Paddy Crop Disease Detection using Machine Learning

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Abstract— **Now a days, Farmers are facing loss in crop production due to many reasons one of the major problem for the above issue is crop diseases. This is due to lack of knowledge about the disease and pesticides or insecticides available in order to control the disease. But finding the current disease and providing best remedies requires expert opinion or prior knowledge in order to control the disease. This is time consuming and expensive. In order to solve the above issue we are developing a Machine Learning model using Convolutional Neural Network (CNN) algorithm to detect the paddy crop disease using the image and provide the suitable remedy. The remedies provide appropriate information regarding to pesticide or insecticide to be use in order to cure the disease.**

Keywords— Machine Learning Model; Convolutional Neural Network (CNN); Training Model; Disease Detection; Bacterial Blight; Rice Blast.

I. INTRODUCTION

In India most of its economy comes from Agriculture itself and it is the second largest producer of wheat and Rice. It provides employment to 60% of the Indian population and generates 17% to the total GDP of India. Indian agriculture is composed of many crops like paddy, wheat, sugarcane, oilseeds, vegetables and fruits. Due to emerging growth in the population agriculture sector needs a better advancement using the latest technologies.

For a better yield, the crop should be healthy. Therefore highly effective and cost efficient method is needed for fast detection of crop disease. Paddy is one of the important food crops in the world and India is a largest producer of paddy. Paddy is infected by some disease which is caused by fungi, bacteria and viruses. But farmers lose a 37 % estimated average of paddy due to paddy crop diseases every year. Major issue is farmers are unable to identify the disease properly and they do not know the proper preventive methods in order to control the disease. There is a number of remedial measures are available like varieties of pesticides or insecticides to control the crop diseases and increase the crop production. But finding the current disease and providing best remedies requires expert opinion or prior knowledge in order to control the disease. This is time consuming and expensive. The presence of disease on the plant is reflected on leaves by showing some specific symptoms related to that disease. This specific symptoms act as a feature in order to detect the particular disease. Using these features we developed a machine learning model a latest technology which is less expensive and provides accurate results with less span of time while detecting the paddy crop diseases and provides the best remedies such as insecticides or pesticides in order to control the disease. We have taken only two paddy diseases which occur frequently and lead to more loss in paddy crop production.

II. PADDY DISEASES

Paddy is frequently affected by Rice Blast and Bacterial Blight thus leads to decrease in paddy crop production. The cause and the symptoms of the rice blast and bacterial blight is discussed below,

A. Rice Blast

Rice Blast is caused by a fungus named as Magnaporthe oryzae and it affects the leaf collar, collar node, neck and leaf node of the paddy crop. Rice Blast can kill the rice plants at seedling stage and leads to yield losses in case it severely infected.

Initially Rice blast symptoms appear as lesions on leaf diamond shape. Later lesion became elliptical with gray center and brownish border. Then it gets enlarged and starts killing the entire leaves. In older lesions leaves became elliptical or spindle shaped and whitish to gray centers with red to brownish or necrotic border. Paddy leaf infected by Rice Blast is shown in the Fig 1.

Fig 1. Rice Blast

B. Bacterial leaf blight

Bacterial leaf blight is caused by bacteria called Xanthomonas oryzae. Bacterial leaf blight is one of the deadly and destructive diseases of paddy and it may leads to

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crop loss of 75%. Blight causes yellowing, drying of leaves and wilting of seedlings.

Initially symptoms appear as water-soaked streaks in leaf tips. In later stage grayish white lesions appear on the leaves leads to yellowing and drying of leaves. Blight is an epidemic disease and it can easily spread in wind and water. The paddy leaf infected by bacterial blight is shown in Fig 2.

Fig 2.Bacterial Leaf Blight

III.   LITERATURE SURVEY

Shruthi U, Nagaveni V, Raghavendra B K proposed "A review on machine learning classification techniques for plant disease detection" shows different   machine learning classification are used to detect the crop disease. The different classification methods are Artificial Neural Network (ANN) classification technique, K-nearest neighbor classification technique, Convolutional Neural Network classification, fuzzy classifier and Support Vector Machine (SVM) classification methods. From above mentioned techniques Convolutionsl Neural Network provides high accuracy compared to other methods and detect more number of diseases in multiple crops [1].

V.Vanitha proposed "Rice disease detection using deep learning" which proposes an automatic disease detection using deep neural network. The developed model is capable of detecting 3 different disease of paddy and also detect the healthy leaf image.The dataset was trained with three CNN architectures and achieved a high accuracy of 99.53% [2].

Shamim Mahbub, Md. Abu Nasim, Md. JahidHasan, Md. Shahin Alom proposed   "Rice disease identification and classification by integrating support vector machine with deep convolutional neural network" represents a system to identify the rice disease and help the farmers to take proper decision to control the disease and also help them to increase production. They have built a AI model by integration of Support Vector Machine(SVM)   with   Deep   Convolutional   Neural Network(DCNN). Model identifies and classifies nine types of rice diseases with an accuracy of 97.5% [3].

Anuradha badge proposed "Crop disease detection using Machine learning: Indian Agriculture" how diseases affecting the less yield and how machine learning technique will help us to detect the disease and help the farmers to take necessary action. They used canny's edge detection algorithm for the efficient detection of crop disease by taking image of crop .They take wheat crop for their research paper [4].

