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AN COMPUTATIONAL INTELLIGENT APPROACH FOR DETECTION OF DISEASES IN RICE LEAF

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Abstract: As plants are the basic components for human being and in fact for all living being because, its plays of the major role in nature and production of oxygen. There are many Biological factors which almost contains plants abbreviation. Due to Environmental cause, day by day plants are decreasing which increases a lots of health risk factor. Its major responsibility of human being to save plants for future cause and save biodiversity. One of the other causes of plant destruction is diseases caused by insects when they get in contact with leaf. Its very necessity to detect the plant diseases and prevent it from destruction. In this paper, the main motive is to get early detection of diseases in plant among rice leaf. We are using Intelligent approach for early diseases detection which majorly include the domain of Artificial Intelligence. Early prediction od disease will be beneficial to prevent the plant from diseases and taking the safety precaution on time. The Rice Leaf is in a shape of an annual grass with round, hallow, rather flat leaves, a terminal panicle and a jointed culm.

Keyword: *- Artificial Intelligence; Biodiversity; Rice Leaf;*

1. Introduction

Rice is an important food crop and the most stable food for most people in the world [1]. To increase demand, the product should be improved. However, plant diseases have been a major loss of yield in rice crop production [2]. In this case, an accurate diagnosis of the plant in the early stages is very important. This disease caused by the rice plant is very difficult to detect using traditional methods such as eye contact [3]. Image processing technology has been widely used in agriculture to diagnose plant diseases. Therefore, plant images can be processed from a computer perspective from the first sign to predicting the disease. The intelligent system is used to analyse the predictor image of the disease on a rice plant using leaf images, by making use of Deep Learning algorithms and various architecture. The leaves of the rice plant can be infected with a number of diseases, such as Bacterial Leaf Blight caused by the bacterium Xanthomonas oryzae, Brown Spot caused by the fungus Helminthosporiose, Leaf Blast caused by the fungal Pyricularia grisea [4]. This can cause serious damage to rice and crop losses. It is difficult to diagnose successfully and accurately by eye contact. Automatic computer-vision detection therefore enables farmers to predict the disease more efficiently and time-consuming on large farms. Anything cannot be controlled by farmers as they have failed to control many farming practices. If a farm is affected by a pest or disease, it should be repaired immediately without delay. Most plant diseases / deficiencies can be detected by leaf monitoring. Farmers used to monitor the plant from time to time and if they could not detect any signs of disease, they would use a fertilizer or pesticide. But often farmers are not in a position to point to the disease itself. This results in the use of improper fertilizer and will eventually affect the plant and the soil. The solution to this problem is to make the disease detection process work automatically. It can be done with the help of various image processing methods.

Bangladesh acquired its highest GDP, BDT 10.73 billion by 2019 [5], from the agricultural sector. Part of the agricultural GDP is derived from rice production. As a result, it also affects about half of household chores (48%) [6]. While providing an important role in the world economy, rice serves as a staple food for many people and provides two-thirds of the daily calorie intake for each individual. According to a USDA report, the total area for rice production and associated production is expected to be 11.8 million hectares and 35.3 million tons respectively for 2019-2020 (May to April) [7]. This economic downturn is a clear indication that proper rice cultivation is a priority in Bangladesh. Free rice farming can play a major role in ensuring sustainable economic growth and maintaining the desired goals.

Monitoring of diseases, their detection and prevalence are crucial for early detection of infected plants, for their timely treatment, and, most important, for planning future disease prevention strategies to reduce losses. Traditionally, the treatment of plant diseases in Bangladesh is done by personally detecting any malformations in the plants, and then classifying them as the disease by a specialist and finally recommending appropriate treatment. This series of activities becomes a major challenge when considering large farms. It takes more time and effort. In contrast, photographing the affected area of plants and testing with a pre-trained model provides a way to better diagnose and diagnose diseases.

