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Classification and Detection Rice leaf Diseases Using Information and Communication Technology (ICT) Tools

Professor Dr. fan fan, Tanmoy Roy, Kalpotoru Roy

Management Engineering Department, Chongqing University of Posts and Telecommunication, China

Abstract*— *Despite sustainable development, increase in use smartphones, drones, satellite and other information communication technologies for data collection and analyzing for decision marking. Crop losses due to insect pests and diseases are a major threat to farming communities globally. In the case of rice, up to 37% of economic losses are caused by insect pests and disease infestation. Timely and accurate disease and insect pest diagnosis and management can not only reduce crop losses. In the last decade, Information and communication technologies (ICTs) have been increasingly used for information sharing. With mobile internet services becoming available in even the furthest locations, ICT-based agricultural solutions are finding a foothold on the farms of poor smallholders. ICT-based tool that supports diagnosis of insect pests and diseases and enables farmers to make timely decisions for better pest management. To identify the rice diseases at any untimely phases is not yet explored. Early classify and detection for estimation of severity effect or incidence of diseases can save the production from quantitative and qualitative losses, reduce the use of pesticide, and increase country's economic growth. The main challenges is to minimize the impacts of attacks. Detection of plant disease through some automatic technique is beneficial as it requires a large amount of work of monitoring in big farm of crops, and at very early stage itself it detects symptoms of diseases means where they appear on plant leaves. In this paper we review different disease classification techniques that can be used for plant leaf disease detection. Also we describe the data collection by information communications technology for rice leaf, different disease classification approaches that can be used for rice diseases detection. Thirdly we suggested the framework for convolutional neural network in Agricultural sector for detection and identification for innovation technology in agriculture.

Keywords*— *Agricultural, ICT, Image Processing, Rice Disease classification and Detection.

I. INTRODUCTION

Agriculture is the main source of the income in Bangladesh. Agriculture is the second largest in farm output production in the world. Information and communication technology in agriculture is developing and applying innovative ways to use ICTs in the rural domain, with a primary focus on agriculture. ICT in agriculture offers a wide range of solutions to some agricultural challenges. It is seen as an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes.

Sometimes farmers are unable to pay attention to the diseases or face difficulty in identifying the diseases, which lead to loss of the crop. Every disease has a different remedy to work out. The current approach of disease detection is manual, which means farmers mainly depend on the guide books or use their experiences to detect and identify of rice leaf diseases using support vector machine and particle swarm optimization techniques[1].

The main issue is an absence of nonstop monitoring of the rice plants. The rice plant diseases are one of the cause of quality and quantity of agriculture[2]. Each plant disease has different stages of growth. Whenever the disease occurs on a plant, farmers have to keep eyes on the

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infection. This approach of disease detection is time-consuming and requires some precaution during the selection of pesticides. The Bangladeshi farmers are not very good for aware information of the disease and it occurrence period. And the continuous monitoring system my fight against disease infection. The classification and detection of a rice plant disease is most significant research field in the agriculture domain.

The performance of a plant disease detection system can be evaluated by measuring the accuracy of the image processing algorithms (classification)[3]. Existing systems cannot provide better accuracy due to limited image features, bad selection of classifiers, and bad selection of features.

Due to possibility of various alternatives at different states of plant disease identification, researchers have attempted various alternatives in both image processing operations and deep learning model. In this article the objective is to emphasize impact of ICT for data collection, and apply concept of image processing and deep learning for build and train to analyze images of rice diseases and identify its disease based on four classes such as health, hispid, leaf blast and brown spot. We carry out a survey on different techniques and approaches used for classification of the Rice plant diseases.

We investigation both image collection and processing techniques and convolutional neural network techniques. Furthermore, utility of the presented image processing and findings is shown in our proposed work in the same direction.

This paper is divided into 4 section. Section II related work for different ICT tools for high resolution data collection and other methods for image processing. Section III Image plant disease identification and discusses various operation. Section IV proposed framework about plant leaves and identification of disease in rice plant based on build and train a model. Finally, Section V, discussion and conclusion.

II. LITERATURE RIVIEW

In this chapter we reviewed importance of ICT in data collection and some traditional image processing in order to understand input and output applications with image processing[4]for making formers decision.

Despite dramatic increase in use of internet, smartphones and other ICT technologies, substantial digital divide exists between service providers and seekers. Moreover, several ICT-based farm tools are not readily applicable for agricultural systems in for plant diseases as well as rice disease identification using pattern recognition techniques[5]. This presentation provides details of ICTs for disease diagnosis and decision making.

