Machine Learning To Detect Fusarium Wilt of Banana

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Background: Cavendish banana production is seriously threatened by Fusarium wilt tropical race 4, characterized by leaf decay patterns detectable through image recognition technology. Although neural networks such as as Biodiversity International's Tumaini app have attempted to detect banana disease, none have harnessed transfer learning as a classification strategy. Methods: Applying random yet realistic transformations, such as horizontal flipping or small random rotations artificially introduced diversity into Biodiversity International's open-source training dataset of approximately 1,500 images. The dataset was used to train a transfer learning model on VGG16, ResNet50, and InceptionV3. Results: Of the three networks, ResNet50 exhibited superior performance, with the highest average accuracy of 0.98. These results may be attributed to ResNet50's unique residual block architecture. Skip connections in ResNet50 carry gradient updates to upper layers, whereas in VGG16 and InceptionV3, the absence of identity mappings may have led to a vanishing gradient problem. ResNet50 is the only network to increase consistently in average accuracy, suggesting that VGG16 and InceptionV3 may have converged at an earlier epoch and overfit on the dataset, reducing validation accuracy. Conclusions: This model presents a proof-of-concept for applying transfer learning to detect plant disease. The results indicate that for this image classification task, ResNet50 outperforms VGG16 and InceptionV3 as a transfer learning base. This model outperforms the state-of-the-art banana disease diagnostic tool, the Tumaini app by 8%. In a future study, the model may be integrated into a mobile application or scanning devices for banana farmers worldwide.

Awards Won:

Second Award of $2,000

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