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LEAF DISEASE DIAGNOSIS MODEL OF RICE PLANTUSING IMAGE PROCESSING AND DEEP CNN ARCHITECTURE

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Introduction

Agricultural production occupies a very important place in a developing country like India. The livelihood of many people of the country depends on agriculture related occupation. Near about 70 percent of India's people maintain their livelihood from agriculture [1]. Rice is one of the important grains among agricultural crops. Rice is eaten in many countries of the world. Most of the people in India like rice as their favorite food [2]. Rice and its related food products contribute a lot to India'seconomy. In India, paddy is cultivated over a large area from east to west and north tosouth. There are many factors that can reduce the yield of rice, in which the soil factor, biological factor, environmental factor, and seed selection are important factors. If any one of these factors is not balanced then it leads to plant disease. Rice diseases are very dangerous and harmful, it reduces the production by about ten to fifteen percent every year in India [3].

Machine learning method is used in computer vision to detect and classify important elements in photographs. Machine learning is utilized to create a classification or predictive model that is developed to learn using training data and then evaluated to predict or classify an unseen input [4]. Deep learning is a new technique for extracting features from leaf photos automatically. Deep Convolution neural network (DCNN) has been a growing topic for picture categorization due to its ability to extract features automatically [5]. It can manage applications related to big data without the need for picture pre-processing. A fundamental step required to build a plant diseaseidentification and classification system using ML is depicted in Figure1.

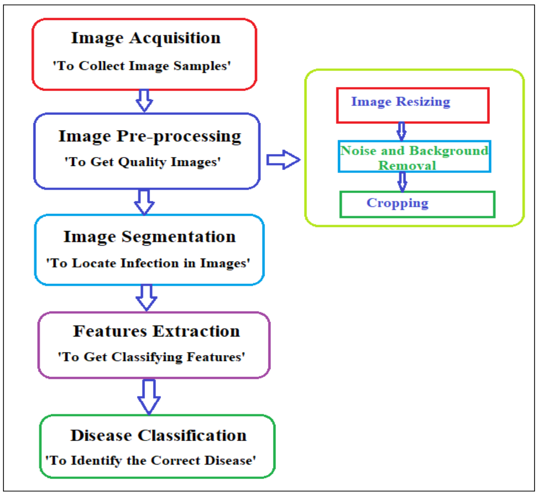


Figure 1 Flow diagram for plant leaf disease detection using ML

1. Image Acquisition: The initial stage in every image processing programme is image acquisition. The goal of image capture is to gather pictures of the plant's sick parts. The photos are obtained either from a benchmarked dataset or from the crop field in this stage. The photographs collected are used as train and test samples.
2. Image Pre-processing: The dataset is cleaned using image pre-processing techniques. Image pre-processing entails a variety of procedures that are carried out according to the requirements of study. Image scaling, background removal, noise reduction, augmentation, and other processes are among them.
3. Image Segmentation: To find contaminated patches in photos, image segmentation is used.

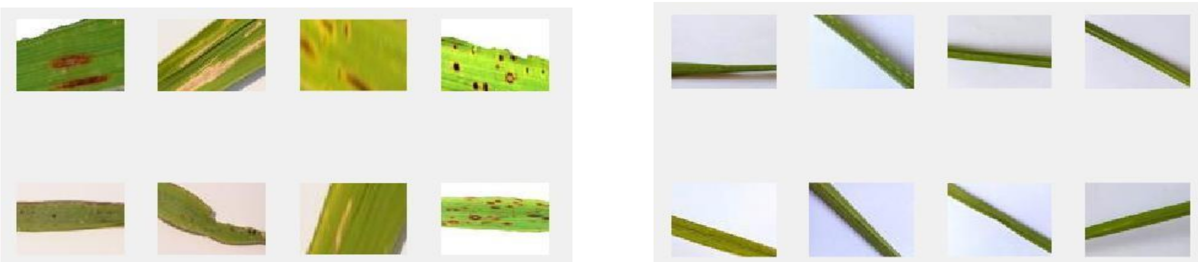
Segmentation aids in identifying just the aspects of an image that are important to the task at hand.

