Automated Plant Disease Identification with Deep Learning AI for Mobile and Edge Devices

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Introduction

Project aim

Investigating the impact of image background removal on plant disease identification for mobile and edge devices.

Objective

To compare the performance of a TensorFlow Lite model with and without background removal for training and test images.

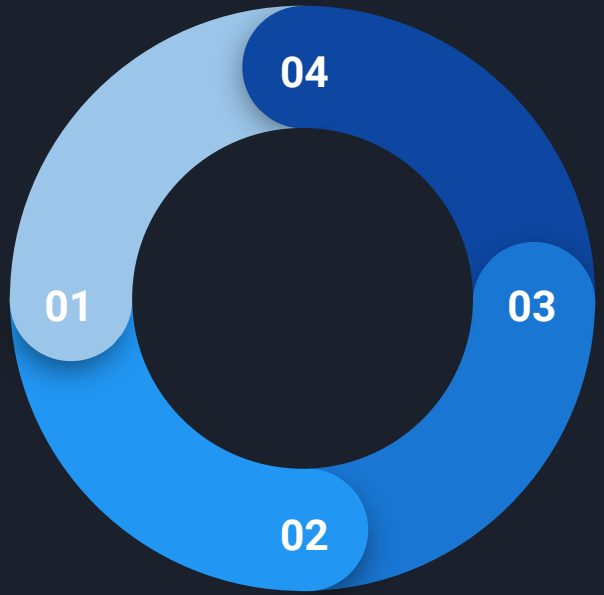
Methods

Data collection

16,585 tomato leaf images from 10 disease classes out of the PlantVillage dataset.

Background removal

Using ‘rembg’ in python to remove image backgrounds from a collection.

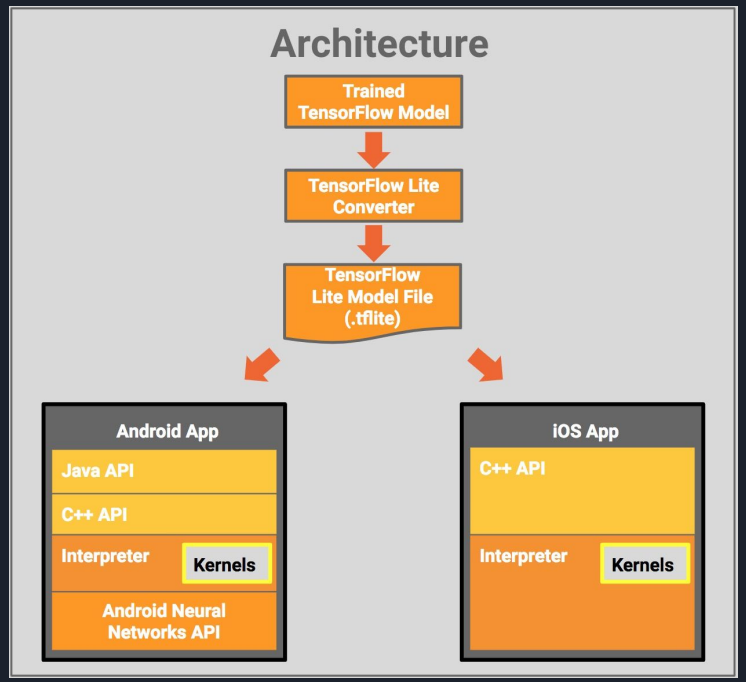


Training & Evaluation

Transfer learning to fine-tune MobileNets, adding layers to the CNN architecture.

Preprocessing

Using Image Data Generator to resize and process in batches.



TensorFlow Lite Advantages

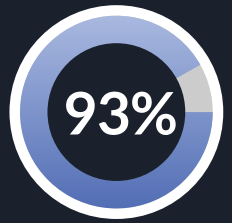
1. Efficiency
2. Small size
3. Interoperability
4. Portability
5. Edge-computing
6. Flexibility

Results: Trained TensorFlow Lite Models

1. **Model 1** : Trained with backgrounds
2. **Model 2** : Trained without backgrounds

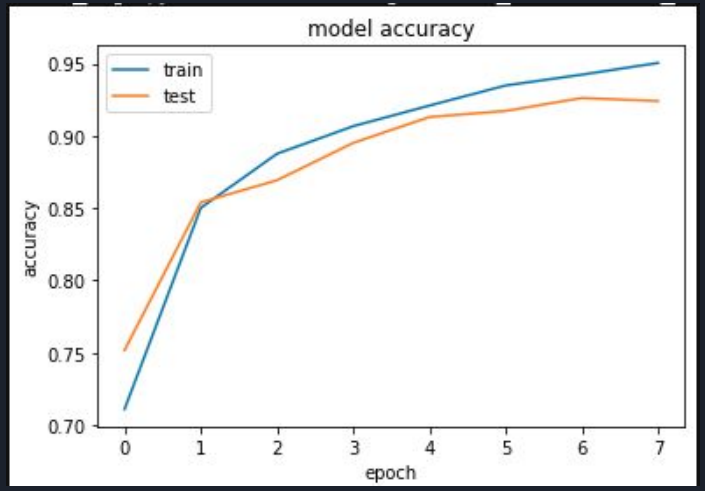
Results: Model 1
(WITH BACKGROUND)