2. Related work

S.No.	Author	Title	Methodology	Feature Extraction
1.	Shrivastava S, Singh SK & Hooda DS	Soybean plant foliar disease detection using image retrieval	It proposes a method to recognize frog eye disease of soybean plant.	Through Shape, colour, texture using statistical and spectral method.

		approaches [8]		Feature feeds to SVM for final classification.
2.	Singh V & Misra AK	Detection of plant leaf diseases using image segmentation and soft computing techniques [9]	It proposes a method to identify infected plant leave by two different type of diseases.	Colour Co-occurrence method is used to extract the feature from the image. For Classification, SVM has been used.
3.	Clémen A, Verfaille T, Lormel C & Jaloux B	A new colour vision system to quantify automatically foliar discolouration caused by insect pests feeding on leaf cells [10]	It proposes a new automatic plant leaf segmentation through the early symptoms in various plant leaves taken by using digital camera.	Images were used to feed for feature extraction methods for final classification.
4.	Barbedo JGA	A new automatic method for disease symptom segmentation in digital photographs of plant leaves [11]	It proposes an algorithm for disease prediction in various plant from early symptoms.	Automatic detection identification accuracy was 58% in segmentation process and manual segmentation approach was 63%.
5.	Ramandeep Kaur, Veerpal Kaur	A deterministic approach for disease prediction in plants using deep learning [12]	It proposes a methodology of detecting plant diseases using Deep Learning Technique.	They used 2589 original images in performing tests and 30880 images for training their model using the Caffe deep learning framework. Accuracy of Prediction model is 96.77%.

Table: - 1 (Comparative approach)

3. Data Exploratory

The dataset considered for this task in in image format which contains rice leaf images of diseases & non-diseases. The dataset has been further splits into two-part, train and validation. Each part contains three sub category as Bacterial Leaf Blight, Blast, Brown spot. Each contain certain number of images which further used for processing of model. Summary of data is mentioned below in Table: -2,

	Train	**Validation**
Bacterial Leaf Blight	108 Images	43 Images
Blast	90 Images	24 Images
Brown spot	123 Images	17 Images

Table: - 2, (Dataset Description)

Each category consists of different types of images which can be visualize from fig. 1. As train & validation are two different visualization of data. The training data is the general form for the samples used to create the model, while the validation data is used to qualify performance. Though, Conventionally the dataset used to evaluate the final model performance is called the test set.

Figure: - 1, (Leaf Categorization)

Due to inadequate of data, it was augmented by rescale, by rotation range=40, by horizontal flip, by width shift at range=0.2, by height shift at range=0.2, by shear at range=0.2, by zoom at range of 0.2. For Training Dataset, all the images where converted into same shape of (299,299. While for validation, the dataset was rescaled.

4. Technical Overview

This paper proposes an early detection of rice leaf disease using various intelligent technique i.e. various algorithm and architectures that can be helpful for disease recognition. Early disease detection plays a vital role in such a way that it prevents the plant to gets wilting. Another advantage of early detection will be is such a way that disease control measures can be a waste of time and money and can lead to the loss of other crops without proper identification and pathogenesis.

For the purpose of Image classification, Deep Learning plays a vital role as Convolution Neural Network algorithm can finely classify the images with suitable metrices (Accuracy, Precision, Recall etc.) To identify diseases in plants we have used deep learning process. In the field of Machine Learning, deep learning is a new era of research, introduced with the aim of moving Machine Learning closer to one of its distinct purposes. Deep Learning about the many categories of representation of layers and concepts that support the making of data comprehension such as definitions, sound, and text.

For Model training, image input shape is (299,299). Optimizer plays a vital role in model training. In this task, Adam was used in optimizer with learning rate of 0.001. Keras, Flattern & Dense layer has been used which is as described in figure: 2.

