Convolutional Neural Network Deep Learning Model for Early Detection of Streak Virus and Lethal Necrosis in Maize: A Case of Northern-Highlands, Tanzania

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DOI: https://doi.org/10.1007/978-3-031-56576-2_8

Abstract

In the Tanzanian context, maize is the dominant food crop that serves as a significant common and traditional food being grown in about 45% of the country's farmland. However, its productivity is hindered by diseases that diminutions its quality and quantity. Maize streak virus (MSV) and maize lethal necrosis (MLN) are the two diseases that have been reported by farmers to dominate for ages. These diseases are likely to be cured if early detected. Nevertheless, sophisticated tools for detecting these diseases are still lagging behind the fast pace of technology in developing countries like Tanzania. That being the case, this study aims to fill the gap by investigating the need and development of a deep learning model for early detection of these two diseases. In doing so, a deep learning solution based on Convolution Neural Networks (CNN) has been developed to predict the early occurrence of these diseases in maize leaves. A CNN model was developed from scratch with a total of 1500 datasets belonging to three classes namely; healthy, MLN, and MSV. The developed model attained a validation accuracy of 98.44%. Since the validation accuracy is more than 70% then, this model is reliable and have potential of being adopted in early prediction of MLN and MSV diseases. However, the vision transformer (ViT) model will be developed, and its efficiency be compared with CNN. The model with best results will be deployed in a mobile device, ready for use by farmers in real-life environments.