

Application of CNN MobileNetV2 Architecture for Spinach Disease Detection in the SeaRex Aquaponic System

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ABSTRACT

This study aims to develop a smart mobile application based on the MobileNetV2 deep learning architecture for early detection of spinach leaf diseases in aquaponics systems. This approach provides a precision solution to overcome the limitations of slow and subjective manual detection. The image dataset was classified into five classes: Healthy Leaf, Anthracnose, Bacterial Spot, Downy Mildew, and Pest Damage. To handle extreme class imbalance, the model was optimized using Focal Loss (Gamma 2.5), MixUp Augmentation data engineering, and Full Fine-Tuning methods. Model evaluation executed using Test-Time Augmentation (TTA) with 20 iterations yielded an overall accuracy of 70.05%. The model also recorded a high sensitivity (Recall) rate in isolating the majority Healthy Leaf class (87.13%) and the minority Anthracnose class (72.22%). The final model was converted into a TensorFlow Lite (TFLite) format sized under 15 MB, enabling the classification processing to run 100% offline without network latency. The result of this research is a practical decision-support application for farmers to rapidly and accurately identify pathogens and apply targeted organic treatments.

Keyword: *Aquaponics, Spinach Plant, MobileNetV2, Disease Detection, Mobile Application, Focal Loss.*