No matter the distance or time spotting of plant diseases, consultation with experts, access to global data and analysis and disease identification and the remedial solution has been easy with ICT tools and IoT[6]. Geographic Information System, Radiofrequency Identification Mobile applications help in identification of diseases associated with the crop. In case of a crop disease farmer clicks a picture of the diseased foliage, uploads the image on the central repository then scientists and plant pathologists study data and analyze it. Crop disease is then identified by experts. Feedback and remedies are shared with farmer via phone messages or social media.

After data collection thought different ICT tools such as smartphones, drones, satellite etc. the different methods that are involved in the classification disease detection are acquisition of image, preprocessing, of image, feature extraction, classification according to[7]. We started read the image, with different types of format images such as jpg, tif, bmp gif can be used. This step of the system is the acquisition of image, involves capturing the images in suitable form. After identifying the images, various processing methods could been concerned with concrete issues of the image for acting the several task.

After digital image processing, we had a massive storage, with preprocessing improves the quality of the image data by reducing artifacts which mean it removing the redundancy present in captured images without affection the details that play a key role in overall process by different steps such as image re-sizing and filtering with low pass filter or high pass filter. RGB model images are converted into gray image using color conversion. To increase the contrast are used different contrast enhancement method or techniques like, stretch to minimum-maximum[8], stretch and clip to Min-Max, histogram equalization and contrast adjustment. In segmentation group of pixel into regions, thereby defining the boundaries of the region of interest, partitions of the image of the distinct regions that pixel containing the similar attributes are used in the images.it separates image

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into meaningful region. The approach or methods like Ostu algorithm, K-means, FCM, PCA, MPSO and PSO are processed.

Feature extraction and selection provides the measurement vectors, should be defined as the interest part of an image and will be detected in different images of the same scene. Classification, also called feature selection, deals with extraction attribute that result in some quantitative information of interest, is a method for identifying the images. All the classification algorithms are based on the assumption that the image depicts one or more features. They are different types of classification features such as fuzzy classification, SVM (Support Vector Machine)[9][10], ANN (Artificial Neural Network), Convolutional Neural Network (CNN). This feature extraction, uses different types of feature values like texture feature, structure feature and geometry feature.

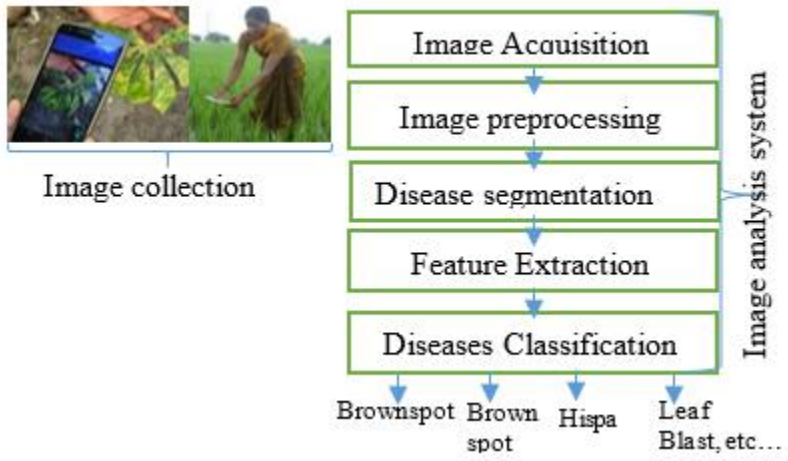

Fig.1: General framework for ICT image collection and plant disease classification approach.

Figure 1 present the generic block diagram of Image analysis system. It includes data collection with image acquisition involves capturing the image in the suitable form. Preprocessing improves the quality of the data by reducing artifacts. Segmentation groups pixels into regions, it defines the region of interest. Feature extraction and classification for different rice diseases. Mathematically, an image may defined as a two dimensional function $f(x, y),$ where x, y are spatial coordinates and the amplitude of f is called the intensity or gray level of the image at that point.

ICT Tools for data collection capturing the images if infected leaves and finding out the information about the disease is best way to know and understand the loss of crop due to disease infection. As a monitoring system which is automated response of this issue or problem, ITC tools such smartphone, drone, satellite with best camera can be installed or deployed at a certain area in the farm to capture images periodically. These images could been sent to a central system for analysis of disease, and the system could been classy and detect the disease and give the feedback information about the disease and pesticide selection.

