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Recognition of Diseases in Oryza Sative Plants using Image Processing and Machine Learning Techniques

Dr. Krishnareddy K R M. Tech. Ph.D.
Prof., Dept. of Computer Science & Engineering
S J M Institute of Technology,
Chitradurga, India

Prof. Ramesh B E M. Tech.
Prof., Dept. of Computer Science & Engineering
S J M Institute of Technology,
Chitradurga, India

Hema B K
Dept. of Computer Science & Engineering
S J M Institute of Technology,
Chitradurga, India

Monisha R
Dept. of Computer Science & Engineering
S J M Institute of Technology,
Chitradurga, India

***Abstract*—Agriculture is the main activity in India. Now a day, Farmers are facing loss in crop production due to many reasons, one of the major problem is crop diseases. The proposed system helps in identification of disease in Oryza Sativa plant. The database obtained from the Kaggle is properly segregated and the different plant species are identified and are renamed to form a proper database then obtain test-database which consists of various plant diseases. Then we use classification to identify disease in leaf with a combination of texture and color feature extraction. Images are classified by Softmax classifier. A combination of texture and color feature extraction results highest classification accuracy. After extensive training on different samples of datasets, our machine learning approach learns gradually and can be more effective in detecting plant diseases. In this project Convolution Neural Network (CNN) is used for prediction, based on this the software will tell us whether the plant is healthy or not, if it is diseased then it will display the remedies.**

Keywords— Image Processing; CNN; Oryza sativa; Disease detection;

I. INTRODUCTION

Agriculture is the main area that needs to be concentrated for the growth of the economy. In India most of its economy comes from Agriculture itself. India 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.

Farmers are held up with various factors such as climatic conditions, soil conditions, various disease, etc. affect the production of the crops. The existing method for plants disease detection is simply naked eye observation which requires more man labor, properly equipped laboratories, expensive devices, etc. Plant diseases are one of the causes in the reduction of quality and quantity of agriculture crops. Sometimes new farmers are not aware of the diseases and its occurrence period.

The detection of a plant disease is one of the important research topics in the agriculture domain. This attempts to apply concepts of Machine Learning and Image Processing to solve the problem of automatic detection and classification of diseases of the rice plant, which is one of the important foods in India. On any plant, diseases are caused by bacteria, fungi, and virus. For rice plants, most common diseases are Bacterial leaf blight, Brown spot, Leaf smut, Leaf blast, and Sheath blight. Image processing operations can be applied on external appearances of infected plants. However, the symptoms of diseases are different for different plants. Some diseases may have brown color or some may have a yellow color. Each disease has its own unique characteristics.

Diseases differ in shape, size, and color of disease symptoms. Some of the diseases might have the same color, but different shapes; while some have different colors but same shapes. Sometimes farmers get confused and are unable to take proper decision for selection of pesticides.

This work concentrates on one of the problems i.e., disease prediction. The identification of disease in plants is a very tough task, and if it's not monitored properly it leads to a decrease in the yield. To resolve the issues caused by unhealthy crops which affect agriculture demands an approach for disease identification and prediction.

The need and challenge of disease detection in crops are solved by CNN approach. In our work, Softmax is used to classify leaf images as diseased or healthy based on the input patterns of the image. We have taken only three types of disease in Oryza Sativa plant which occur frequently and lead to more lose in Oryza Sativa crop production.

II. EXISTING WORKS

Image processing techniques are used to detect the plant leaf diseases. This consist of Image preprocessing, Segmentation of the leaf using K-means clustering to determine the diseased areas, feature extraction &

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Classification of diseases. Texture features are extracted using statistical Gray-Level Co-Occurrence Matrix (GLCM) features and classification is done using Support Vector Machine (SVM). First, the data base is constructed using 60 images of citrus leaves, with 35 diseased leaves and 25 normal leaves. The images in RGB color format are converted into L*a*b* color space and segmented using K-Means algorithm. The number of clusters is selected as three. The segmentation of the diseased leaves results in identifying the diseased parts of the leaves. The classification of the leaves into diseased or not is done by classification using SVM. The input image is resized after training of the classifier by training vectors, classification is done. Classification accuracy of 0.9 to 1.0 is obtained using the proposed method. They concluded that the method for detection and classification of leaf diseases is implemented. The segmentation of the diseased part is done using K-Means segmentation. Then, GLCM texture features are extracted and classification is done using SVM [1].

Grape constitutes one of the most widely grown fruit crops in the India. Productivity of grape decreases due to infections caused by various types of diseases on its fruit, stem and leaf. Leaf diseases are mainly caused by bacteria, fungi, virus etc. Diseases are a major factor limiting fruit production and diseases are often difficult to control. Without accurate disease diagnosis, proper control actions cannot be used at the appropriate time. Image Processing is one of the widely used technique is adopted for the plant leaf diseases detection and classification. This paper is intended to aid in the detection and classification leaf diseases of grape using SVM classification technique. First the diseased region is found using segmentation by K-means clustering, then both color and texture features are extracted. Finally classification technique is used to detect the type of leaf disease. The proposed system can successfully detect and classify the examined disease with accuracy of 88.89% [2].

