PLANT DISEASE CLASSIFICATION USING DEEP LEARNING MODELS

An end to end Android application which detects plant diseases using deep learning model

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INTRODUCTION

Plant diseases pose a threat to food security globally as they contribute 10–16% of global crop losses each year costing an estimated US$220 billion. In Africa alone, 80% of agricultural production comes from smallholders and the identification of plant diseases remains difficult due to the lack of necessary infrastructure. Research was carried out to realize an intelligent system of detection of plant diseases based on simple images of leaves of healthy and diseased plants, using deep learning methods to help farmers overcome this problem.

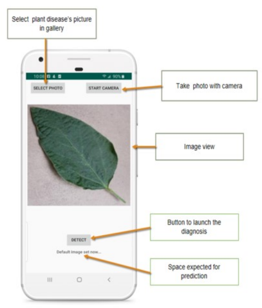
For this purpose, two models of convolutional neural networks were developed and trained using plantVillage's open dataset of 54,306 images of leaves containing 14 species, spread over 38 distinct classes of combinations [plants, diseases], including healthy plants.

The best performance achieved an accuracy of 93.01%. This high success rate makes this model a very useful advisory or early warning tool. An Android application was immediately developed to make it available to farmers. It should be noted, however, that this approach could be further improved by integrating several other varieties of plant species and diseases taken under actual crop conditions and from several geographical areas.

OBJECTIVES

- To build and compare CNN models that classify plant diseases
- To build an end to end AI system which detects plant diseases to help farmers
- To make the project open source

USED APPROACH



To date, convolutional neural networks seem to be the most appropriate method for image-based plant disease classification because they are the most efficient.

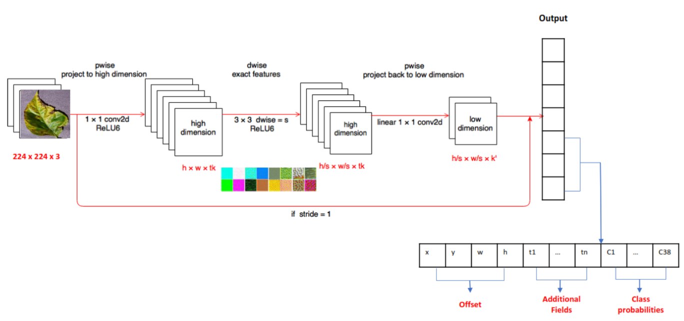
A. DATASET

We used PlantVillage's open dataset of 54 306 images of leaves containing 14 species, spread over 38 distinct classes, including healthy plants .

B. USED MODEL - TRANSFER LEARNING

Inception V3 - Preprocessing and the training Diagram Flow

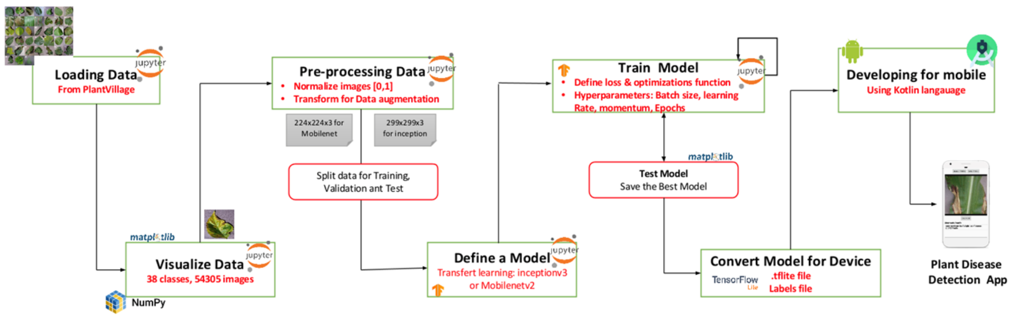
MobileNet V2 - Preprocessing and the training Diagram Flow



C. GOOGLE COLAB

CPU	Google Compute Engine backend
RAM	12.72 GB
DISK	358.27 GB

D. IMPLEMENTATION PROCESS



RESULTS

Model	Optimizer	Epoch	Training Accuracy	Training Loss	Validation Accuracy	Validation Loss	Execution Time
Inception v3	Adam	10	91,9%	0.482	93,89%	0.4227	9,126 s (2h30 min)
	RMSProp	10	90,69%	0.556	92,23%	0.434	9,126 s (2h50min)
MobileNet V2	Adam	10	93,01 %	0.3037	93,84 %	0.2925	5,253 s (1h28 min)
	RMSProp	10	92,69 %	0.401	93,13 %	0.317	5,459 s (1h36 min)

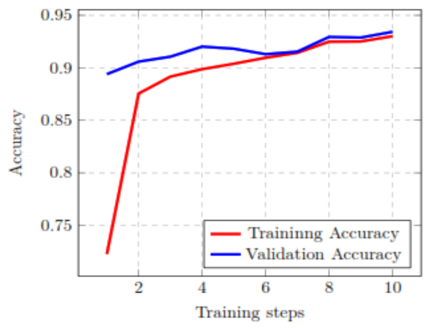


Fig. 10. MobileNet Accuracy

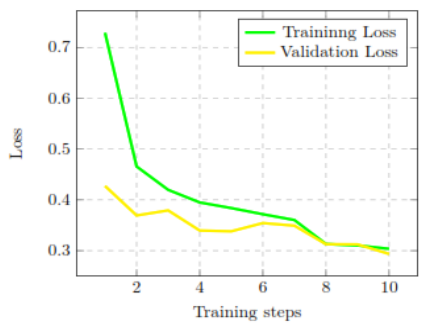
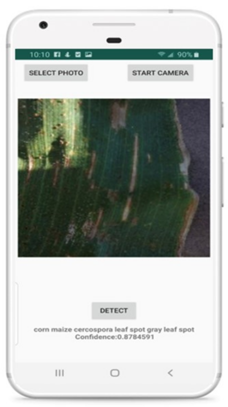
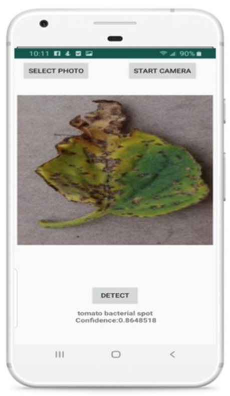


Fig. 11. MobileNet Loss





CONCLUSION

To detect plant diseases from a picture of an infected or healthy leaf, we developed two deep learning models based on two convolutional neural network architectures, namely Inception v3 and MobileNet v2.

The best performing model architecture was MobileNet V2, which achieved a accuracy of 93.01% with a 0.30% loss.

So we deployed this model in the android mobile platform.

So a farmer in a remote location could be warned of a possible threat to his crop and an agronomist could have a valuable advisory tool.

Despite the high accuracy of the developed system, it is far from being a perfect tool that can be used under all conditions, and it will be necessary to integrate several other varieties of plant species and diseases from several sources in different geographical areas. This task will require sufficient financial resources and expertise. Any investment is a risk that may or may not be profitable: but with innovation, you always win.