Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)

Volume 6- Issue 1, Paper 4,January 2023

PREDICTING PADDY LEAF DISEASES USING CONVOLUTIONAL NEURAL NETWORK (CNN)

Abisha R[1], Sheebha Rani P.R[2]

Department of Computer Science & Engineering,

St.Xavier's Catholic College of Engineering,

Nagercoil, Tamil Nadu, India.

Abstract-- Most of the countries are depends on agriculture, where Tamil nadu is the land of agriculture. Here paddy cultivation is major source of earning. People in Tamil nadu, consumes rice as main meal for three times in a day. Various factor such as diseases on paddy leaf, changes in temperature and pest attack etc., the production of paddy will be affected approximately 40% to 50% and the diseases in paddy will be vary from certain region to region and season to season, the most commonly affected paddy diseases in Tamil nadu are bacterial leaf blight, brown spot and rice blast. Rice related diseases should be detected in early stage to protect the paddy because it will destroy the entire farm land. The proposed system uses pre-processing and augmentation to extend the dataset, pre-trained Inception_v3 and deep learning based CNN algorithm to predict the paddy leaf diseases and these algorithm produces good accuracy rate and take less time to classifying the diseases.

Keywords-- rice diseases prediction, classification, convolutional neural network (CNN), deep learning, and image recognition.

I. INTRODUCTION

Agriculture plays an important role in Tamil nadu in which paddy cultivation is more important in every human being life because people in Tamil nadu consumes rice as main food for three times in a day, its consider as low cost and more nutrient food so that everyone is directly or indirectly depends on agriculture. But rice production cause loss every year due to some diseases in paddy leaf as well as insert pest attack it will directly affect our country economy. Farmer should use proper precaution methods to protect the paddy diseases in initial stage, because rice diseases will spread by air and water to entire farm land, once it spread it's very difficult to farmer to protect the paddy diseases which cause great loss in paddy cultivation. Scope of this project is to detect the diseases in paddy leaf and to notify the farmer about the affected diseases types so that farmer can take early precaution to protect the paddy diseases in initial stage. If the diseases are identified in early stage there is no need to spray a high dose fertilizer on the paddy crops.

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The paddy crops are affected by the bacteria, fungus and virus diseases. Most of the critical diseases affect in paddy are bacterial leaf blight, brown spot and rice blast it will causes great economy loss in the field of agriculture.

a. Bacterial leaf blight

Bacterial leaf blight is bacterial diseases these diseases mainly caused by "Xanthomonas Oryzae" and it's an monsoon season diseases (kharif) these type of diseases can be identified by the symptoms of water soaked lesson are started at the leaf margins, spread to leaf base. Once it's not identified in early stage it will become as yellowish to light brown with yellowish border in between the dead and the green part of paddy leaf. The diseases are caused by rainy, cloudy and stormy climate as well as high nitrogen fertilizer. The bacterial leaf blight diseases cause loss in Tamil Nadu, Kerala, coastal Andhra Pradesh and Orissa.

Figure 1: Bacterial leaf blight

b. Brown spot

Brown spot is caused by "Helminthosporiumoryzae" its fungus diseases it occurs mainly in kharif season. The symptoms of these diseases are leaf with small brown spot once it developed the leave is look like round or oval brown spots. The diseases are transfer from the infected paddy seeds. It causes fewer seedlings. This type of diseases found in Orissa, Tripura and Tamil Nadu.

Figure 2: Brown spot

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c. Rice Blast

Rice blast is occurring in kharif and Rabi season that's November to February it's caused by "Magnaporthe Oryzae" its fungus diseases and its symptoms is elliptical spots with light colour center and reddish edges. The yield reduces up to 50%. This types of diseases found in Tamil Nadu, Kerala and Karnataka

Figure 3: Rice Blast

In this paper, section 2 describe about literature survey, section 3 describe proposed methods, section 4 explain result and discussion and section 5 has conclusion and future work to be carried out.

II. LITERATURE SURVEY

Before executing the proposed work, I have done some study on related paper.

