Maize Disease Detection using Deep Learning Models

Development of a lightweight model utilising ResNet and EfficientNet for maize disease detection.

INTRODUCTION

- Maize is a crucial crop for farmers in Ghana and West Africa, serving as both a food source and an economic backbone; however, farmers face significant challenges due to low yields caused by maize plant diseases.
- The main objective of this project is to develop a **lightweight model** to facilitate early detection and classification of maize plant diseases.
- This project leverages advanced models such as ResNet9 and EfficientNet4 to build a lightweight model using **image data** of maize plant leaf diseases.

METHODOLOGY

- The dataset consists of images from six different classes: **one healthy class and five disease classes.** A visual representation is shown in figure 3 and data distribution in figure 4.
- During the Exploratory Data Analysis (EDA) process, data analysis, cleaning and preparation were conducted to identify trends and gain insights into the distribution and characteristics of the disease classes.

Data Preprocessing & EDA → Model Development → Visualisation & Deployment

- Advanced computer vision models, **ResNet9** and **EfficientNet4** were developed to ensure robustness and accuracy in disease detection.
- Both models were subsequently integrated into the application's backend, with the model showing the highest confidence being used to display the detected disease.
- The application is built using **Streamlit**, leveraging its capabilities to create dynamic and interactive interfaces. Figure 1 below shows the architecture of the application.

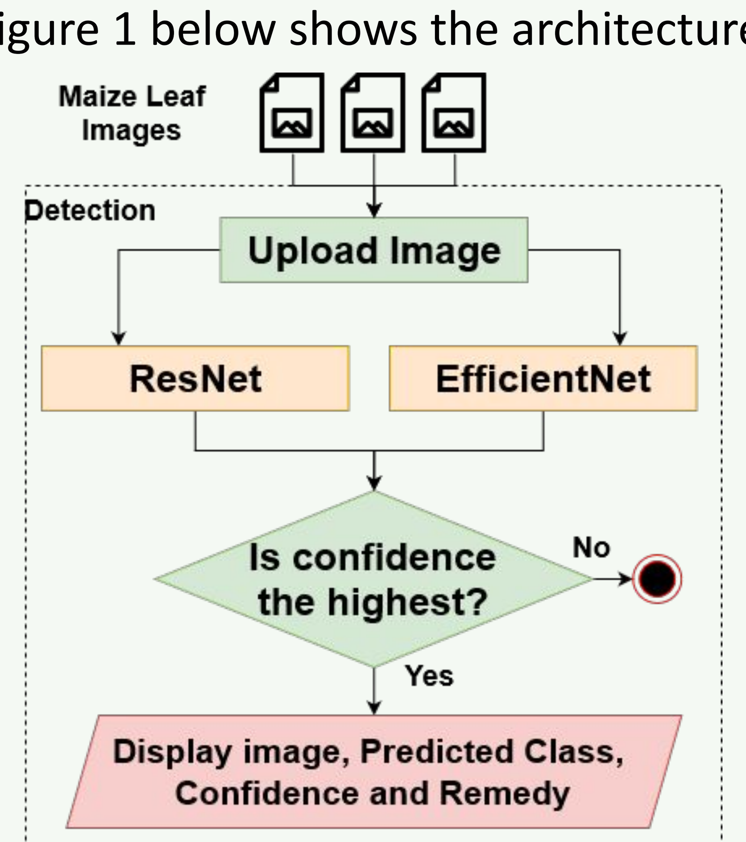

Figure 1: Application Architecture

RESULTS

	ResNet Accuracy	EfficientNet Accuracy
Precision	0.98	0.95
Recall	0.98	0.94
F1 Score	0.98	0.95