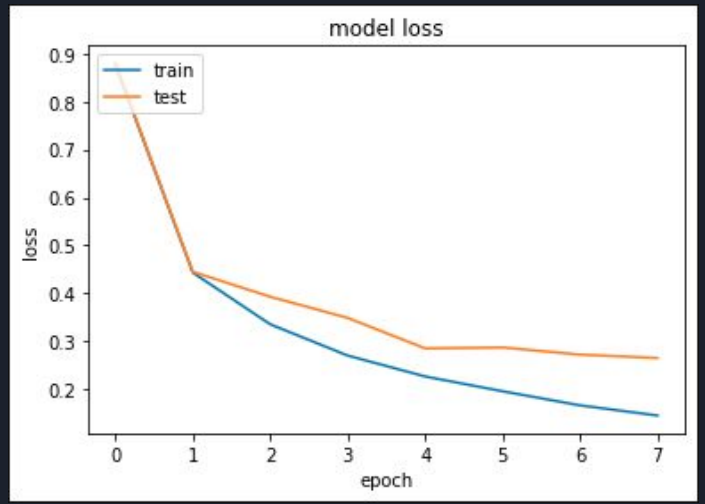
Train accuracy



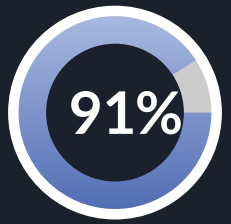
Validation accuracy

The loss and accuracy lines moved in a converging direction towards the 4th epoch but started to diverge from there.

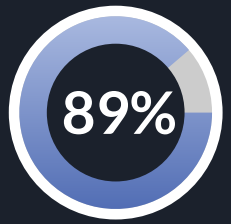




Results: Model 2
(NO BACKGROUND)

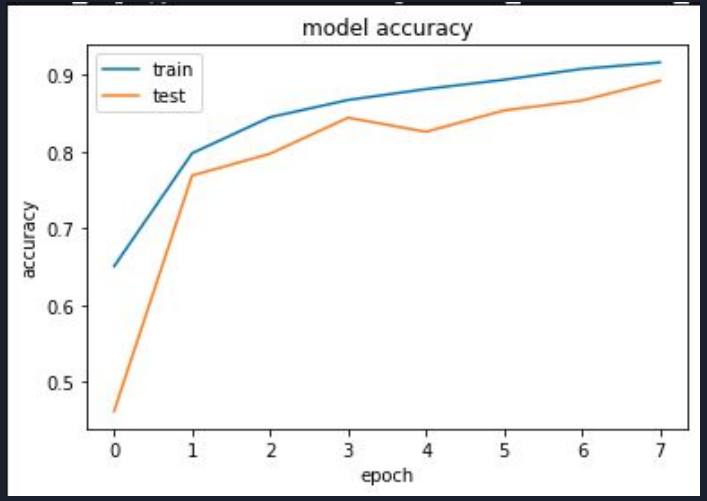


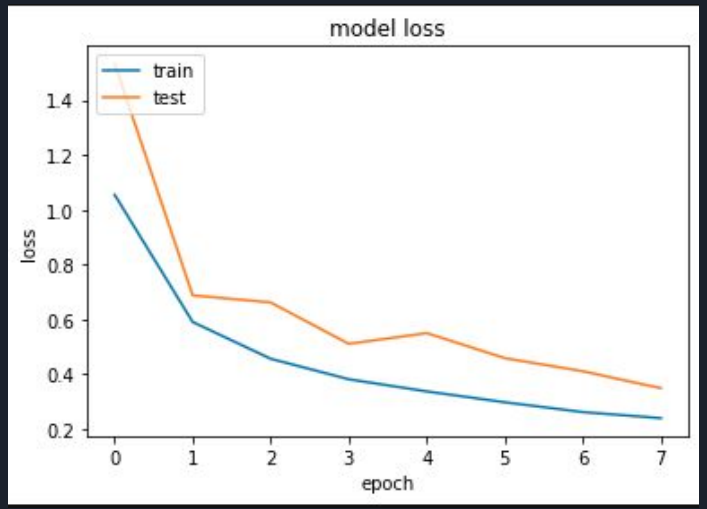
Train accuracy



Validation accuracy

The training and validation lines did not converge but were in that direction all through the epochs, and kept moving closer.