Archana, *et al.*, propose the segmentation methods to predict the disease, using feature extraction and classification but drawbacks here are still lacking to predict the diseases [1]. Chen, *et al.*, carried out deep transfer learning to detect the rice plant diseases uses Dense Net on Image Net and Inception module to train the neural network and this method is fail to hides the circle area coverage [2]. Ferentinos, *et al.*, propose CNN algorithm for plant diseases detection and diagnosis problem facing here is it doesn't accurately detect the plant diseases [3]. Jiang, et al., propose CNN algorithm and introduces GoogLeNet Inception and Rainbow concatenation methods are used to train the model and detect five apple leaf diseases achieve 78.80% detection accuracy, drawback on this technology is identify single object at a time [4]. Kathiresan, *et al.*, propose a Custom transfer learning based system for rice disease classification using generative adversarial network here the advantage is produces good accuracy rate and demerits is lack of samples [5]. Kawcher, *et al.*, propose rice leaf disease detection system using machine learning algorithm like KNN achieved 75.463% accuracy on training set and 70.8333% accuracy on test set [6]. Liang, *et al.*, suggest CNN algorithm to recognize the rice blast diseases include LBPH and Haar-WT model, this method needs to optimize its parameter [7]. *Li, et al.*, present video is

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converted into still image then detect the rice diseases using faster R-CNN and use transfer learning VGG16, ResNet-50 and YOLOv3 to train neural network [8]. Lu, *et al.*, presence deep learning based method like convolutional neural network here the images can be given directly to the model to train the network [9]. Prajwal, *et al.*, propose deep learning with machine learning method here the disadvantage is resulting in dimensionality reduction [10].

