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A Study of Deep Learning-Based Automated Plant Disease Detection Using Image Processing Techniques

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ABSTRACT

Deep learning-based automated plant disease detection using image processing techniques has emerged as a powerful solution for improving agricultural productivity and ensuring food security. Plant diseases significantly affect crop yield and quality, leading to economic losses for farmers. Traditional disease identification methods rely on manual inspection by experts, which is time-consuming, labor-intensive, and prone to human error. In contrast, deep learning approaches, particularly Convolutional Neural Networks (CNNs), enable automatic extraction of complex features from leaf images without the need for handcrafted descriptors. The process typically involves image acquisition, preprocessing steps such as noise removal, segmentation, and color normalization, followed by feature extraction and classification. CNN models learn hierarchical patterns such as texture, color variation, and lesion shape that are crucial for accurate disease detection. Techniques like data augmentation, transfer learning, and batch normalization enhance model performance and generalization across different environmental conditions. Optimized architectures also reduce computational complexity, enabling real-time detection through mobile or embedded devices. This AI-driven framework supports early diagnosis, minimizes pesticide misuse, and promotes precision agriculture.