A Study on Paddy Disease Detection

using Color Co-occurrence Features

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Out-Line

- Introduction
- Why choose paddy disease detection?
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- Reference

Introduction

Paddy Diseases

Paddy Blust[1]

Paddy Disease

Narrow Brown Spot[2]

etc.

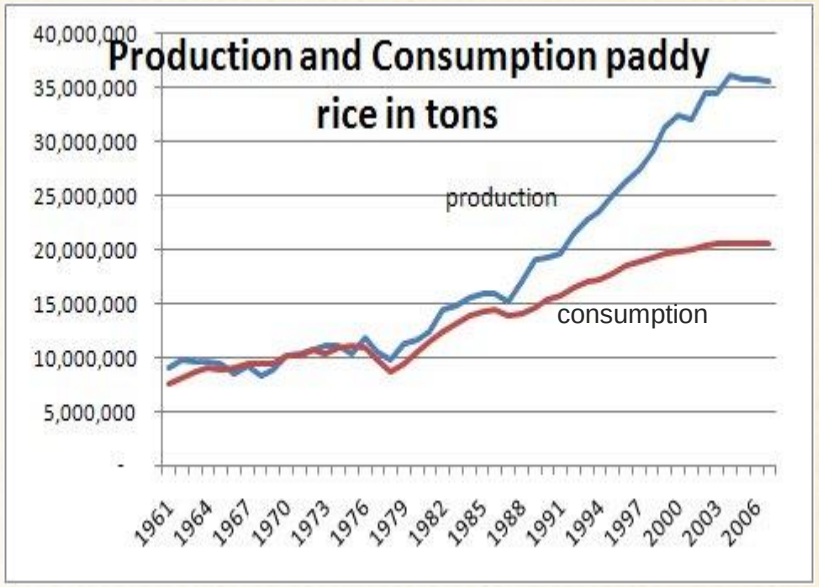
Brown Spot[3]

ref:

1. *http://farm6.static.flickr.com/5018/5576376970_659c176dbe.jpg*
2. *http://www.agriskmanagementforum.org/sites/agriskmanagementforum.org/files/narrow%20brown%20spot.jpg*
3. *https://bugwoodcloud.org/images/768x512/5390491.jpg*

Why Paddy Diseses Detection?

- As an agricultural country, Bangladesh gets it's one-sixth of national income from rice
- About 10.5 million hectares lands produce 25.0 million tons rice ever year [2014][1]
- Now govt.'s target is to produce another 30 millions over the next 20 years



Rice Production Statistics [1]

- Main Obstacle for gaining the target is those paddy diseases
- If disesases can detect easily with image processing, taking action will be faster

ref:

1. *ref::http://www.ruraldevelopment.info/siteimages/pro%20and%20con%20rice.jpg*

Background Study

- Studied about paddy diseases and list three diseases for our work
- Visited local agriculture office
- Gone through some related work and summarized

Reading Report [1]

ref:

1. http://s3.amazonaws.com/libapps/accounts/91304/images/reading_report.png

Workflow

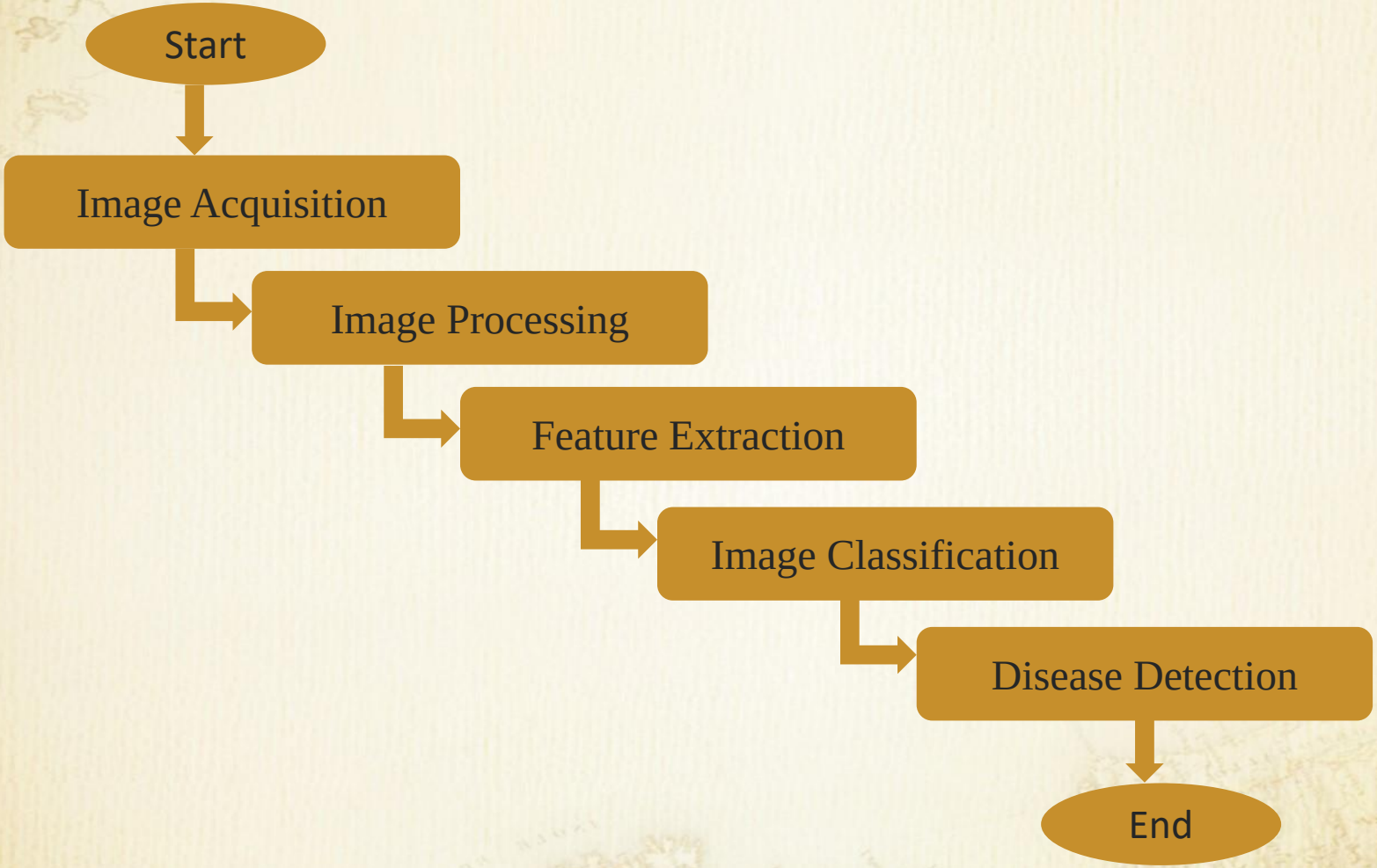


Fig: Block Diagram of proposed methodology

Image Acquisition

- Image acquisition is the first step as it is to get the dataset for training and testing any system

- Images has been taken from the internet

- Total images 218
  - Paddy Blast 87
  - Brown Spot 56
  - Narrow Brown Spot 35
  - Normal 10
  - Other 30

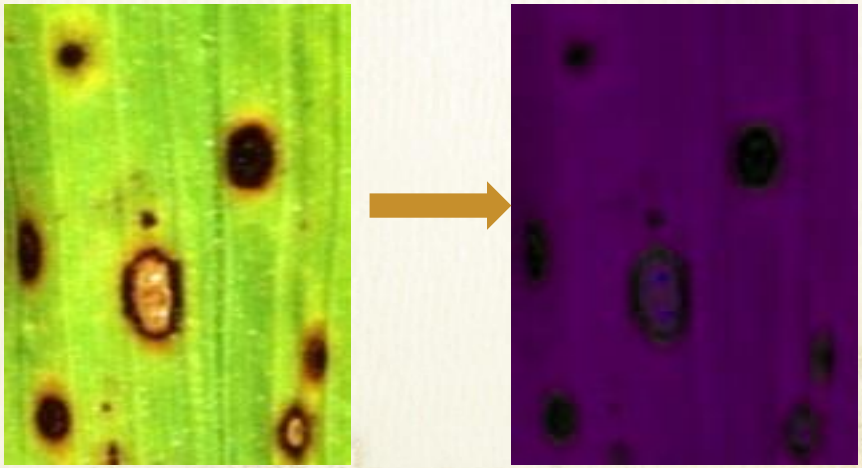
Internet [1]

ref:

1. https://pixabay.com/en/internet-global-earth-communication-1181587/

Image Processing

- Objective is to obtain better image with approximation of human color perception
- Lab image is produced form RGB image



RGB Image Lab Image

Feature Extraction [CCM]

- Gives spatial information about color image
- Distribution of co-occurring pixel values at given offset

$$C_{\Delta x,\Delta y}(i,j) = \sum_{x=1}^{n} \sum_{y=1}^{m} \begin{cases} 1, if\ I(x,y) = i\ and\ I(x+\Delta x, y+\Delta y) = j \\ 0, otherwise \end{cases}$$

- Offset value $(\Delta x, \Delta y)$ calculated by spatial direction

$$0°, \text{ then } \Delta x = 0,\ \Delta y = 1$$
$$45°, \text{ then } \Delta x = 1,\ \Delta y = 1$$
$$90°, \text{ then } \Delta x = 1,\ \Delta y = 0$$
$$135°, \text{ then } \Delta x = -1,\ \Delta y = 1$$

Textural Features

1. Angular Second Moment $f_1 = \sum_i \sum_j (p(i,j)^2)$
2. Contrast $f_2 = \sum_{n=0}^{N_g-1} n^2 \left\{ \sum_{i=1}^{N_g} \sum_{j=1}^{N_g} p(i,j) \right\}$
3. Correlation $f_3 = \frac{\sum_i \sum_j (ij) p(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$
4. Sum of squares: Variance $f_4 = \sum_i \sum_j (i-\mu)^2 p(i,j)$
5. Inverse Difference Moment $f_5 = \sum_i \sum_j \frac{1}{1+(i-j)^2} p(i,j)$
6. Sum Average $f_6 = \sum_{i=2}^{2N_g} i p_{x+y}(i)$
7. Sum Variance $f_7 = \sum_{i=2}^{2N_g} (i - f_8)^2 p_{x+y}(i)$

Textural Features [Cont.]

8. Sum Entropy $f_8 = -\sum_{i=2}^{2N_g} p_{x+y}(i) log\{p_{x+y}(i)\}$

9. Entropy $f_9 = -\sum_i \sum_j p(i,j) log\{p(i,j)\}$

10. Difference Variance $f_{10} = variance\ of\ p_{x-y}$

11. Difference Entropy $f_{11} = -\sum_{i=0}^{N_g-1} p_{x-y}(i)\ log\{p_{x-y}(i)\}$

12. & 13. Information Measure of Correction

$$f_{12} = \frac{HXY - HXY1}{max\{HX, HY\}}$$

$$f_{13} = (1 - exp[-2.0(HXY2 - HXY)])^{1/2}$$

14. Maximal Correction Coefficient $f_{14} = (second\ largest\ eigenvalue\ of\ Q)^{1/2}$

Where, $Q(i,j) = \sum_k \frac{p(i,k)p(j,k)}{p_x(i)p_y(k)}$

Feature Selection

1. Homogeneity
2. Angular Second Moment(ASM)
3. Energy
4. Information Measure of Correlation 1
5. Information Measure of Correlation 2

Classification

RGB Calculation

- RGB calculation is used to find out the normal leaf image
- Whole image scanned to calculate maximum and minimum value for each channel

- $93 \leq R_{min} \leq 211$ & $93 \leq R_{max} \leq 211$
- $142 \leq G_{min} \leq 222$ & $142 \leq G_{max} \leq 222$
- $64 \leq B_{min} \leq 155$ & $64 \leq B_{max} \leq 155$

Classification [Cont.]

