AI DRIVEN EXPERT SYSTEM FOR SUSTAINABLE DISEASE CLASSIFICATION OF VANILLA PLANIFOLIA USING SVM TO SUPPORT SDGS

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BACKGROUND: *Vanilla planifolia* is one of the most valuable agricultural commodities with steadily increasing global demand. However, its productivity is often limited by diseases such as *Fusarium* (stem rot), *Phytophthora* (root rot), and leaf spot, which significantly reduce yield and quality. Conventional diagnosis methods rely on visual inspection, which is time-consuming and prone to errors. The application of artificial intelligence, particularly expert systems, provides an innovative solution for fast, accurate, and consistent diagnosis. Support Vector Machine (SVM) has proven effective in solving classification problems with complex, high-dimensional data, making it highly suitable for vanilla disease detection.
METHOD: An SVM-based expert system was developed to classify vanilla diseases. The dataset consisted of 1,200 leaf images evenly divided into four classes: healthy, *Fusarium*, *Phytophthora*, and leaf spot (300 images each). Preprocessing included normalization (resizing to 256×256 pixels), data balancing, and light augmentation such as rotation, flipping, and brightness/contrast adjustment. Feature extraction combined multiple descriptors: color (color moments, HSV histogram), texture (GLCM, LBP), and shape (Hu moments). The dataset was split into 80% training and 20% testing, while SVM hyperparameters (RBF kernel, C, and γ) were optimized using grid search with 5-fold cross-validation.
RESULTS & DISCUSSION: The optimized SVM model achieved strong performance with 92.5% accuracy, 91.8% precision, 93.2% recall, and 92.4% F1-score. Class-wise performance was balanced, with F1-scores ranging from 91.7% to 93.6%. The combination of color, texture, and shape features effectively represented vanilla leaf conditions. Compared to manual inspection, the system demonstrated superior speed, accuracy, and scalability, offering practical benefits for farmers in disease management.
CONCLUSION: This study successfully developed an SVM-based expert system for vanilla disease detection with high reliability. The system has strong potential for real-world deployment as a decision-support tool for early diagnosis, contributing to improved productivity and sustainability in vanilla cultivation.
KEYWORDS: Expert System, Support Vector Machine, Plant Disease, Vanilla planifolia, Leaf Image