Table 1: Model performance matrices

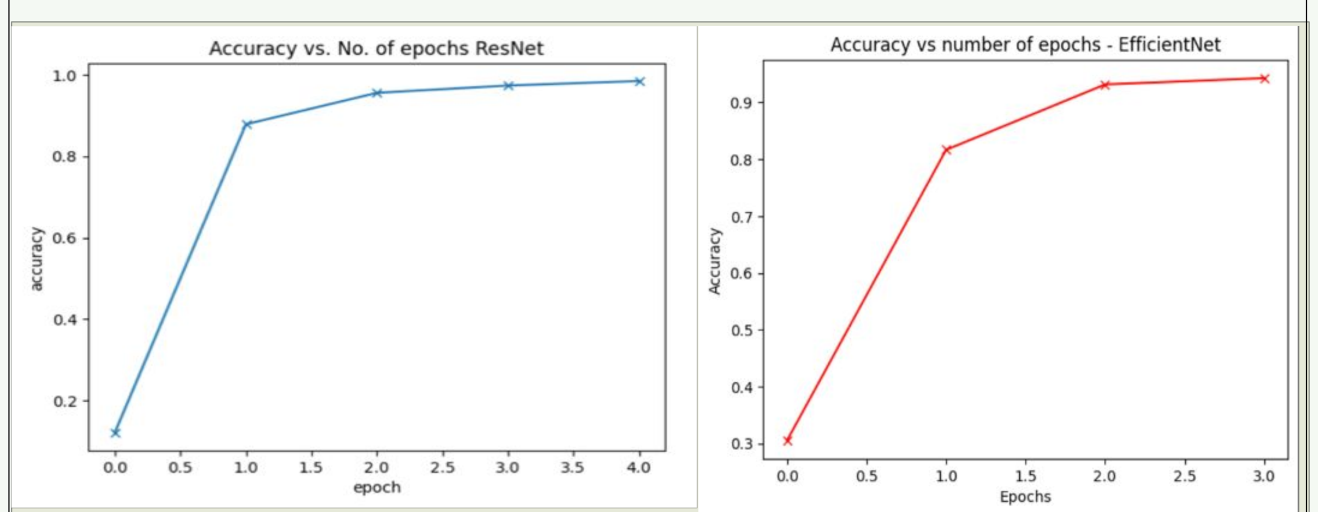

Figure 2: ResNet and EfficientNet model accuracy

DISCUSSION

- Table 1 shows the precision, recall, and F1 score of both models. The scores for both models are above 90%, indicating the models ability to distinguish between disease classes and healthy leaves.
- Figure 2 depicts the accuracy for ResNet and EfficientNet models. The ResNet model achieved an accuracy of **98.44%**, while the Efficient Net achieved an accuracy of **94.3%**.
- Both models F1 Score indicate that the class imbalance does not affect model performance.
- It can be observed from figure 5 and 6 that both models performed exceptionally well, achieving a classification accuracy above **90%**.

CONCLUSION

The proposed model presents a promising solution to address the agricultural challenges faced by farmers in Ghana and West Africa. The model's performance underscores its practicality in real-world scenarios and its robustness in enhancing disease management in maize plants.

Future work: Model parameter optimisation using grid search, and expansion to other diseases and plants need to explored. Additionally, both models can be used as feature vectors to be fed into a Machine Learning Multi-class model.

