

Disease Detection in Grape Cultivation Using Strategically Machine Learning Techniques

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Abstract: *Grape cultivation faces numerous challenges, including pest infestations, management issues, fertilizer quality concerns, and diseases caused by bacteria, fungi, and viruses. Among these, powdery mildew and blotches are particularly significant, each exhibiting distinct visual and biological characteristics that require precise and timely detection to minimize crop losses and maintain yield quality.*

Traditional disease detection methods primarily rely on manual observation and capturing images of diseased leaves, often leading to delayed responses and increased damage. To overcome these limitations, this research proposes an intelligent, data-driven approach that leverages deep learning and machine learning algorithms to analyze images collected by strategically placed cameras across grape farms. By continuously monitoring plant health, the system can identify disease symptoms early, allowing for timely intervention and smarter resource management.

The primary objective of this study is to design and implement an automated disease detection system capable of accurately classifying grapevine leaf images into categories of powdery mildew, blotches, and healthy leaves. The proposed system not only provides real-time disease alerts to farmers but also supports decision-making processes by recommending authorized actions based on detected conditions. After the individual classification performances are evaluated, a stacking ensemble method is implemented to combine the strengths of multiple classifiers and select the optimal model that delivers the highest accuracy. This ensemble approach not only improves overall system performance but also reduces the risk of overfitting associated with single models..

Keywords: *Feature extraction, machine learning algorithms, grapes, image preprocessing, Image Processing, Convolutional Neural Network (CNN), Machine Learning, etc*

