CLASSIFICATION OF CASSAVA LEAF DISEASES USING DEEP LEARNING MODELS

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING (M.Eng.) DEGREE IN INFORMATION AND COMMUNICATION ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE

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ACCEPTANCE

This is to affirm that this dissertation has been accepted in partial fulfillment of the requirements for the award of a Master of Engineering in Information and Communication Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria.

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DECLARATION

I, SALAMI, FAITH IFEDOLA (19PCK01992), declare that this dissertation is a representation of my work and is written and implemented by me under the supervision of Dr. Oluwadamilola I. Oshin of the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria. I affirm that the dissertation has not been submitted elsewhere, in whole or in part, for granting any degree. This dissertation acknowledges all sources of data and scholarly information used.

SALAMI, FAITH IFEDOLA

Signature and Date

CERTIFICATION

We certify that the dissertation titled **"CLASSIFICATION OF CASSAVA LEAF DISEASES USING DEEP LEARNING MODELS"** is an original research work carried out by **SALAMI, FAITH IFEDOLA (19PCK01992)** meets the requirement and regulations governing the award of Master of Engineering (M.Eng.) degree in Information and Communication Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated first and foremost to God Almighty, the custodian of all wisdom, knowledge, and understanding, for His grace and favour throughout this research. Then to my family for their endless support and love.

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LIST OF ABBREVIATIONS AND SYMBOLS

*	Convolution
∑	Summation
ADAM	Adaptive Moment Estimation
AI	Artificial Intelligence
BLS	Brown Leaf Spot
CBB	Cassava Bacterial Blight
CBSD	Cassava Brown Steak Disease
CGM	Cassava Green Mottle
CMD	Cassava Mosaic Disease
CNN	Convolutional Neural Networks
DL	Deep Learning
DN	Deep Neural Network
FFT	Fast Fourier Transform
FN	False Negative
FP	False Positive
GMD	Cassava Green Mite Damage
GPIO	General purpose input/output
GPU	Graphical Processing Unit
ILSVRC	ImageNet Large Scale Visual RecognitionChallenge
ML	Machine Learning
R-CNN	Region-based Convolutional Neural Network
ReLU	Rectified Linear Unit
ResNet	Residual Network
RMD	Red Mite Damage
RPN	Region Proposal Network
RPN	Region Proposal Network
SDG	Sustainable Development Goal
SGD	Stochastic Gradient Descent
TN	True Negative
TP	True Positive
VGG	Visual Geometry Group

ABSTRACT

Agricultural production, both qualitative and quantitative, yields economic benefits, which can be realized through crop monitoring, disease detection, and prevention. The cassava plant is renowned for being a rich source of carbohydrates, yet it is susceptible to a number of diseases that threaten food security in sub-Saharan Africa. Traditional methods of identifying plant diseases involve manual inspection of the plants which becomes impractical with a vast expanse of farmlands; thereby, necessitating the need for automation. Disease detection through image classification and recognition is known to be the best and most cost-effective method for early detection and prevention of diseases to prevent further damage to a plant. However, some researchers concentrated on identifying just one form of cassava leaf disease while some classified just two forms of cassava leaf disease. Also, numerous methods that were proposed in the literature were trained and tested using the Makerere University AI Lab Kaggle dataset or Scholar sphere dataset. In this study however, three datasets were combined – Makerere University AI Lab dataset from Kaggle, Scholar Sphere Penn State University libraries dataset, and Oba-Ile Akure (OBA) cassava leaves dataset. Three convolutional neural network models were trained to classify cassava leaf diseases and healthy plants. The four types of diseases are Cassava Bacterial Blight (CBB), Cassava Brown Streak Disease (CBSD), Cassava Green Mottle (CGM), and Cassava Mosaic Disease (CMD). Pre-trained ResNet50 model was used on the OBA cassava leaves dataset for cassava leaf detection, which yielded a precision of 97%. Classification of cassava leaf diseases was done using MobileNetV2, VGG16, and Inception-ResNet-v2 models yielding accuracies of 88.47%, 96.58%, and 96.58% respectively. In addition, VGG16 yielded a precision of 96.58%, a recall of 94.8%, and F1 of 96.6% thereby outperforming other models used. The result obtained in this work presents an excellent way for classifying cassava leaf diseases quickly thereby helping farmers on the field to take actions quickly, consequently improving food security.

Keywords: Deep learning, Convolution Neural Network, Cassava leaf disease classification, Inception-ResNet-v2, MobileNet-v2, VGG16