Crop Disease Auto-Localization and Classification

Prof. Jyothi R, G Deepank, R Tharun Raj, Aditya Verma and Shivani Bisht
Department of Computer Science and Engeneering, PES University

Problem Statement

The classification and identification of different crop diseases using various deep learning models (algorithms) and techniques. Followed by auto-localization of area of interest.

Background

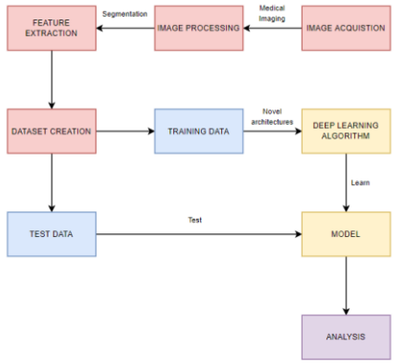
Learnt that hyperspectral imaging techniques in combination with proper deep learning models can be used to identify specific features that distinguishes a healthy plant from an infected one, with sufficiently high accuracy.
Use of genetic algorithm for disease detection and Chan-Vese algorithm for segmentation.

Dataset and Features/ Project Requirements/ Project Features

Dataset:A CSV file containing the file paths of all the images, their respective disease labels and the bounding box coordinates of their areas of interest was created to be parsed and preprocessed later while creating the model.
Requirements: H5 file, DICOM, Flask, Python, spreadsheet, Labellmg, and TensorFlow
Project features: Classification/Recognition and Auto-localization of the disease and providing solutions for the disease.

Design Approach/ Methods

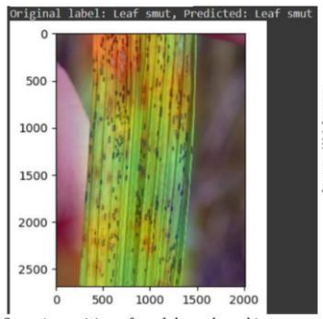
Performing classification with localization.
Images then subjected to 'medical imaging' using DICOM format.
Evaluation, visualization, analysis of different NN models. Grad-CAM analysis.



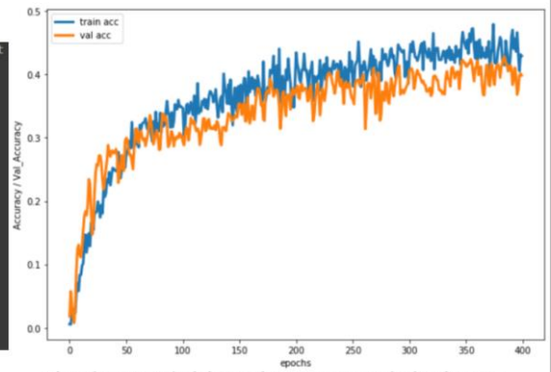
Constraints: Software and hardware on the user's side must be compatible with our requirements.
Lack of relevant and reliably curated datasets on plant pathology.

Results and Discussions

Testing: Comparison of time taken for DICOM segmented and unsegmented rice crop images
Train-Test split of 80:20 used to compare various NN models.
An IoU score of about 0.5 is obtained in bounding box regression.



Superimposition of model result and image



Plot of accuracy/validation dataset accuracy for localization

Summary of Project Outcome

VGG16 slightly better than Xception and MobileNet in crop classification.
Medical imaging achieves similar classification accuracy. It is also able to speed up model training.
Model does a decent job in localizing areas of interest. Localization can be further improved by labelling coordinates stringently. This idea is attempted in semantic segmentation.

Conclusions and Future Work

Different neural network architectures were used for identification, classification with localization like Resnet50, MobileNet, VGG16, and Xception networks and were then evaluated and analysed.
Employed the use of GRAD-CAM to validate the performance of the different neural network models.
Future Work: Experimented with adopting 'region proposals' strategy for finding areas of interest in crop disease detection like R-CNN, Fast-RCNN, Faster-RCNN etc.
A better coordinate features while labelling the localized areas of interest of a diseased leaf especially ones with multiple areas of interest.
Mask R-CNN can be used which tries to detect and segment the locations and shapes of the infected areas.

References

Nagasubramanian, K., Jones, S., Singh, A.K. et al. Plant disease identification using explainable 3D deep learning on hyperspectral images. Plant Methods 15, 98 (2019).
Konstantinos P. Ferentinos, Deep learning models for plant disease detection and diagnosis, Computers and Electronics in Agriculture, Volume 145, 2018, Pages 311-318, ISSN 0168-1699


Prof. Jyothi R


G Deepank


R Tharun Raj


Aditya Verma


Shivani Bisht