plantnosis - An AI Plant Diagnostic Tool.

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Abstract

Plant disease is an ongoing challenge for smallholder farmers, which threatens income and food security. The recent revolution in Smartphone usage for computer vision applications has created an opportunity for image classification in agriculture. Convolution Neural Networks (CNNs) are considered state-of-the-art in image recognition and offer the ability to provide a prompt and definite diagnosis. In this poster, the performance of a pre-trained model in detecting crop disease from leaves is investigated. The developed model is deployed as both a web and mobile application and is capable of recognizing plant diseases out of healthy leaf tissue and goes further to recommend/suggest treatments for the predicted disease. A dataset containing leaf images; captured in a controlled environment, is established for training and validating the model. Validation results show that the proposed method can achieve an accuracy of 82 %. This demonstrates the technical feasibility of CNNs in classifying plant diseases and presents a path towards AI solutions for smallholder farmers.

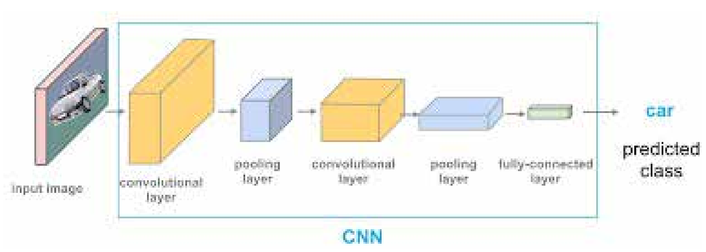
Introduction

One of our primary occupations in Nigerian is agriculture and Nigeria is ranked seventh in the latest World Bank's evaluation of countries' performance in agriculture and farming across Africa, behind South Africa, Kenya and Ghana, among others. This was revealed in World Bank's 'The Enabling the Business of Agriculture (EBA)' report December 2019.
Here in Nigeria, farmers cultivate a great diversity of crops. Various factors such as climatic conditions, soil conditions, various diseases, etc affect the production of the crops.

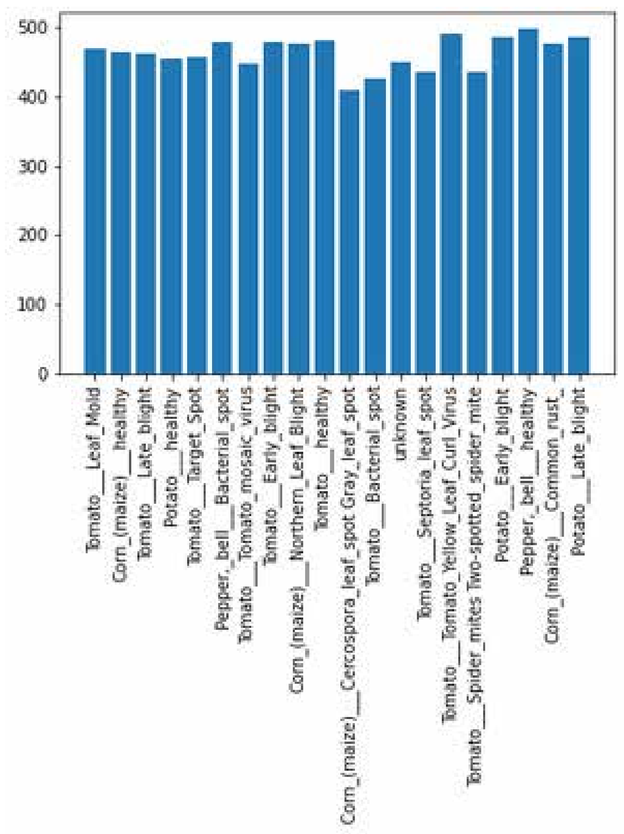
Currently, the existing method for plant disease detection is simply naked eye observation which requires more man labour, properly equipped laboratories, expensive devices, etc. And improper disease detection may lead to improperer pesticide usage

Methodology

The method we are adopting to detect plant diseases is image processing using Convolution neural network (CNN). This was eventually deployed as an edge predictive model on an android application for use.



To completely model this problem, we used a dataset containing images of various plant diseases gotten from kaggle. This dataset originally had 39 classes but was reduced to 19 to focus on plant diseases peculiar to Nigerian farmers e.g tomatoes, pepper and maize(corn).
In other to capture unknown classes to the CNN, we introduced a new label "unknown" which contains 70 randomly selected images from classes outside the 19 classes selected. This, therefore, made the total number of classes 20 (19 + Unknown). See figures 1 for class distribution.



Data preprocessing

All images are captured in a controlled environment. Due to this, model bias is expected, to solve this problem:

1. randomly selected images were generated with new backgrounds using neural-style transfer (Image superimposition),

2. data augmentation (such as random rotation, shifts, shears, flips etc).and regularization technique for modelling.

Model Architecture

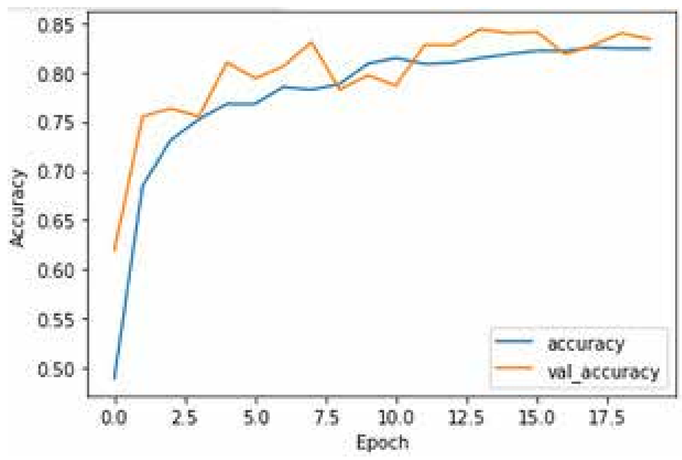
The Architecture used in modelling this problem is a convolutional neural network of 3 convolutional layers, 3 fully connected layers, with some 2 dropout layers; this summed up to a trainable param of 32.6 million. The diagram below shows the model architecture. Having built the model the architecture was pruned using tensorflow_model_optimization toolkit (pruning API).