- Simple Neural Network is used
- 4 classes (3 diseases + 1 other class)

minimized equation, $Y = WX + B$

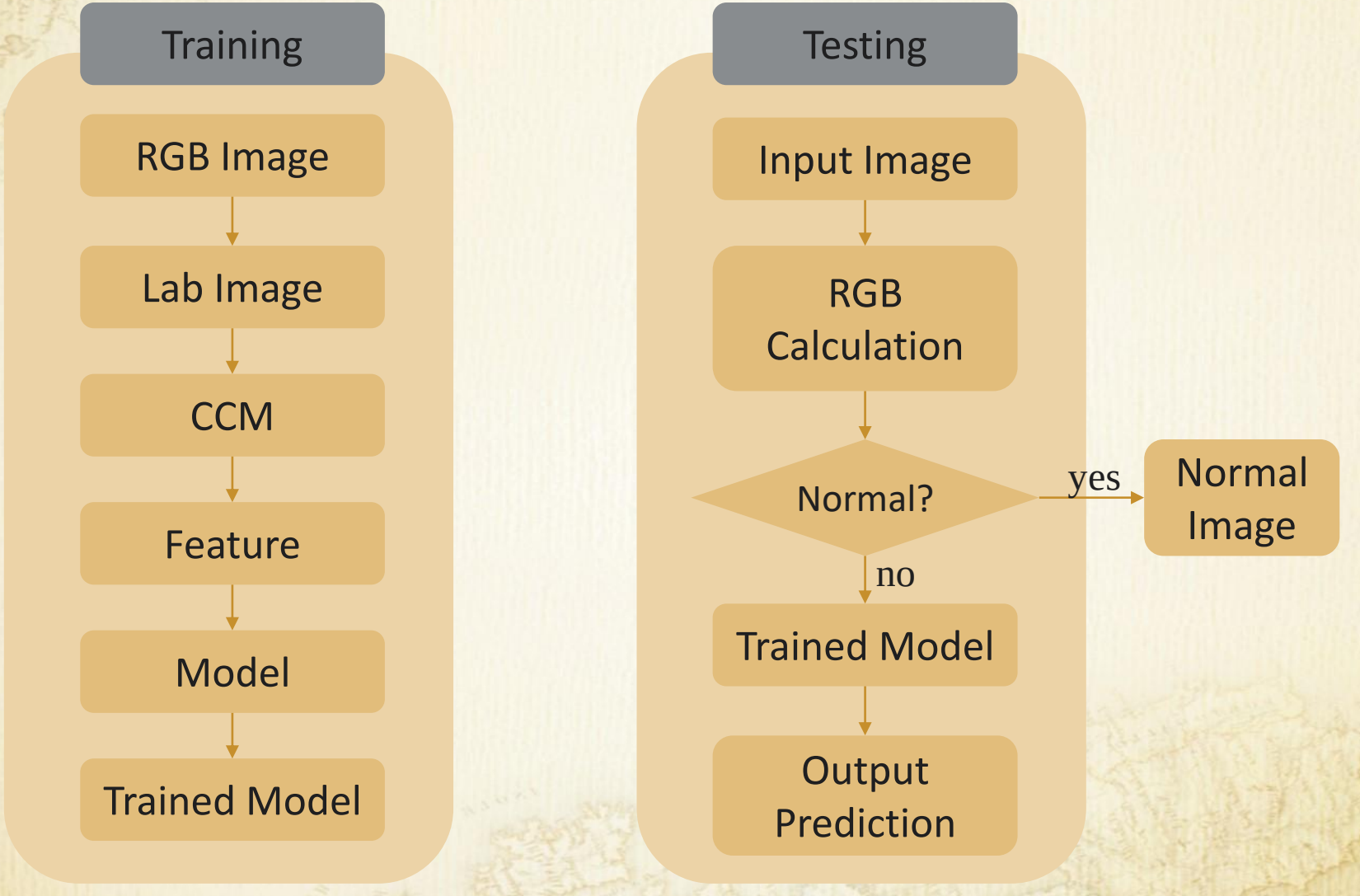
where, $X = Input\ Features$

$W = weights$

$B = biases$

- W and B are optimized by number of iterations
- Around *40,000* iterations are needed to get maximum *84%* accuracy
- Deep learning framework TensorFlow is used

