

Smart Agriculture: Computer Vision, Machine Learning, and IoT for Disease Detection in Greenhouse

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Modern smart greenhouses, equipped with cutting-edge Internet of Things (IoT) based environmental monitoring and controlling systems offer the potential to optimize crop growth for increased yield and quality. One such application involves the integration of computer vision (CV) and machine learning (ML) techniques to augment existing crop management systems, thus maximizing agricultural productivity. Implementation of early detection strategies for diseases and pests is one such application of CV/ML in Smart Agriculture. This study presents a cost-effective, energy-efficient disease detection system for local farmers. A unique feature of this work is combining automated aerial imagery with smartphone images for disease analysis. Data collection included plant image capture using a ZED camera and smartphone, covering top-view and leaf-level shots. Disease detection was accomplished using the Mask Region Convolutional Neural Network (Mask RCNN). Two models were used for disease identification: Inception v3 and a Custom CNN. The chosen Custom CNN model for disease classification was integrated into a mobile application. This application enables farmers to input leaf data and receive disease classification results. Additionally, the application provides disease descriptions, preventive measures, and treatment recommendations to aid farmers in managing plant health effectively. The performance evaluations of these two approaches reveal significant gains, with disease detection achieving an enhancement of 50% and disease classification reaching 87.5%. This research marks the nascent phase of aerial data analysis within greenhouse environments. The dataset generated with this study will enable the development of more sophisticated models with expanded capabilities in subsequent research efforts. As agriculture adapts to technological advancements, the merger of computer vision and machine learning techniques within smart greenhouses emerges as a promising avenue to bolster crop health and yield, ensuring sustained global food security.

Keywords: Smart agriculture, IoT, Computer vision, Machine learning

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