Layer (type)	Output Shape	Param #
input_6 (InputLayer)	[(None, 224, 224, 3)]	0
xception (Functional)	(None, 7, 7, 2048)	20861480
global_average_pooling2d_2 (	(None, 2048)	0
dense_8 (Dense)	(None, 3000)	6147000
dropout_4 (Dropout)	(None, 3000)	0
dense_9 (Dense)	(None, 1500)	4501500
dropout_5 (Dropout)	(None, 1500)	0
dense_10 (Dense)	(None, 100)	150100
dense_11 (Dense)	(None, 20)	2020

Total params: 31,662,100
Trainable params: 10,800,620
Non-trainable params: 20,861,480

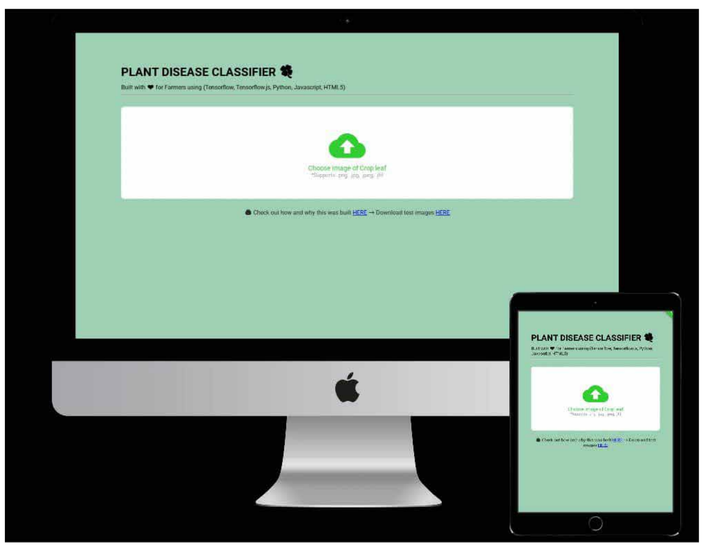
Result

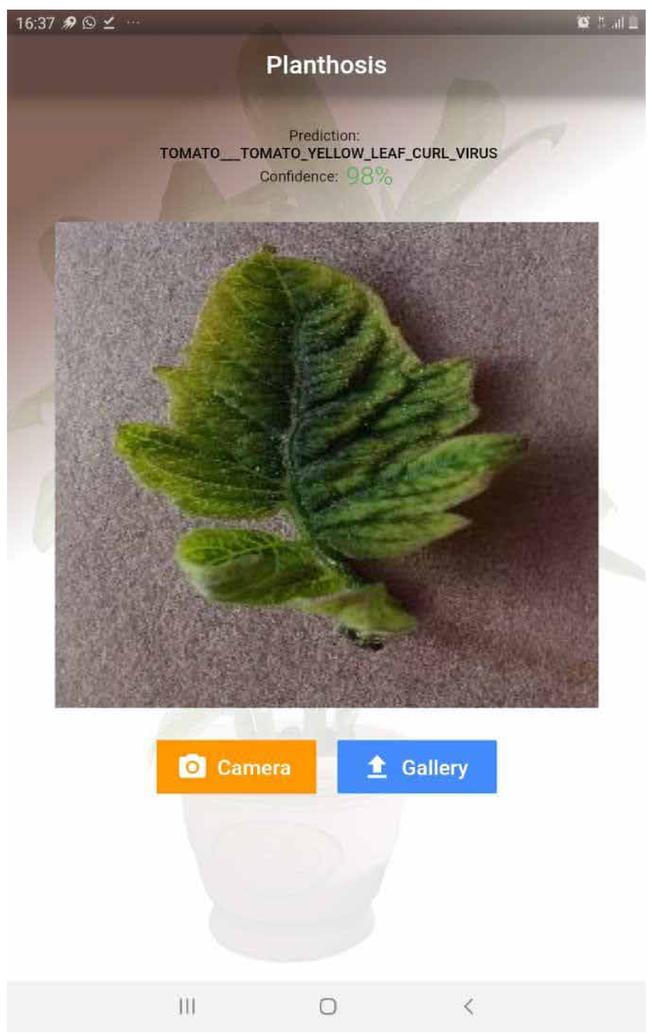
The following are the obtained results of the modelling. The metric used in evaluating the architecture is 'accuracy'. The optimizer used is 'Adams' and the loss metric is 'categorical cross-entropy'. The figure below shows the train and validation accuracy for 60 epochs of training. At the end of the training, the data architecture had an accuracy of 83% on unknown data, 75% on known data.



Model Deployment

Web app:
https://rexsimiloluwah.github.io/PLANT-DISEASE-CLASSIFiER-WEB-APP-TENSORFLOWJS/index.html





Refrences

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2. https://docs.google.com/document/d/1TrG-gR_5JWN_eg2bZYyy_7oL-RaC_jYI25C_zYHwI55ZM/edit?usp=sharing
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