The survey help us to find out the best machine learning algorithm, for the proposed system as described in [1] CNN provides highest accuracy and processing speed compared to other algorithms.

IV.   PROPOSED METHODOLOGY

In this system for detecting the rice blast and Bacterial leaf blight disease of paddy, it involves major two phases one is training the model and the other part is detecting the given image of the disease. The first phase deals with training the model using the image dataset. Both healthy and disease leaf image dataset are collected. Here we have collected 2000 images of Rice blast, 2000 images of Bacterial Blight and 2000 healthy paddy leaf images. The images are downloaded from the kaggle website. These images are trained with the help of Convolutional Neural Network (CNN) Algorithm.

A.   CNN Architecture

A CNN consists of an input layer, multiple hidden layer and an output layer. In hidden layer consist of Convolution layer, Rectified Linear Unit, pooling layer and fully connected layer. The CNN architecture for the proposed model is shown in figure 3. The input layer takes the resized, gray scaled image and output layer produces the detection of the disease and provides remedies. The detailed explanation of the remaining layers as fallows,

1.   Convolutional Layer

The training data (images of the diseased and healthy rice plant) was sent to input layer of CNN. The convolution operation is then performed on input samples; the input is convolved with filters called kernels, that is, a number of filters slide over the feature map of the previous layer, to produce output feature maps.

2.   Rectified Linear Unit (ReLu)

In this layer is usually called as activation function layer, ReLu is one of the activation function. There are various types of activation function available such as sigmoid, Tanh, ReLU, Softmax, etc. In our model ReLu activation function is used in hidden layers. It is the most widely used activation function. In ReLu layer the image with negative pixel values are replaced with pixel value 0 and remaining pixel retain as it is. The ReLU function can be written in the mathematical form in equation 1,

$$f(x) = \begin{cases} 0 & \text{if } x<0 \\ x & \text{if } x>=0 \end{cases} \quad (1)$$
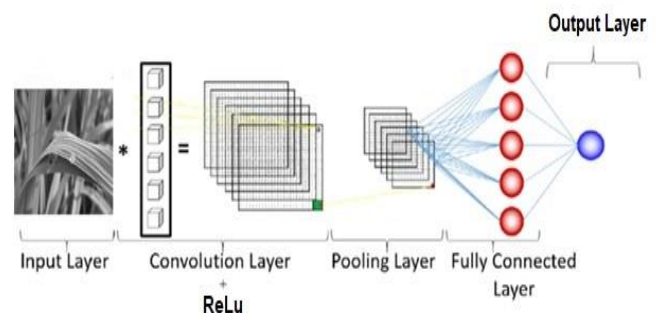
where x is a pixel value

Fig 3.Convolutional Neural Network Architecture

3. Pooling Layer

A pooling layer performs reduction operation along the dimensions of image (Width, Height), resulting dimensionality reduction. The primary aim of pooling operation is to reduce the size of the images as much as possible. This scans across the image using a window and compresses the image extracting features. Average pooling and Max pooling are the most commonly used methods in pooling layers. In max pooling largest value of the pixel is taken from the selected window of the image, while average pooling takes the average of all pixel values within the window.

4. Fully Connected Layer

After the convolution + RELU+ Pooling layers, we stack up these layers many times until the image is reduced to a vector. In this layer actual classification will going to happen. In this layer all the neurons are interconnected; this layer produces an N-dimensional vector, where every neuron in this layer contains the vectors of the features extracted from the image.

The proposed system has concentrated on detecting the paddy diseases and provides the suitable remedies, thus leads to increase in paddy crop production. In this system it detects the most common and frequently occurring paddy diseases (Rice blast and bacterial Blight) and provides pesticides or insecticides as a remedy to control the disease. The type of paddy disease is detected by CNN algorithm. The proposed system architecture is shown in Fig 4.

Fig 4. Proposed Architecture

As shown in figure 4, first the data set is loaded and the data set is preprocessed by reducing the size and converting it to the gray scale, then the features are extracted using the convolutional layer of CNN these features will help the model in training. After training the model is able to detect the disease.

In the testing phase same data preprocessing is done and the image data is uploaded to CNN algorithm then the given image is vector is compared with the training model vector then the model is able to detect the disease and provides the remedies. If more data set is used during the training the model provides better accuracy while detecting the paddy leaf disease. Some of the results obtained from our model is shown in the figure 5.

a. Healthy Leaf   b. Rice Blast

c. Bacterial Blight

Fig 5. Results

V. CONCLUSION AND FUTURE WORK

Farmers are facing the issues with paddy crop disease identification and unable to find effective pesticide or insecticide to control the infected disease. We solve the above issue by developing a machine learning model using the Convolutional Neural Network (CNN) algorithm that detects the Rice Blast, Bacterial Blight and Healthy paddy leaf images and provides the solution as insecticide or pesticides in order to control the Rice Blast and Bacterial Blight. We see that the system is robust, user friendly, fast and cost efficient result than existing method.

In Future other Paddy crop diseases can be trained and Mobile Application can be developed and make it available free on the Google play store. Other crop diseases can be trained and integrate with the paddy crop model, so that model can be able to predict other crop diseases.

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