**CHAPTER ONE**

**INTRODUCTION**

* 1. **BACKGROUND OF THE STUDY**

Plant diseases significantly affect agricultural productivity, leading to substantial economic losses and food insecurity. Dong et al. (2022) noted that traditional methods of plant disease detection rely on skilled agricultural professionals diagnosing diseases based on visual symptoms, which can be subjective, time-consuming, and dependent on experienced experts. Recent advancements in deep learning have demonstrated promising results in automating plant disease detection through image-based classification models. Convolutional Neural Networks (CNNs) and other deep learning architectures have shown high accuracy in identifying plant diseases from images, reducing the dependency on manual inspection. Mohanty et al. (2016) demonstrated that a deep convolutional neural network could achieve an accuracy of 99.35% in classifying crop species and diseases. Despite these advancements, challenges such as dataset variability, model generalization, and real-time application persist. This research focuses on enhancing plant disease detection using deep learning models, specifically for Corn (Maize) and Cassava species, to improve accuracy and accessibility for farmers.

Reducing crop loss and increasing agricultural productivity depend on the early diagnosis of plant diseases. Conventional techniques, which rely on human inspection, are laborious and prone to mistakes. Convolutional Neural Networks (CNNs), Vision Transformers, Resnet, EfficientNet etc. are examples of advanced deep learning models that have demonstrated great promise in automating the classification of plant diseases. Using a Mendeley dataset which was gotten by expert plant virologist in Ghana, this project aims to develop a high-performance deep learning model for crop disease identification. The Cassava, Cashew, Maize and Tomato (CCMT) dataset includes 24,881 raw pictures from 22 classes and the date of research by the authors was on April 26, 2023. I'll be concentrating on maize and cassava crops.

By leveraging deep learning techniques, researchers and agricultural stakeholders can develop systems capable of detecting diseases in crops such as Corn (Maize) and Cassava with high precision. These crops are vital to food security in many regions, and their susceptibility to diseases like maize leaf blight, streak virus, cassava mosaic disease, and bacterial blight makes early detection essential. Despite progress in AI-driven plant disease detection, challenges remain in optimizing models for diverse environmental conditions, addressing dataset biases, and developing real-time deployment solutions that can be used by farmers in the field.

This study aims to bridge these gaps by enhancing plant disease detection models using deep learning. By training and evaluating multiple architectures, integrating real-time user-input systems, and exploring ensemble learning techniques, this research seeks to improve the accuracy, efficiency, and accessibility of AI-driven plant disease detection solutions.

* 1. **STATEMENT OF THE PROBLEM**

Despite progress in deep learning for plant disease detection, many models still struggle with accuracy, generalizability, and real-time application. They often underperform on diverse datasets due to factors like varying lighting, image quality, and disease symptoms. Smallholder farmers in developing regions lack access to reliable disease detection tools, making early intervention challenging (Wang & Liu, 2024). Existing models also face limitations, such as imbalanced datasets, poor image diversity, and the lack of real-time capabilities, which hinder their practical use in agricultural settings. Additionally, many models require significant computational resources, making them unsuitable for low-resource farming communities. This study aims to improve the accuracy, efficiency, and accessibility of plant disease detection through optimized deep learning models.

* 1. **AIMS AND OBJECTIVES**
     1. **AIMS**

To use deep learning models and real-time image-based disease diagnosis to improve the precision and effectiveness of plant disease detection in cassava and maize.

* + 1. **OBJECTIVES**
* Conduct a comprehensive literature review on deep learning applications in plant disease detection.
* Preprocess and augment the dataset to develop and improve model generalization and robustness.
* Train and compare multiple deep learning architectures, including CNNs, EfficientNet, and newer models.
* Implement ensemble learning techniques to improve classification accuracy.
* Develop a real-time user-input system to detect plant diseases instantly.
* Evaluate model functionality and performance using standard metrics which are accuracy, precision, recall, F1-score and compare results with existing studies.
  1. **RESEARCH QUESTIONS**
* How effective are deep learning models in detecting diseases in maize and cassava species?
* Which deep learning architectures provide the best accuracy for plant disease detection?
* How can real-time user input enhance the efficiency of a crop disease detection system?
* What impact do transfer learning and ensemble learning techniques have on model accuracy?
  1. **JUSTIFICATION OF THE STUDY**

Agriculture is a crucial sector for food production and economic stability, particularly in regions reliant on staple crops like Corn and Cassava. Early and accurate detection of plant diseases can help mitigate crop losses and improve food security (Li et al., 2021). By leveraging deep learning models, this study seeks to provide a more efficient and accessible approach to plant disease detection, benefiting farmers, researchers, and policymakers.

The implementation of advanced deep learning techniques for plant disease detection offers several advantages. These models can process large amounts of data quickly and accurately, potentially outperforming traditional methods. Convolutional neural networks (CNNs) and deep learning techniques have shown promise in identifying subtle disease symptoms that traditional image processing methods might miss (Mohanty et al., 2016; Shrestha et al., 2020). Additionally, with the increasing availability of smartphones, these technologies can be made accessible to farmers in remote areas, democratizing access to advanced agricultural tools. By developing more effective disease detection methods, this study seeks to benefit a wide range of stakeholders in the agricultural sector, from individual farmers to researchers and policymakers, ultimately contributing to more resilient and productive agricultural systems worldwide.

* 1. **SCOPE OF THE STUDY**

This study focuses on enhancing plant disease detection for Corn (Maize) and Cassava species using deep learning techniques. The research includes data collection from publicly available datasets which is the Mendeley dataset which was gotten from expert virologists in Ghana (Mensah Kwabena et al., 2023), model preprocessing and exploratory data analysis, model training and evaluation, and implementation of a prototype system for real-time disease detection which is user input system in the code. The study does not cover other crop species or non-image-based detection methods. Also, this study does not involve building an application for it.

* 1. **REPORT THESIS OVERVIEW**

This dissertation is organized into several chapters. Chapter One introduces the research topic, problem statement, objectives, and justification. Chapter Two presents a literature review on plant disease detection and deep learning models. Chapter Three outlines the research methodology, including data sources and model development techniques. Chapter Four discusses the results and findings of the study. Chapter Five discusses the discussion and analysis plus documentation of the results while Chapter Six provides conclusions and recommendations for future research and applications.

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