

Chapter 10

An Enhanced Deep Convolutional Neural Network for Plant Disease Detection and Classification: Elevating Sustainable Agriculture

Wasswa Shafik

 <https://orcid.org/0000-0002-9320-3186>

School of Digital Science, Universiti Brunei Darussalam, Brunei

Ali Tufail

Universiti Brunei Darussalam, Brunei

Liyanage Chandratilak De Silva

Universiti Brunei Darussalam, Brunei

Rosyzie Anna Haji Mohd Apong

Universiti Brunei Darussalam, Brunei

ABSTRACT

This research introduces a novel enhanced deep convolutional neural network for plant disease detection and classification, a cutting-edge tool that is set to revolutionize the field. The study enhances the ResNet50 network by replacing the fully connected layer with three layers that improve discrimination and feature extraction, namely the convolution, batch normalization, and Leaky rectified linear unit (RELU) activation layers. Experimental performance assessments were conducted to evaluate

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the performance of the proposed model in comparison to the original ResNet50, EfficientNet, DesNet201, and Inception Version 3 using popular evaluation criteria such as precision, recall, and F1-Score. The proposed model achieved an accuracy of 99.33% and 93.93% on the Namibia University of Science and Technology Maize Dataset and the Nelson Mandela African Institution of Science and Technology Maize dataset, respectively.

1 INTRODUCTION

Increasing pressure on the global population requires intensive agricultural output. Adverse biotic stressors are mainly responsible for declining productivity. Early-stage plant biotic stress classification and detection technologies are required, as 30–40% of potential agricultural productivity is lost to pathogens and pests. To improve human decision-making, it is important to understand the results of AI models. AI classification research is a burgeoning technology enriched with a myriad of applications (Ojja et al., 2024). Monitoring plant health has become easier, and farmers need not know coding to check plant status. Plant stressors are multifaceted traits with fluctuating effects. The most effective approach to imaging is computer vision. The computer vision revolution is regarded as the best potential application in minimizing the workload of biotic stress detection facilitators, rendering it a first-class asset in botany and biotic stress detection (Wollburg et al., 202).

However, a significant number of hurdles remain concerning the explainability of AI and computer vision for plant biotic stress. AI and computer vision applications are inadequate or ineffective and necessitate a substantial financial commitment and enhanced accuracy for participants to select them as the most promising research area in plant science. Farmers, researchers, and hospitals may use data to make big decisions in the future (Ashwini & Sellam 2024). With the extension of precision agriculture and plant disease detection into deep neural networks, forward thinkers and researchers have come up with a solution that other large data may benefit from in terms of validity. Deep learning has attracted enormous interest from many researchers in the field of explainability diagnostic analysis prevention research. Yet, according to clarification in AI, it has the properties of machine learning, deep learning, and the salvation of the explanations within the moderation themselves (Makhubu et al., 2024). There is not a strong link between average time declared and actual time, as the length up to date needs fast-tracked and outlier interpretation.

The need for efficient plant stress detection and classification within Sub-Saharan Africa (SSA) is paramount for eliminating hunger and food insecurity by 2025, as per the African Union Summit, Agenda 2063, and the global sustainable development goal of zero hunger by 2030. This research introduces a novel enhanced deep convo-

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