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
keras_layer (KerasLayer)     (None, 2048)              21802784
_________________________________________________________________
flatten (Flatten)            (None, 2048)              0
_________________________________________________________________
dense (Dense)                (None, 512)               1049088
_________________________________________________________________
dropout (Dropout)            (None, 512)               0
_________________________________________________________________
dense_1 (Dense)              (None, 3)                 1539
=================================================================
Total params: 22,853,411
Trainable params: 1,050,627
Non-trainable params: 21,802,784
```

Figure: - 2, (Model Configuration)

Categorical Cross entropy was the loss function used for model compiling. The model was trained up to 30 epochs and was obtained the training accuracy of 95.46% while the validation accuracy of 82.81% was achieved. Accuracy Loss curve of the model is described in figure:3.

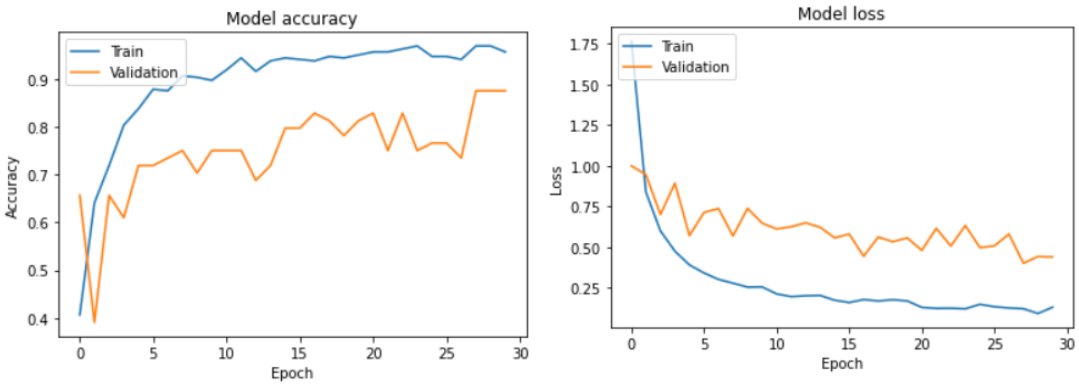

Figure: - 3, (Accuracy Loss curve for training & validation)

The model has been evaluated on the basis of several metrices such as Accuracy, Precision, Recall, F-1 score. The Precision, Recall and F-1 score are calculated with the help of confusion matrix as shown in figure: 4. A 3x3 confusion matrix has been plotted between actual value and predicted value which helps during model evaluation.

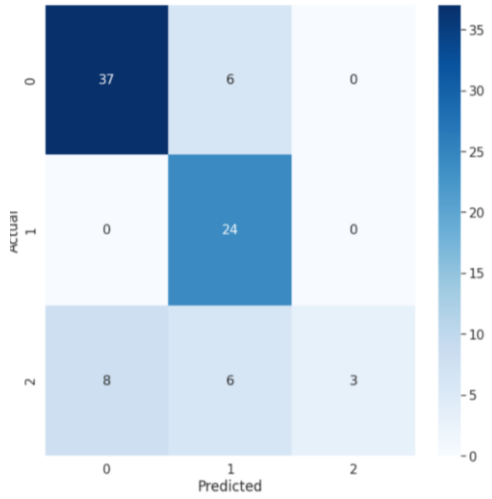

Figure: - 4, (Evaluation of model)

From the above confusion matrix, Precision, Recall and F-1 score has been calculated according which is illustrated in Table: - 3 & 4 mentioned below.

		PREDICTED VALUES		
		Class A	Class B	Class C
ACTUAL VALUES	Class A	37	6	0
	Class B	0	24	0
	Class C	8	6	3

Table: -3, (Structured 3x3 Confusion Matrix)

	Precision	**Recall**	**F-1 score**
Class A	0.8222	0.8604	0.8408
Class B	0.6666	0.1000	0.1738
Class C	0.1000	0.1764	0.1273

Table: -4, (Evaluation of metrics)

Here, Precision is the ratio of correctly predicted positive observations to the total predicted positive observations. Recall is the ratio of correctly predicted positive observations to the all observations in actual class. F1 Score is the weighted average of Precision and Recall. Therefore, this score takes both false positives and false negatives into account [13].

5. Result Analysis

Our experimental research and its results in particular will focus in depth on Deep Learning. This algorithm will first take an input image, which is in RGB form. We get the part of the disease with this disease. We took two sets of data called train data and validation data. The train data set contains images, which have already been processed, and diseases and feature releases have been detected. Another with validation data contains images, which need to be processed to diagnose diseases. One image from the validation data set is taken and its features are matched to images in the training database. The key to this work is that the total area, infected with the disease, will be calculated as a percentage of the% and hence diseases are detected

6. Conclusion

In agriculture field fast and accurate disease prediction of crop plays an important role. The algorithm separates sign colour, leaf colour and illumination from different colour channel. Many existing segmentations cannot propose such approach as this paper proposes intelligent approach. So newly developed but widely used methodology will play an important role in recognition of diseases from rice leaf. The result indicates that an algorithm made easy for final feature analyses. A novel method for disease prediction of plants based on classification technique is proposed with the accuracy rate of 95.46%.

In future aspect, we might propose the methodology of identification of various diseases from rice leaf. There are many diseases which rice leaf contain such as, Rice Blast, Brown Spot of Rice, Sheath blight of Rice, Bacterial leaf blight, Sheath rot of Rice. It's necessary to early detection of particular disease which plant have and start taking care of plant according to disease before wilting.

7. Conflict of Interest Statement

In the research work entitled "AN COMPUTATIONAL INTELLIGENT APPROACH FOR DETECTION OF DISEASES IN RICE LEAF", the authors Mr. Gaurav Patil & Mr. Prateek Dutta declares no conflict of interest. This research work does not comply to harm any of the living beings either humans or animals.

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