Challenge for Bangladesh and Rice disease is the foremost staple food in Bangladesh, and provides more than 40% of national employment. It has been estimated that by 2020, rice production in Bangladesh will have to be increased by 60% to feed the growing population. The average land-use intensity has already reached 180% in Bangladesh, one of the highest in the world. The susceptibility of MVs to several major pests and diseases is a common reason for production losses.

Table1: Common rice disease and causal in Bengali

Disease	Causal organism
Rice blast*	Magnaporthe grisea
Brown spot	Cochiobolus miyabeanus
Narrow brownspot	Cercospora oryzae
Sheath blight*	Rhizoctonia solani

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Sheath rot	Sarocladium orysae
Stem rot	Sclerotium oryzae
False smut	Ustilaginoidia virens
Foot rot and bakane	Fusarium moniliforme
Bacterial blight*	Xanthomonan campestris
Bacterial leaf streak	Xanthominan campestris
Tungro	Rice tungro virus
Grassy stunt	Rice grassy stunt virus (RGSV)
Root knot	Meloidogyne spp.
White tip	Aphelenchoides bessyi

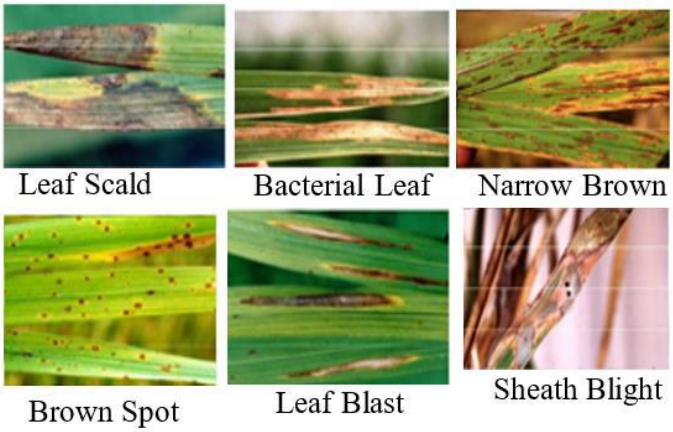

Fig.2: Different types of rice diseases, source of images

III. METHOD BASED MULTI-TASK PROCESS OF PLANT DISEASES IDENTIFICATION

This section explains the General process of plant disease identification. The process is divided into two parts: (1) Image processing and (2) CNN.

A. Image Processing Tasks

1) *Image Acquisition*

Image must be captured by a camera and converted into a manageable entity. This is the process known as image acquisition. The image acquisition process consists of three steps; energy reflected from the object of interest, an optical system which focuses the energy and finally a sensor which measures the amount of energy[11].

An image database specifically for rice disease pictures is available at International Rice Research Institute. Therefore, we need to prepare image database by our own, which requires image acquisition from live farm. In this process, images are captured from the farm using a digital camera to get them directly in digital form with numerical values[1]

2) *Image Preprocessing*

For getting better results in further steps, image preprocessing[12] is required because dust, dewdrops, insect's excrements may be present on the plant; these things are considered as image noise. Furthermore, captured images may have distortion of some water drops and shadow effect, which could create problems in the segmentation and feature extraction stages. Effect of such distortion can be weakened or removed using different noise removal filters. There may be low contrast in captured images; for such images contrast enhancement algorithms can be used. Sometimes background removal techniques may also be needed in case of region of interest needs to be extracted. In case of the images captured using high definition cameras, the size of the pictures might be very large, for that reduction of image size is required. Also, image reduction helps in reducing the computing memory power[13]. See the following image segments:

