**CHAPTER ONE**

* 1. **INTRODUCTION**

Agriculture is a crucial sector for global food security and economic stability, yet it faces significant challenges due to plant diseases. These diseases lead to reduced crop yields, food shortages, economic losses etc. Traditional methods for detecting plant diseases depend on expert visual inspection, which can be time-consuming, subjective, and prone to errors (Dong et al., 2022). Advancements in artificial intelligence (AI), particularly deep learning, have provided promising solutions for automating plant disease detection. Convolutional Neural Networks (CNNs) and other deep learning architectures have demonstrated high accuracy in classifying plant diseases based on image analysis. Mohanty et al. (2016) found that deep learning models could classify crop diseases with an accuracy of 99.35%, reducing the reliance on manual inspections. However, despite these advancements, existing models face challenges such as dataset biases, variations in environmental conditions, lightening, and difficulties in real-time deployment for practical use. The study will leverage the CCMT dataset, from Mendeley, containing 24,881 raw images collected by expert plant virologists in Ghana (April 26, 2023). By utilizing advanced deep learning architectures such as CNNs, ResNet, and EfficientNet etc, this project develops a high-performance model capable of accurately identifying diseases in these crops. the research also aims to address challenges in model generalization and real-time usability; by integrating real-time user-input. By improving early disease identification, the project will contribute to reducing crop losses, increasing agricultural productivity, and strengthening global food security.

* 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**
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To use deep learning models 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, VGG16, and newer models.
* Implement ensemble learning techniques to improve classification accuracy.
* Evaluate model functionality and performance using standard metrics which are accuracy, precision, recall, F1-score and compare results with existing studies.
* Develop a user-input system to detect plant diseases instantly.
  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 user input enhance the efficiency of a crop disease detection system?
* What impact do transfer learning, ensemble approach and other deep learning techniques have on model accuracy?
  1. **JUSTIFICATION OF THE STUDY**

Plant diseases pose a serious threat to agriculture, leading to economic losses and food insecurity. Traditional detection methods rely on expert visual inspection, which is slow and subjective (Dong et al., 2022). Deep learning, particularly CNNs, has shown great potential in automating disease detection with high accuracy. Mohanty et al. (2016) achieved 99.35% accuracy in classifying crop diseases using deep learning models. Despite these advancements, challenges remain, such as environmental variations affecting model performance and the need for real-time, farmer-friendly solution in which this study aims to provide according to the aims/objectives. By refining these models and integrating user input, this research seeks to provide a deep learning model that will improve accuracy to help farmers identify diseases early and reduce crop losses.

* 1. **SCOPE AND LIMITATIONS OF THE STUDY**

This study focuses on enhancing plant disease detection for 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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