III. PROPOSED METHOD

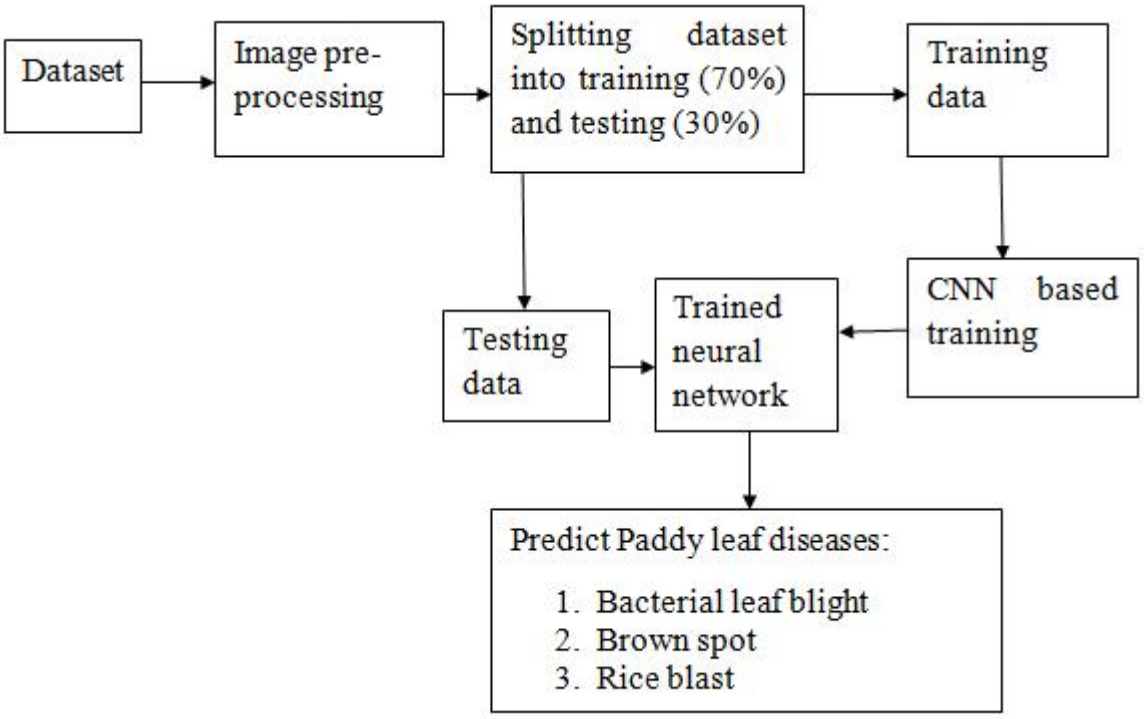

Figure 4: Proposed Block diagram

The proposed system has training and testing phase. In training dataset are trained with more number of paddy infected diseases leaf images. There are three disease commonly affected in rice namely bacterial leaf blight, rice blast and brown spot. The dataset images are collected from the website kaggle. These disease dataset are stored in separate folder. Divided the dataset into two parts as training data and validation data, in which 70% of data used for training and 30% of data used for validation. Therefore dataset contained 157 training images and 84 test images.

a. Pre-processing

First, step is pre-processing which is used to remove the unwanted noise from the loaded infected paddy leaf image, here using image resizing (50*50) pixel to make the entire image into same size so that it's easy for training the CNN network.

b. Image augmentation

The image augmentation is the method to increase the original dataset. Here image rotation, image blurring and image flipping augmentation method are using to extend the dataset artificially. The extended original paddy diseases image dataset to 628 images.

c. GANs augmentation

Still the dataset are little small it may cause Overfitting problem in training to avoid this kind of problem here using generative adversarial networks (GANs) to extend the dataset which is used to easy training of CNN algorithm. By using GANs method extend the dataset up to 5000images for training the neural network.

d. Classification

Training module

Transfer learning Inception_V3

Inception_V3 method is more popular techniques its mainly used for image classification, main aim of using this method is it can be reuse pre-trained model on our new model, it help in the way of reducing the training time it will increase the performance rate and calculate the loss function, then optimize the epoch rate. The convolutional and pooling layers are act as filter to extract the feature from the image dataset

Fully connected layer or dense layer is used for classification purpose here using unsupervised classification algorithm like Convolutional neutral network (CNN). Here directly using the RGB image pixel value used for classification. CNN algorithm using various layers like keras layer, flatten layer, dense layer, dropout layer and dense_1 layer of total params 22,853,411 here trainable params is 1,050,627 and non-trainable params is 21,802,784. This method trains the neural network by teaching various diseases in paddy leaf. Activation function SoftMax is used to predict the diseases type.

Testing module

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Testing is a method of predicting the output of classifier as healthy leaf as well as types of paddy affected diseases like bacterial-leaf blight, brown spot and rice blast. These are tested in testing phase to check whether the given input is predicting correct paddy leaf diseases types or not.

Algorithm:

1. Collect dataset
2. Import libraries
3. Read the label name
4. Do pre-processing steps
5. Prepare dataset for training and testing
6. Display the image using matplotlib
7. Build the model
8. Create layers for CNN algorithm
9. Apply loss function
10. Create optimizer
11. Run the trained CNN model
12. Predict the diseases with accuracy rate.

IV. RESULT AND DISCUSSION

The pre-processing result of bacterial leaf blight, brown spot and rice blast is

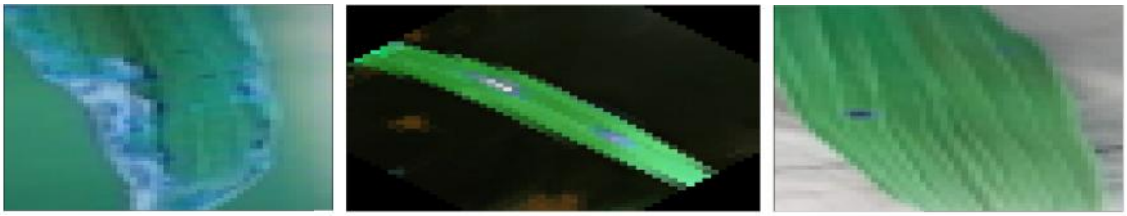

Figure 5: pre-processing result of bacterial leaf blight, brown spot and rice blast