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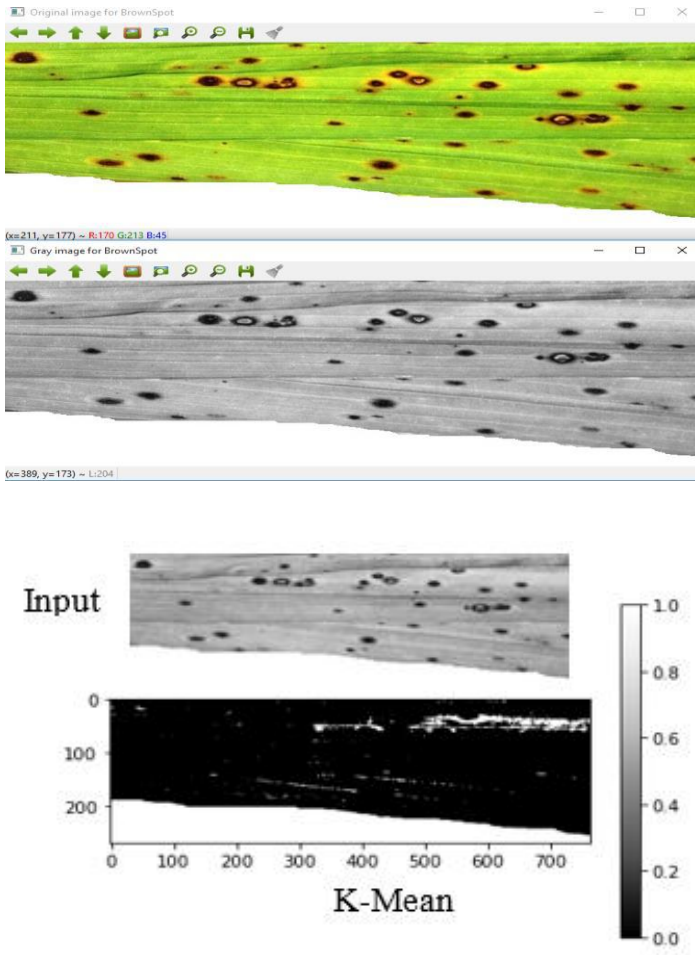

Fig.3: Image segmentation from original image to the grayscale image with the K-mean segment.

3) Image Segmentation

Image segmentation can play a vital and important role in plant disease detection with different prediction rule[14]. Image segmentation means to divide the image into particular regions or objects. The primary aim of segmentation is to analyze the image data so one can extract the useful features from the data. There are two ways to carry out the image segmentation: (1) based on discontinuities and (2) based on similarities. In the first way, an image is partitioned based on sudden changes in intensity values, e.g., done via edge detection. While in the second way, images are partition based on the specific predefined criteria, e.g., thresholding done using Otsu's method. 4) Feature Extraction The feature extraction aspect of image analysis focuses on identifying inherent characteristics or features of objects present within an image. These features can be used to describe the object. Generally, features under following three categories are extracted: color, shape, and texture. The color is an important feature because it can differentiate one disease from another. Furthermore, each disease may have different shape; thus system can differentiate diseases using shape features. Some shape features are area, axis, and angle. Texture means how color patterns are scattered in the image[15].

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Table 2: Comparative Study of Segmentation Techniques

Technique name	Thresholding Type	Segmentation type	Complexity	Segmentation effect	Merit	Demerit
OSTU'S Method	Global	Thresholding	Very high	Good & stable	Regardless of uniformity &shape measures, it works on real world images	Takes more in processing
Fermi energy based	Global	Thresholding	Low	Better compared to OSTU&k-mean	Overcomes the limitation of selecting proper threshold value	Only works when non-uniform illumination is present
k-means	Local	Clustering	Low	Accurately distinguish infected & uninfected regions of plants	Minimizes sum of square distance between object and centroid	Difficult to predict K with fixed number of clusters
Grey-level thresholding	Global	Thresholding	Normal	More accurate compares to OSTU'S method	Grey level transformation (2G-R-B) provides contrast for disease region and background	Every time needs to select proper threshold value for getting better result in segmentation
Fuzzy C-Means	Local	Clustering	High	Better compared to ostu and k-mean	Uses partial membership, therefore, more useful for real problems	Sensitive to initialization condition of cluster number and cluster center

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Table 3. Analysis of machine learning operations applied in rice

Ref.	Types of classifier	Parameters for classification	Inputs	Accuracy
[16]	Nearest Neighbour	RGB range, shape, length, width, diameter	Membership function	Rice blast-80%
[17]	Support Vector Machine	Radial Basis Kernel Function	Image Features	Model-97.2%, model2-88%, model3-11.1%
[18]	Support vector machine. Neural network, Ensemble learning, Quadratic Discriminant analysis	Default parameters	Image features	SVM,EL,QDA-85%, NN-80% , SMV+RBNF-98.3
[19]	Support Vector Machine	Not specified	Image Features	82%
[20]	IF-Then Classifier	Color and shape features	Images features	75%
[21]	Bayes classifier Support Vector Machine	Not specified	Image feature	Support vector Machine-68.1%, Bayes classifier-79.5%
[22]	Backpropagation neural network	3 hidden layers	R,G and L pixels	90%
[23]	Production rule with forward chaining	Not specified	Image Features	Local entropy-100%
[24]	Rule generation	Feature, value pair	Image features	92.29%
[5]	Self-organizing map neural network	50 epochs	Gray values of pixels	RGB Sport -92% Fourier transform of spot-84% rotation of 50% spot-82%

B. Convolution neural net (CNN)

1) Classification: Is mapping the data into specific groups or classes. Classification is usually called as supervised learning approach[21]. Classification is a two-step process: First the classifier model is generated which describes predefined set of classes[25] . This step is called as learning phase (Training step), where classification algorithm develops the classifier by "learning from" the data with their specific class labels. In the second step, the model, which is generated in first step, is used for classification[26]. In other words, test data is used to estimate the accuracy of the trained model by evaluating how good it performs on the test data.

