Automated Plant Disease Detection Using Leaf Images and Explainable Convolutional Neural Networks

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Abstract: *Plant diseases significantly affect agricultural productivity and food security worldwide. Early and accurate identification of plant diseases is crucial for reducing crop losses and improving yield quality. Traditional disease diagnosis relies heavily on expert knowledge and manual inspection, which is time-consuming, subjective, and often unavailable in rural areas. This paper presents an automated plant disease detection system using deep learning and Explainable Artificial Intelligence (XAI). The proposed approach employs a Convolutional Neural Network (CNN)-based architecture for classifying plant leaf images into healthy and diseased categories. To enhance trust and transparency, Grad-CAM-based visual explanations are integrated to highlight disease-affected regions on the leaf surface. Experiments conducted on a publicly available plant disease dataset demonstrate that the proposed model achieves high classification accuracy while maintaining interpretability. The results indicate that the system can serve as a reliable computer-aided diagnostic tool for precision agriculture.*

Keywords*: Plant Disease Detection, Deep Learning, CNN, Explainable AI (XAI), Grad-CAM, Precision Agriculture*