VISUALISATIONS

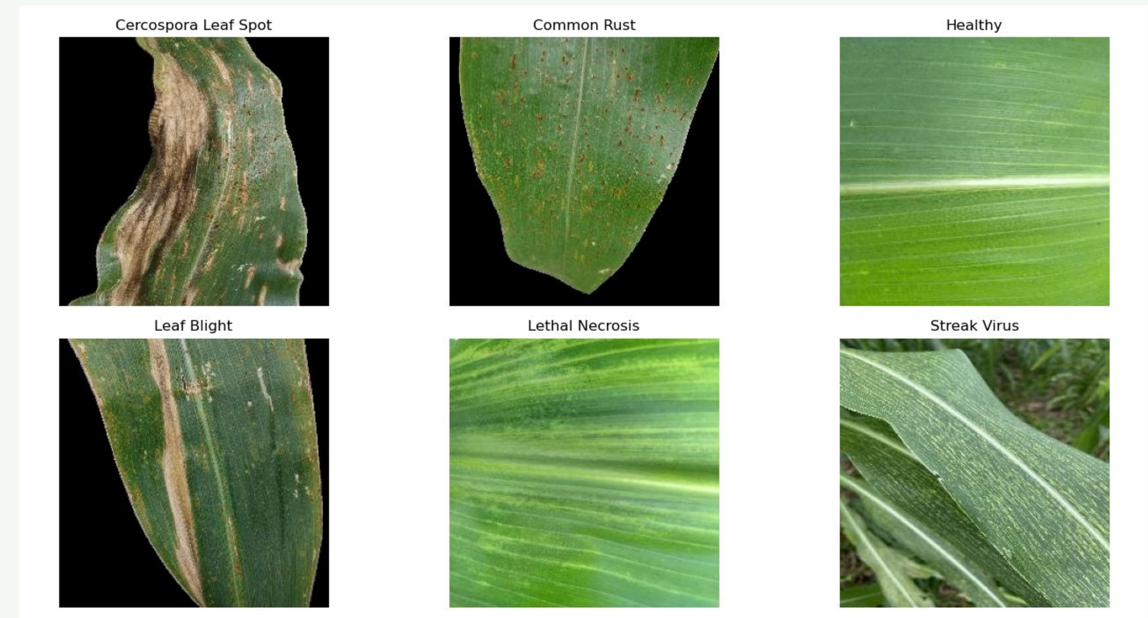

Figure 3: Visual representation of images from each disease class

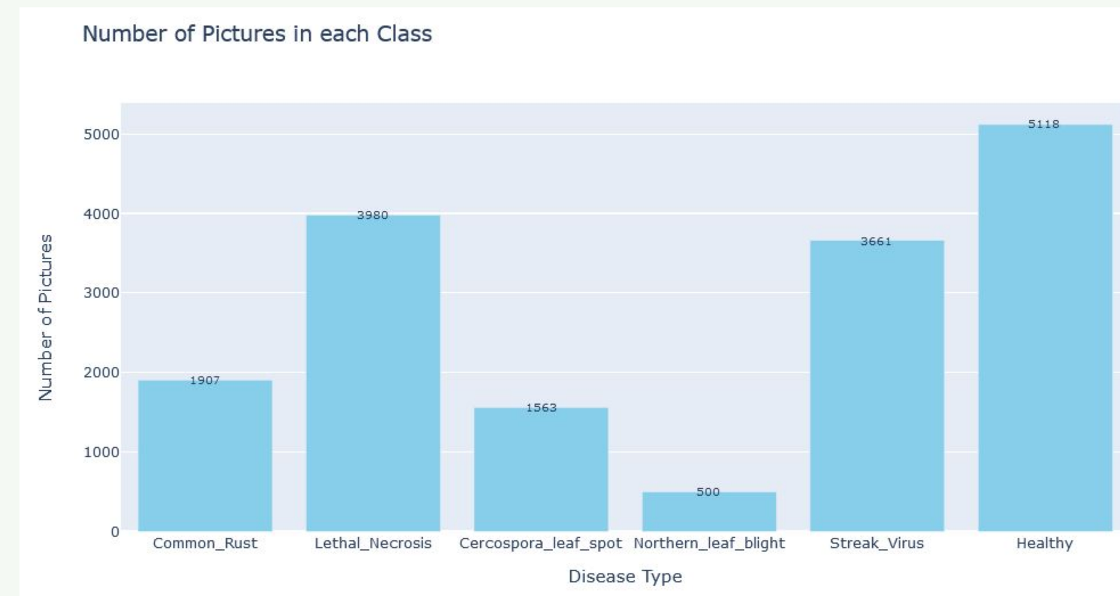

Figure 4: Images distributions across disease classes

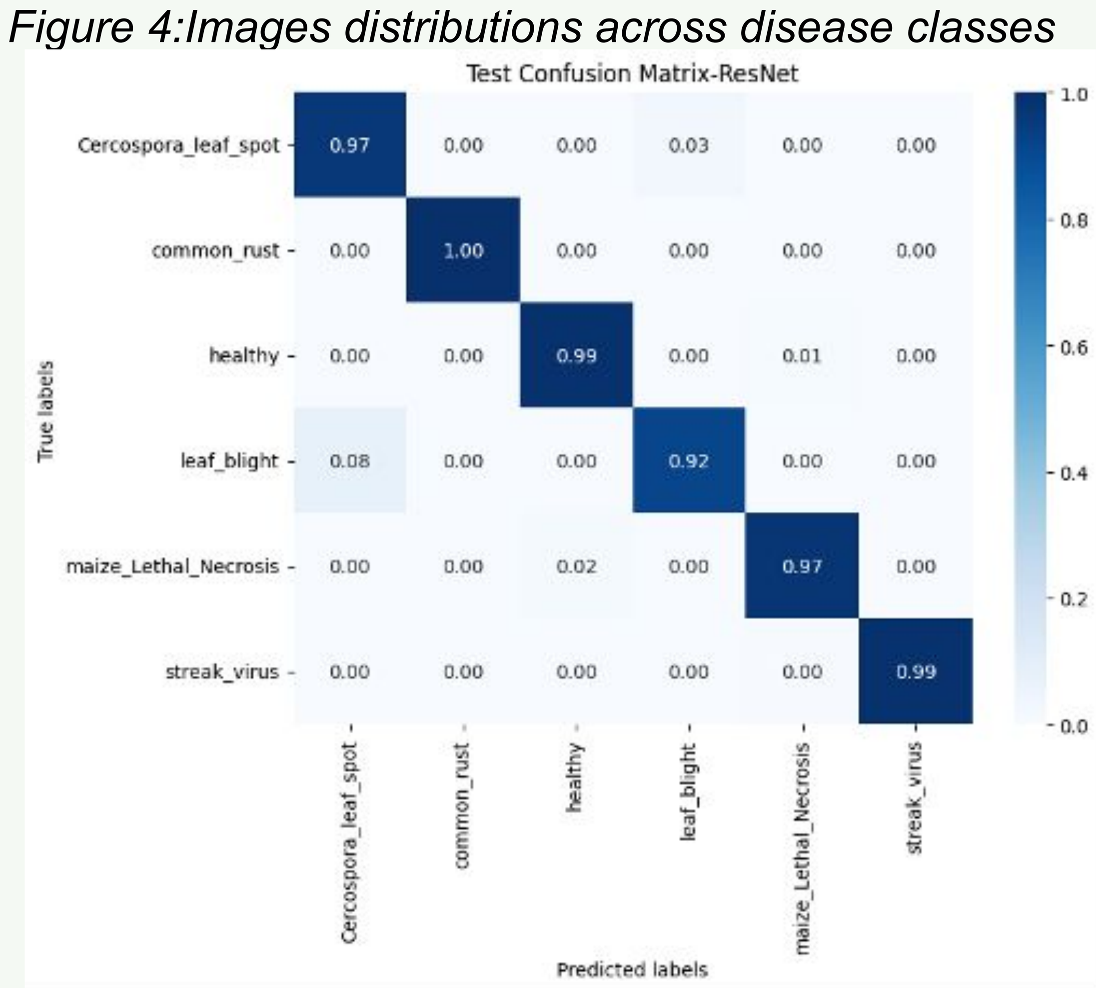

Figure 5: ResNet Confusion Matrix

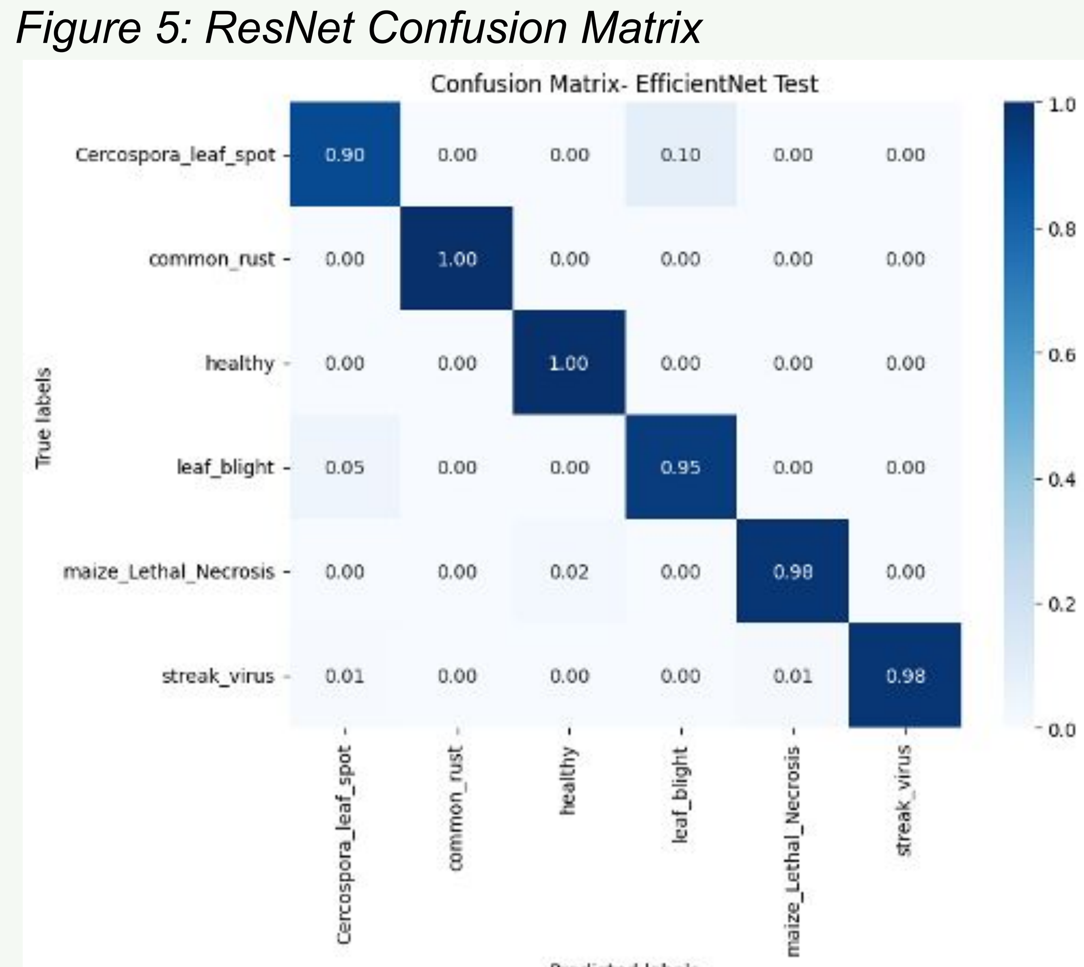

Figure 6: EfficientNet Confusion Matrix

Boikanyo Radiokana, Wendy Mapamela, Partner: Stephen E.Moore , University of Cape Coast, Ghana

Department of Computer Science
Faculty of Engineering, Built Environment and Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Capstone Project - MIT 808

Course Coordinators:
Dr. Vukosi Marivate (vukosi.marivate@cs.up.ac.za)
Abiodun Modupe (abiodun.modupe@cs.up.ac.za)

Scan me