Early Disease Diagnosis for Rice Crop

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Research Aims

- To reduce the spread of damage, early disease diagnosis of rice crop using deep neural network model – Mask R-CNN
- Provide an easy to use solution to farmers

Introduction

Many existing techniques provide automatic estimation of crop damage due to various diseases. However, early detection can prevent or reduce the extend of damage itself. The limited performance of existing techniques in early detection is lack of localized information. We instead propose a dataset with annotations for each diseased segment in each image. Unlike existing approaches, instead of classifying images into either healthy or diseased, we propose to provide localized classification for each segment of an images. Our method is based on Mask R-CNN and provides location as well as extend of infected regions on the plant. Thus the extend of damage on the crop can be estimated. Our method has obtained overall 87.6% accuracy on the proposed dataset as compared to 58.4% obtained without incorporating localized information.

Methodology

A baseline CNN model and an advanced Mask R-CNN model

Mask R-CNN Model:

- Mask R-CNN based image data classification and localization method
- ResNet 101 as its backbone
- Two regression heads for healthy and diseased plant classification
- Fully connected layer predicts class label and bounding box coordinates
- Convolutional layers draws segmentation masks around predicted proposed regions.
- Model training is done on Google Cloud CPU
- Mean Average Precision is 0.65

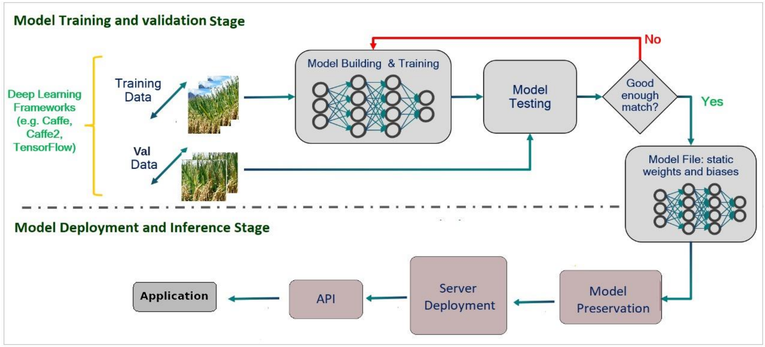
CNN Model:

- CNN based classification architecture for comparison with Mask R-CNN
- Three convolutional layers with batch normalization in between activation layer, followed by pooling layers
- Input to the fully connected layer is flatten out and class label is obtained from output layer. is used as activation function of hidden layers, whereas sigmoid is applied on the output layer
- Trained using SGD with Adam Optimizer

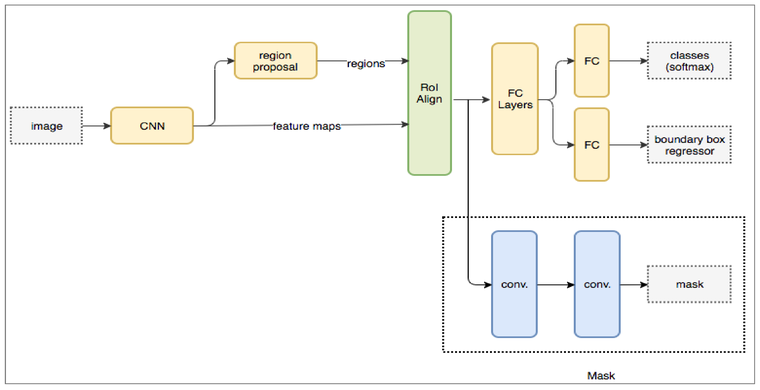
Dataset Collection

- Real Field Data collection from the fertile land near Chanab River
- 1700 mobile images
- Healthy and diseased images
- Land scape and portrait both orientation images

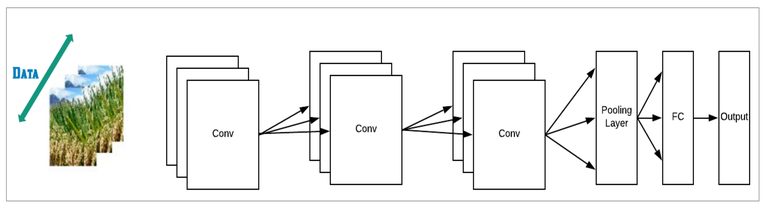
Disease Detection Methodology



Mask R-CNN Architecture*



CNN Architecture



* Jonathan Hui, Image segmentation with Mask R-CNN (May 2019)

Mask R-CNN Configurations

Configurable Parameter	Value
Backbone	resnet101
GPU Count	2
Image/GPU	1
Mini Mask Shape	(56, 56)
Steps/epoch	100
Image shape	[1024 1024 3]
Learning Momentum	0.9
Learning Rate	0.001

CNN Configurations

Configurable Parameter	Value
Batch size	50
Steps/epoch	30
Learning rate	0.01
Optimization algorithm	Adam
Image Shape	[256, 256, 3]

Original vs Localized Image

Results – CNN vs Mask R-CNN

Metrics	CNN	MaskR-CNN
Accuracy	0.584	0.876
Precision	0.598	0.821
Recall	0.662	0.962
F1 score	0.628	0.886

Discussion & Future Goals

- Dataset extension
- Development of multiclass disease detector
- Multilingual mobile application development