Training the neural network with the help of classification algorithm. Number of times the given input is training with 30 epoch rate. Achieve accuracy of 95.7% on training with loss rate of 0.1081, val_loss 1.1025 and the val_acuuracy is 0.7500

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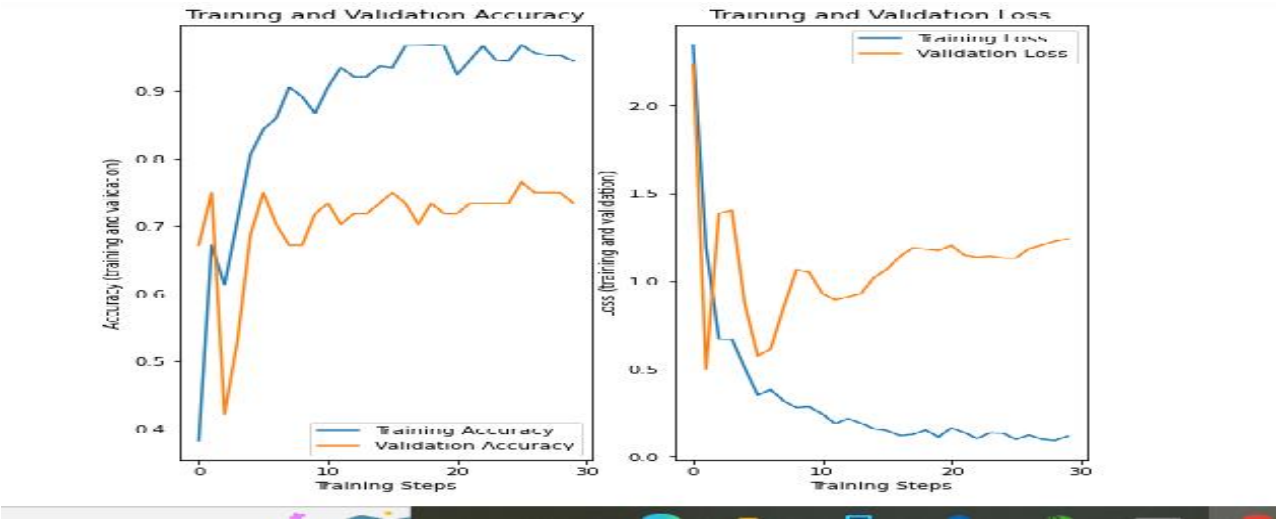

Figure 6: Analysis

Training accuracy achieves 95.7% and in testing brownspot achieves 99.6%, bacterial leaf blight achieves 82.1% and rice blast achieves 91.8%. Pre-trained model Inception_v3 and deep learning based CNN algorithm doesn't cause Overfitting problem.