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In the plant disease classification, the diseases are classified according to the features extracted from the images. Different classification models are support vector machine, neural network, nearest neighbors, and rule-based classifier.

2) Clustering is a process of grouping data into different groups based on the similarity of the data. It means the data points with the similar objects are grouped into one group and dissimilar objects are grouped into another group[27]. Clustering is also called as data segmentation because it partitions large data into groups based on their similarities. Clustering is an unsupervised learning approach. Unlike classification, clustering does not depend on the predetermined classes, due to this clustering is called as learning by observation not learning by examples. Clustering is also used for color image segmentation, because in an image different objects may have different color intensities. Therefore, clustering can group similar intensity pixels in one cluster and other different intensity pixels into other clusters.

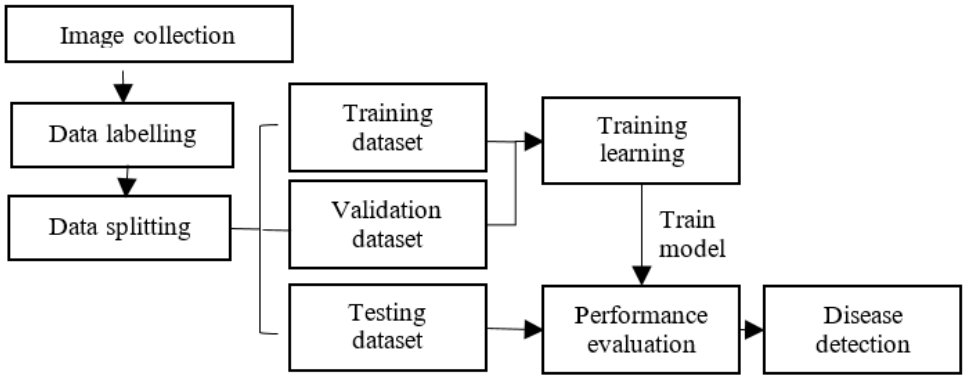

Fig.4: framework Convolutional Neural Network (CNN) Plant Disease detection from different Images

The first step of this rice plant disease, is for data collection which is a challenge for identifying the rice diseases and pests. By using CNN architectures for classification, we need huge data collected in different season such as winter, summer, printer and son. To make sure that you have all data for all period which can be affected by different bacteria. We will also captured images if disease part in both summer and winter, this will help with training the model in way that can do well in real life scenario in different weather. Similarity and dissimilarity is a necessary feature of any real life image.

Secondary is for improving or increasing classification accuracy, when you captured an image of disease area of a rice plant in rice field, you meet with different background composed on the other rice pants like soil, people or other objects. By detection with heterogeneous background makes some difficulty to segment the region of interest.

Thirdly, the training model for CNN architectures we will been used a large number of trainable parameters such as VGG16[28] which applied to automatic detection of tomato disease. Training from scratch. And by reducing model size because of lack of network or some ICT infrastructure in rural areas of developing countries, CNN models need to run offline in rice disease and pest detection for oriented mobile applications. We should reduce the number of parameter in CNN models, to obtain the classification capability can been decreasing which can reduce their utility as a tool for diseases and pest classification module.

