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Intelligent Precision Agriculture for Rice Production Using Convolutional Neural Networks and Genetic Algorithms

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ABSTRACT

Precision agriculture has emerged as a transformative approach to enhance crop productivity, optimize resource utilization, and ensure sustainable farming practices. In rice cultivation, nutrient management plays a pivotal role in determining yield, quality, and environmental impact. Traditional fertilizer application methods often result in either nutrient deficiency or excessive usage, leading to reduced productivity and ecological imbalance. This seminar presents an intelligent framework for rice production that integrates Convolutional Neural Networks (CNNs) with Machine Learning techniques and Genetic Algorithms to achieve efficient nutrient management. The proposed system utilizes image-based data captured from rice fields to detect nutrient deficiencies at early growth stages through CNN-based classification models. By analyzing leaf color, texture patterns, and morphological features, the model accurately identifies deficiencies in essential nutrients such as nitrogen, phosphorus, and potassium. Further, machine learning algorithms are employed to predict nutrient requirements based on soil parameters, climatic conditions, and crop growth stages. To enhance optimization, a Genetic Algorithm is incorporated to determine the optimal fertilizer dosage and scheduling, thereby minimizing cost and maximizing yield. This integrated approach supports data-driven decision-making, reduces excessive fertilizer application, improves soil health, and promotes sustainable rice farming. The model demonstrates improved prediction accuracy, efficient nutrient allocation, and enhanced productivity compared to conventional methods. The study highlights the potential of combining deep learning and evolutionary optimization techniques in advancing precision agriculture systems for rice production.

Keywords: *Rice Production, Convolutional Neural Network, Nutrient, Machine Learning, Farming.*