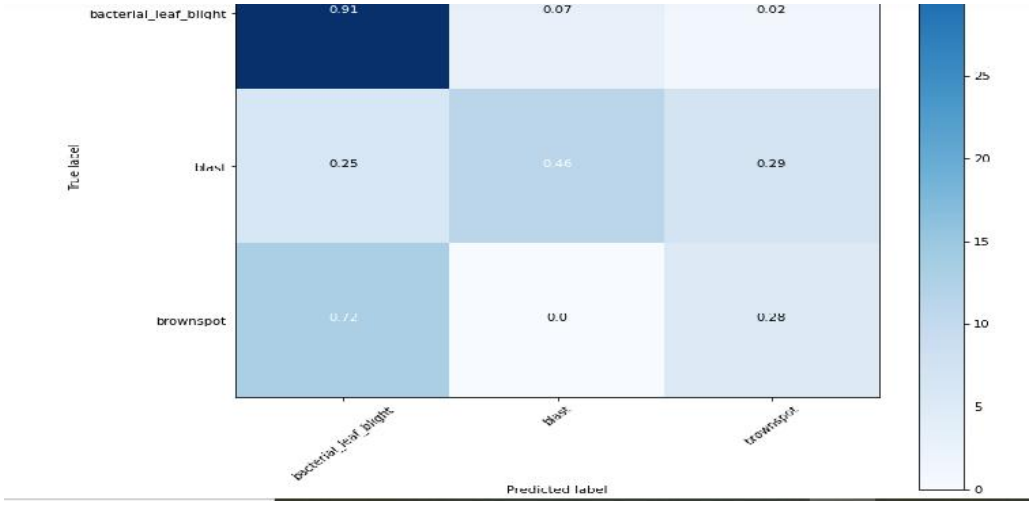

figure 7: confusion matrix output of three paddy leaf diseases

Precision = TP/ TP +FP

Recall = TP/ TP +FN

F1 = 2* precision* recall / precision + recall

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Accuracy = TP + TN / TP+FN+TN+FP

Here,

TP = true positive

FP = false positive

FN = false negative

comparison with existing method like RestNet-50, DenseNet-201, VGGNet-19 and proposed inception_V3 pre-trained method.

Table 1: comparison with various existing accuracy with proposed accuracy

methods	Training accuracy	Testing accuracy
RestNet-50	56.86	52.67
DenseNet-201	91.14	62.67
VGGNet-19	77.71	60.67
Proposed Inception_V3	95.7	75.00

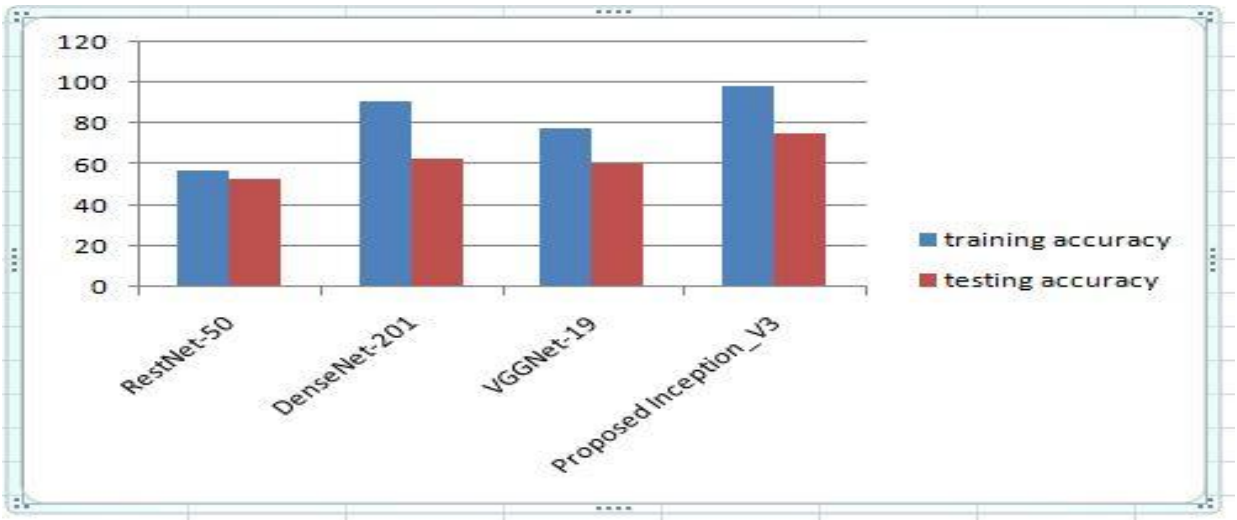

Figure 8: comparison with existing methods

V. CONCLUSION

Thus concluded that the deep learning based methods become easier for the farmer to predict the paddy diseases in initial stages and helps to take necessary action before the entire

paddy farm are get affected. This method becomes more users friendly. The propose method use CNN algorithm which produces good accuracy rate of 75.8% and it is possible to identify the three types of paddy diseases on leaf like bacterial leaf blight, brown spot and rice blast. The proposed work can be further extended for various new algorithms to improve accuracy rate and extend dataset.

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