Sample data collection

Rice disease happen in different parts of the plant, for training my model I used kaggle open source dataset of 3355 images which have four classes, Health, Hispa, BrownSport and LeafBalst. These leaf have different symptoms of different disease with labelled, table2 for the number of each images per class. By define transform and create data loaders, we suggest a train with transform randomly 45 rotation, rising by 224, horizontal flip and normalized for two vector. And with augmented data for validation was resized by 224x32 with 224 transformation of center crop with the same normalizing of training. The number of sub process to use for data loading with zero number works, and samples per batch size 20 and 0.2 valid size as percentage of training set to use as validation. After creating data loader we specified class names as rice diseases classification. Data visualization, we define the

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help function to un-normalize and display image and to obtain one batch of training images with different iteration lastly, we plot the images in batch with their labels by display 20 images see figure 6. Build and train the classifier by used pre-trained models VGG to achieve high accuracy with less time on training, by download the pre-trained model will different steps by initialized training model with tracking for minimum validation loss and monitor training and validation loss and save the model if validation loss has decreased. Lastly we predict plant disease with the model as you see figure 5

Table 4: labelled dataset per each category

Categories	Number of images/ category
Health	1488
Hispa	565
Leaf Blast	779
BrownSpot	523

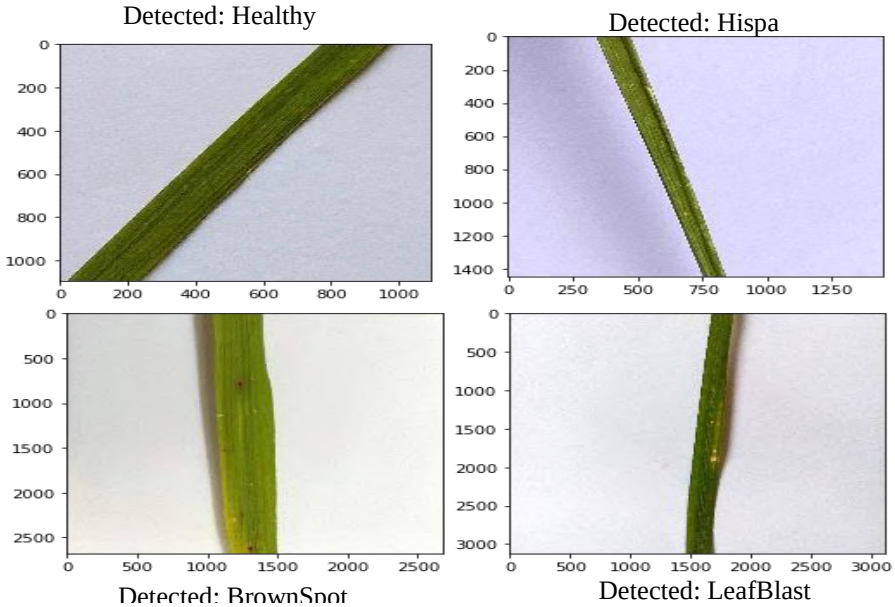

Fig.5: predict plant disease with VGG model, by different detected disease label.

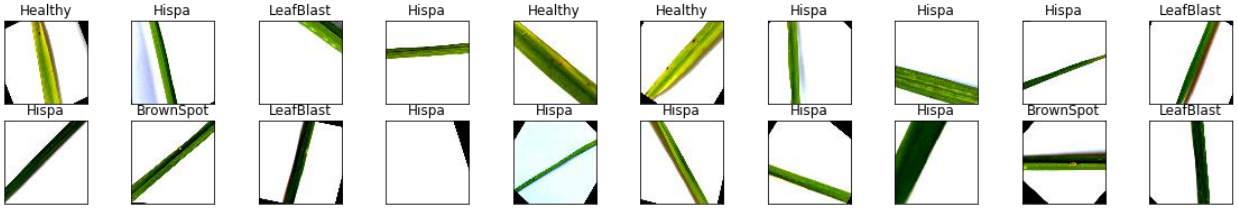

Fig.6: Image of rice disease visualizing in their different batch of training

IV. DISCUSSION

We discussed with ICT tools due to the disease image processing. Because of the some poor infrastructure which are not reached to the rural farm area, we explain different method for image processing. But after model reduced the even some rural aria will be better and easily using. Lastly we train some dataset from kaggle.com by using CNN and VGG model by pre-trained, we suggesting after have been done our data collection to the Bangladesh will be better to train our system for rice disease detection.

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V. CONCLUSION

In this paper we describes the ICT roles to data collection and acquisition, the image processing methods to detect and classify rice disease. Identifying the disease through the ICT tool for data collection is the main purpose of the proposed method. The result indicate that it is an efficient method, which can help an accurate classification of rice disease in a huge computational effort.

In further work, I will collecting the leaves from rice for Bangladesh farm using Canon EOS 1500D and preparing a dataset of images of rice plant leaves having a main rice disease. After applying traditional image processing techniques and then convolution neural network to build and train a model to analyses images of these collected dataset for different classes or categories in order to improve rice monitoring system timely. Secondly I will continuing compared with other methods in way of getting a best accurate.

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