Data set description

In order to conduct the two suggested investigations, we used a rice leaf database. Thedataset is made up of four different varieties of rice leaves picture samples accessed from Kaggle [6]. As indicated in Table 1, each variety of rice leaves is made up of 4000 rice leaves pictures. These are photographs of both sick and healthy leaves. Among four classes, three classes belong to diseased leaves and one class belongs to healthy leaves. In these three classes, one class consists of Brown Spot infected leavesimages, the second class consists of Bacterial Leaf Blight infected leaves images, and the third class contains Leaf Smut infected leaves images. Figure 1 depicts a healthy and sick sample of rice leaf pictures adopted in this study.

Table 1 Description of Dataset

Paddy leaf Classes	Samples count
Bacterial Leaf Blight (BLB)	4,000
Leaf Smut (LS)	4,000
Brown Spot (BS)	4,000
Healthy Leaves	4,000



(a) Infected leaf images **(b) healthy leaf images**

Figure 2 Dataset samples (a) Infected leaf images (b) healthy leaf images

First model is developed without removing the background information from picture samples. Whole image with background is given as input to the proposed system. In first model, only image resizing operation is used as pre-processing step. Four CLs are employed in the suggested network to extract significant characteristics from the dataset's pictures. Each input channel is normalized using a batch normalization layer (BNL) across a mini-batch size. BNL is used just after the Convolution layer (CL). BNL is followed by the ReLu layer. The ReLu layer removesthe negative activations. After the ReLu layer, the max-pool layer is utilized to select the most significant features of the feature map. thus max-pooling layer down-samples the input picture. The network's last layer is made up of 4 FC layers (flatten layers) along with a Softmax layer that divides the pictures into 4 categories (1 healthy and 3 sick). A feed-forward neural network is employed to perform the classification operation at the FC layer. The structure of the proposed CNN is shown in Table 2.

Table 2 Structure of proposed fully connected CNN

S.N.	Layer's type	Filter's size andStrides	Inputsize	Learnables
1.	Input	64 x 64 x 3	64x64x3	-
2.	CL	8 9x9x3/1	64x64x8	Weights 9x9x3x8Bias 1x1x8
3.	BNL	Batch-Normalizationwith eight channels	64x64x8	Offset 1x1x8Scale 1x1x8
4.	RL	ReLU	64x64x8	-
5.	MPL	2x2/2	32x32x8	-
6.	CL	16 6x6x8/1	32x32x16	Weights 6x6x8x16Bias 1x1x8
7.	BNL	Batch-Normalizationwith sixteen channels	32x32x16	Offset 1x1x16Scale 1x1x16
8.	RL	ReLU	32x32x16	-
9.	MPL	2x2/2	16x16x16	-
10.	CL	32 3x3x16/1	16x16x32	Weights 3x3x16x32 Bias 1x1x32
11.	BNL	Batch-Normalizationwith thirty-two channels	16x16x32	Offset 1x1x32Scale 1x1x32
12.	RL	ReLU	16x16x32	-
13.	MPL	2x2/2	8x8x32	-
14.	CL	64 3x3x32/1	8x8x64	Weights 3x3x32x64 Bias 1x1x64
15.	BNL	Batch-Normalization with sixty-fourchannels	8x8x64	Offset 1x1x64Scale 1x1x64
16.	RL	ReLU	8x8x64	-
17.	FC	4 FC layers	1x1x4	Weights 4x4096Bias 4x1
18.	Softmax Layer	Softmax	1x1x4	-
19.	Classification Output	Classification	-	-

Conclusion

This research provided a novel method for detecting and categorizing illnesses found in rice plants by combining 4 hidden layered CNN with Otsu's thresholding- based background removal strategy. This method extracts distinguishing characteristics from leaf pictures based on the color, shape, and size of infectedregions in the leaves. Deep CNN architecture is designed so well that it is able to recognize and categorize rice diseases with great accuracy (99.10%). From the validation and training process depicted in experiment 1 (Figure 3.11), it is very clear that the suggested approach 1 does not face an overfitting problem.

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