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FINAL YEAR PROJECT INTERIM REPORT

FYP01-DS-T2430-0144

Plant Disease Detection using Deep Learning

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COMPUTER SCIENCE

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PLANT DISEASE DETECTION USING DEEP LEARNING

BY

NICHOLAS TAN ZHI XUAN

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MULTIMEDIA UNIVERSITY

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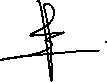
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# Declaration

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# Abstract

Ever since the explosive growth in data, convolutional neural networks (CNNs) have significantly advanced image analysis and processing systems. To date, U-Net and EfficientNet are widely regarded as highly effective architectures in the imaging community for segmentation and classification tasks, respectively. However, challenges persist when working with limited or imbalanced datasets, as these architectures may suffer from reduced performance or overfitting.

This research aims to investigate and compare the performance of a U-Net segmentation model combined with an EfficientNet classification model to address these challenges. A system for medical image analysis will be developed using the proposed framework. U-Net will be employed for precise segmentation of anatomical structures, followed by feature extraction from segmented regions for classification using EfficientNet. A comprehensive evaluation will be conducted on a medical imaging dataset to assess the performance of the hybrid approach.

To enhance efficiency and accuracy, a data preprocessing pipeline including augmentation techniques and noise reduction will be implemented. Despite some challenges, such as computational resource requirements and handling class imbalance, preliminary results indicate that the proposed U-Net and EfficientNet-based system outperforms standalone models in terms of segmentation accuracy and classification precision. This research contributes to the development of a robust framework for integrating segmentation and classification in medical image analysis.

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# Chapter 1: Introduction

## 1.1 Background of the Research

Cassava, the second-largest provider of carbohydrates in Africa, is a staple crop essential for food security. It is predominantly grown by smallholder farmers across Sub-Saharan Africa due to its ability to thrive under harsh conditions. Approximately 80% of household farms in the region cultivate this starchy root. However, viral diseases such as Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD) are significant threats, often leading to poor yields and substantial economic losses.

Traditional methods for cassava disease detection involve visual inspection and diagnosis by government-funded agricultural experts. While effective, this approach is labour-intensive, costly, and inaccessible for many smallholder farmers. Additionally, such methods are limited in scalability, leaving numerous farms vulnerable to undetected disease outbreaks. The challenge is further compounded by practical constraints faced by farmers, such as reliance on low-quality mobile phone cameras and limited internet bandwidth for real-time disease diagnosis.

Recent advancements in data science and artificial intelligence provide an opportunity to address these challenges. Leveraging machine learning models, particularly deep learning techniques, can automate the identification of cassava diseases, enabling farmers to diagnose and treat diseased plants efficiently.

This research focuses on classifying cassava leaves into five categories: four disease types and a healthy leaf category. By developing an accurate and scalable classification system, the project aims to empower farmers with a tool to detect diseases early, potentially saving crops from irreparable damage and ensuring better yields.

## 1.2 Problem Statement

Traditional methods of identifying cassava leaf diseases rely on manual inspection by experts, which is often time-consuming, labour-intensive, and impractical for large-scale farms. Additionally, the lack of access to skilled professionals in remote farming areas further exacerbates the problem, leaving farmers unable to detect and mitigate diseases in a timely manner.

The emergence of deep learning, particularly Convolutional Neural Networks (CNNs), offers a promising solution for automating the classification of cassava leaf diseases based on visual symptoms. However, implementing CNN-based models poses challenges, such as achieving high accuracy with limited and imbalanced datasets, handling variations in image quality, and ensuring computational efficiency for deployment on resource-constrained devices.

Thus, there is a pressing need to develop a robust, accurate, and scalable CNN-based system for cassava leaf disease classification. Such a system must address the challenges of limited data, variations in disease symptoms, and the practical constraints of deployment, enabling farmers to diagnose and manage diseases effectively.

## 1.3 Research objectives

There will be two main objectives for this research, which include:

1. Design build and train Convolutional Neural Network for cassava leaf disease classification
2. Analyze and evaluate the performance between the proposed method and the existing methods

## 1.4 Project Scope

The scope for this research project includes:

1. Collect plant disease dataset for cassava plant leaf
2. Constructing Convolutional Neural Network
3. Analyze, evaluate and compare the performance of the proposed model and the conventional model

## 1.5 Gantt Chart

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Task/Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Learning and based research |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Literature Review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data Collections, Explorations and pre-processing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Design framework |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Design flow and methodology |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| prototyping |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Result evaluation/checking |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 1: Gantt Chart for FYP1

## 1.6 Summary

# Chapter 2: Literature Review

## Overview

## Heading

## Sub-heading

# Chapter 3: Theoretical Framework

# Chapter 4: Research Methodology

## 4.1 Overview

## 4.2 Dataset

## 4.3 Experiments

# References

# Appendix A