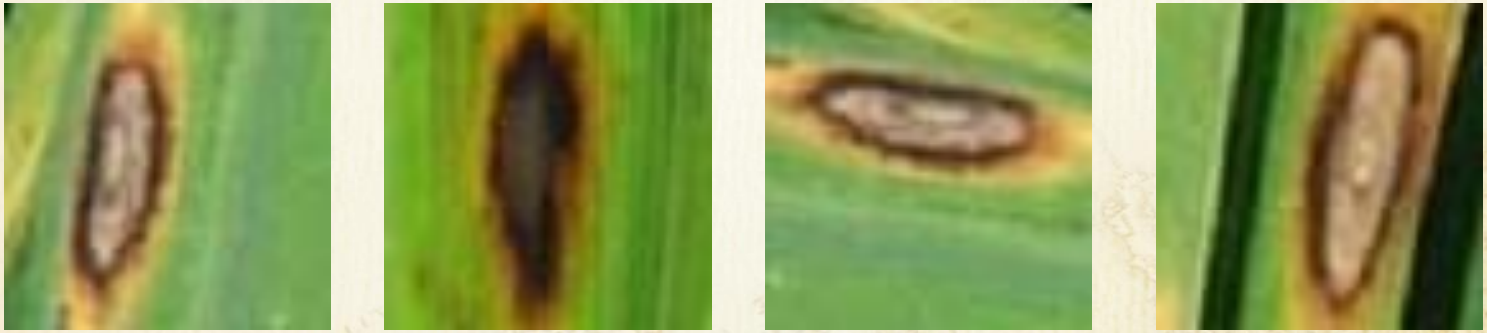
Model Overview



Result Analysis

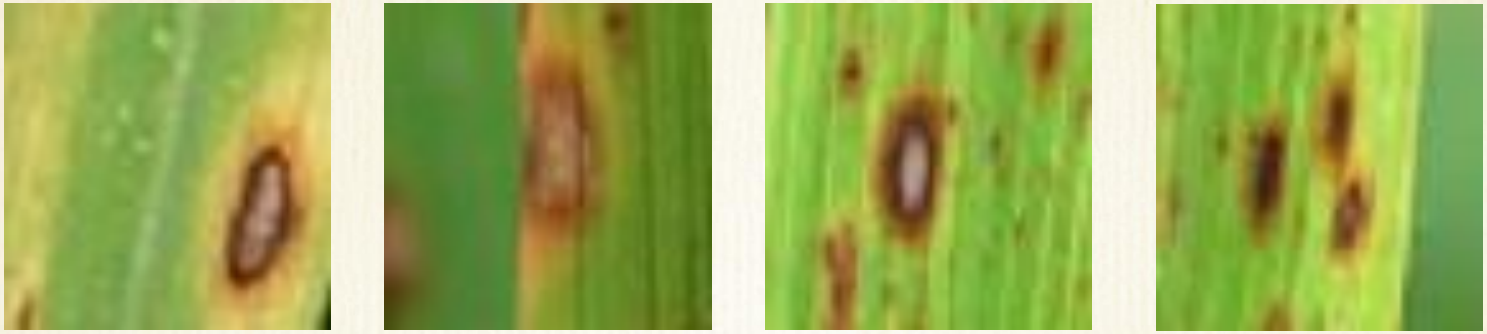
- Paddy Blast (Accuracy = *88.51%*)
  - Correctly Classified

