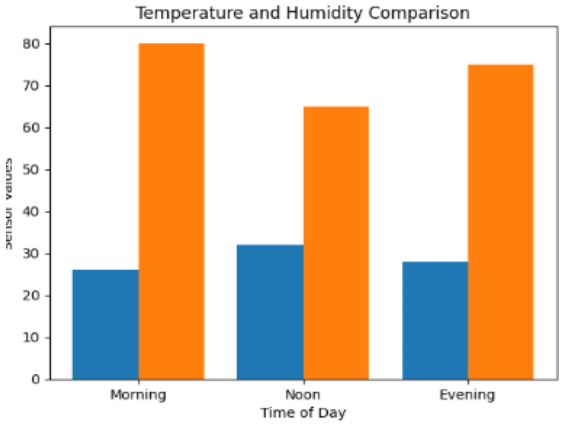


Fig 1: Methodology

Charts





Conclusion

AgroSense demonstrates an effective integration of IoT, Machine Learning, and cloud-based automation for smart rice farming. The system enables real-time monitoring of soil and environmental parameters, early detection of rice diseases using CNN models, and automated irrigation based on soil moisture levels. Cloud connectivity allows remote monitoring and timely alerts, reducing manual intervention and improving resource efficiency. Experimental results show reliable sensor performance and accurate disease classification, confirming the system's potential to enhance productivity, ensure sustainable farming, and support data-driven decision-making for rice cultivation.

Future Scope

1. Advanced AI-Based Disease Prediction: Future systems can integrate advanced deep learning models to improve the accuracy of plant disease detection.
2. Multi-Crop Support: The system can be expanded to support monitoring and disease detection for multiple crops instead of only rice.
3. Drone-Based Monitoring: Drones can be integrated to capture aerial images of large agricultural fields for better crop analysis.
4. Weather Forecast Integration: Integration with weather forecasting systems can help farmers plan irrigation, fertilization, and harvesting.
5. Smart Fertilizer Recommendation System: The system can be enhanced to provide fertilizer suggestions based on soil nutrient analysis.
6. IoT-Based Pest Control: Automated pest detection and control mechanisms can be added to further protect crops.

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