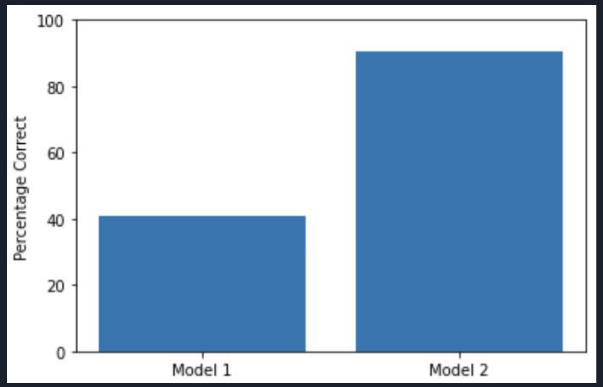




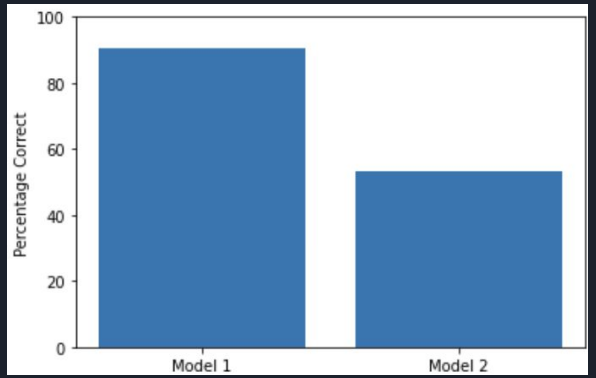
Findings

	Train acc	Val acc	Test acc (**Bg**)	Test acc (**NoBg**)
Model 1 **(with background)**	95%	93%	40%	**90%**
Model 2 **(No Background)**	91%	89%	**90%**	53%

Comparing prediction accuracy



Test images
with backgrounds

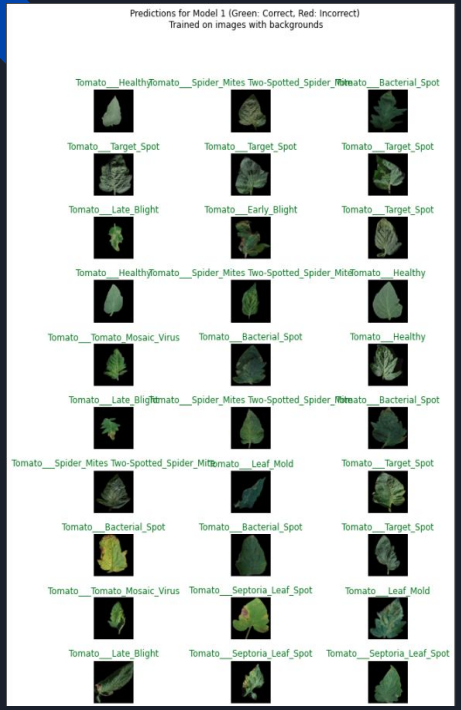


Test images with
backgrounds REMOVED

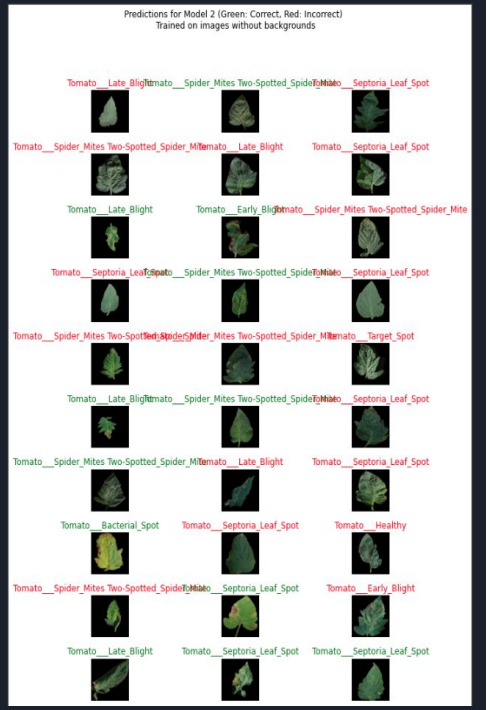
Model 1 (with Background)
Accuracy: 40%

Model 2 (No background)
Accuracy: 90%

Visualising predictions on test images with backgrounds.



Model 1 (with Background)



Model 2 (No background)

Visualising predictions on test images with backgrounds REMOVED.

Conclusion

1. Background removal is effective in improving model accuracy for plant disease identification.
2. Removing the background from train and test images may reduce the test accuracy.
3. The use of training images with different collection conditions may improve prediction accuracy.

Further research:

To evaluate the performance when the background of only the training images are removed, while valid and test backgrounds remain.

Limitations

1. The images used for training and testing have similar backgrounds and may cause overfitting.
2. Experiments were independent of any agric or plant expert.

Demo on Test images

1. Test images with background
2. Test images without background

Thank you!

Q&A