  - Incorrectly Classified

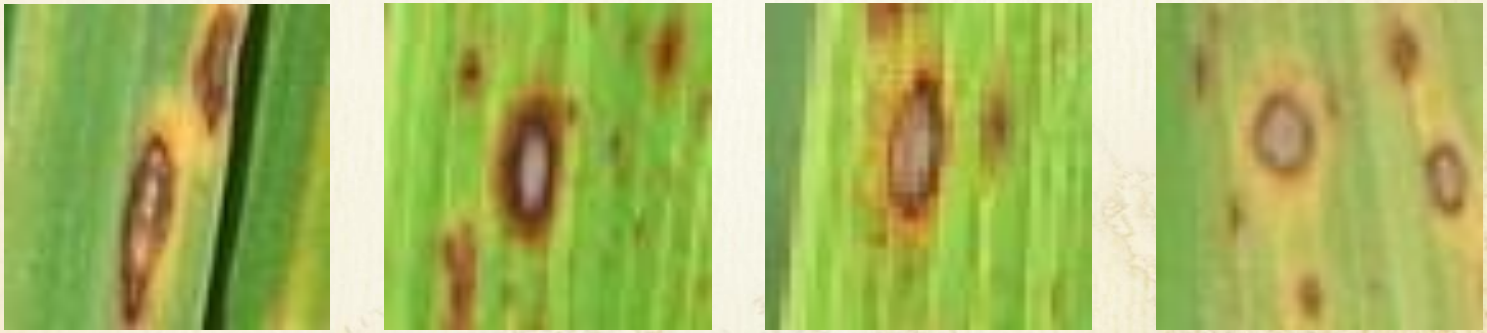


Result Analysis [cont.]

- Brown Spot (Accuracy = *75.00%*)
  - Correctly Classified



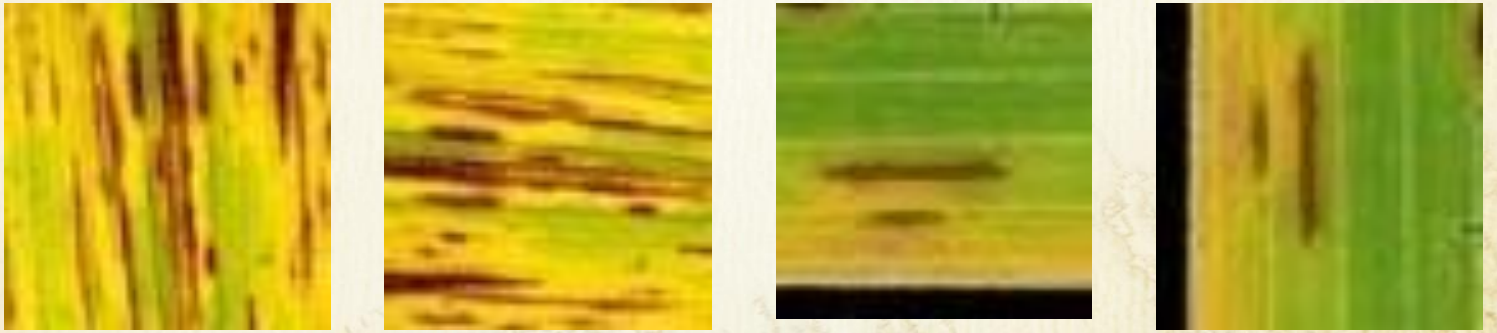
  - Incorrectly Classified



Result Analysis [cont.]

- Narrow Brown Spot (Accuracy = *87.87%*)
  - Correctly Classified

  - Incorrectly Classified



Result Analysis [cont.]

- Random Test (k-Fold)

Run	Fold	Fold Accuracy(%)	Run Accuracy(%)	Total Accuracy(%)
1	1	72.2	80.58	82.24
	2	80.6		
	3	80.6		
	4	91.7		
	5	77.8		
2	1	83.3	82.78	
	2	80.6		
	3	83.3		
	4	77.8		
	5	88.9		
3	1	80.6	83.36	
	2	91.7		
	3	80.6		
	4	88.9		
	5	75.0		

Conclusion

- There are not many impediments in our proposed strategy. Our accuracy is around 83% which is satisfactory. This problem can be solved by using the whole image as features in the neural network but which is very computationally costly and will become slow in practical life. So we tried to extract the important features and use them in learning which is computation friendly.

Reference

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THANK YOU

Questions???