Farmers in rural India have minimal access to agricultural experts, who can inspect crop images and render advice, Delayed expert responses to queries often reach farmers too late. Many of the farmers will be unaware of the non-native diseases, and they cannot go to experts always and take suggestions from them if they are in some rural areas. So the image processing techniques can be applied to detect the healthiness of the leaf by acquiring the image of it and applying algorithms to detect the disease. It requires less cost and helps in increased production. We design a system which tells the farmer about the type of the disease present or occurring to their plants. We are considering paddy plant for the experimental purpose, later which can be implemented for other crops also. The diseases we are focusing are leaf blast, leaf blight. First the leaves are classified into healthy and the diseased samples. They use Bhattacharya's calculation method for finding similarity in histogram of test image or sample images with respect to clinically proved healthy image(standard image). During the training phase, we used 100 sample images of healthy, disease one, disease two leaves for obtaining standard values which represents respective types, based on which type of the test leaf is detected [3].

The spread of plant pests and diseases has increased dramatically in recent years. Globalization, trade and climate change, as well as reduced resilience in production systems due to decades of agricultural intensification, have all played a part. Plant pathogens can be fungal, bacterial, viral or nematodes and can damage plant parts above or below the ground. Identifying symptoms and knowing when and how to effectively control diseases is crucial. In this paper, we propose the idea of leaf detection using leaf images. In this system, they proposed the use of several image processing techniques for the detection and classification of the paddy leaf disease. The proposed system is capable of detecting the disease at an earlier stage as soon as it occurs on the leaf. Hence saving the loss and reducing the dependency on the expert to a certain extent is possible. It can provide the help for a person having less knowledge about the disease. Depending on these goals, they extract the features corresponding to the disease. This is one of the reasons that disease detection in plants plays an important role in the agricultural field, as having diseases in plants is quite natural. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring a big farm of crops, and at a very early stage itself, detects the symptoms of diseases, i.e., when they appear on plant leaves[4].

Cotton is the most important cash crop in India. It is also known as "White Gold" or "The King of fibers" among all cash crops in the country. About 80–90% of the diseases which occur on the leaves of cotton are alternaria leaf spot, Cercospora leaf spot, Bacterial blight and Red spot. This paper presents a survey on detection and classification of cotton leaf diseases. It is difficult for human eyes to identify the exact type of leaf disease which occurs on the leaf of plant. Thus, in order to identify the cotton leaf diseases accurately, the use of image processing and machine learning techniques can be helpful. The images used for this work were acquired from the cotton field using digital camera. In pre-processing step, background removal technique is applied on the image in order to remove background from the image. Then, the background removed images are further processed for image segmentation using Otsu thresholding technique. Different segmented images will be used for extracting the features such as color, shape and texture from the images. At last, these extracted features will be used as inputs of classifier [5].

The brown planthopper Nilaparvata lugens (BPH) is one of the most harmful insect pests in rice paddy fields, which causes considerable yield loss and consequent economic problems, particularly in the central plain of Thailand. Accurate and timely forecasting of pest population incidence would support farmers in planning effective mitigation. In this study, artificial neural network (ANN), random forest (RF) and classic linear multiple regression (MLR) analyses were applied and compared to forecast the BPH population using weather and host-plant phenology factors during the

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crop dry season from 2006 to 2016 in the central plain of Thailand. Data from satellite earth observation was used to monitor crop phenology factors affecting BPH population density. An ANN model with integrated ground-based meteorological variables and satellite derived host plant variables was more accurate for short-term forecasting of the peak abundance of BPH when compared with RF and MLR, according to a reasonably validating dataset (RMSE of natural log-transformed (ln) BPH light trap catches = 1.686, 1.737, and 2.015, respectively). This finding indicates that the utilization of ground meteorological observations, satellite-derived NDVI time series, and ANN have the potential to predict BPH population density in support of integrated pest management programs. We expect the results from this study can be applied in conjunction with the satellite-based rice monitoring system developed by the Geo-Informatic and Space Technology Development Agency of Thailand (GISTDA; http://rice.gistda.or.th) to support an effective pest early warning system [6].

Identification of diseases from the images of a plant is one of the interesting research areas in the agriculture field, for which machine learning concepts of computer field can be applied. This article presents a prototype system for detection and classification of rice diseases based on the images of infected rice plants. This prototype system is developed after detailed experimental analysis of various techniques used in image processing operations. They consider three rice plant diseases namely Bacterial leaf blight, Brown spot, and Leaf smut. They capture images of infected rice plants using a digital camera from a rice field. They empirically evaluate four techniques of background removal and three techniques of segmentation. To enable accurate extraction of features, they propose centroid feeding based K-means clustering for segmentation of disease portion from a leaf image. They enhance the output of K-means clustering by removing green pixels in the disease portion. They extract various features under three categories: color, shape, and texture. They use Support Vector Machine (SVM) for multi-class classification. They achieve 93.33 % accuracy on training dataset and 73.33% accuracy on the test dataset. They also perform 5 and 10-fold cross-validations, for which they achieve 83.80% and 88.57% accuracy, respectively. They concluded that Rice plant diseases can make a big amount of loss in the agriculture domain. They used K-means clustering with feeding centroid values for disease segmentation. They removed unnecessary green portions from the disease cluster by applying thresholding on the hue component of disease portion. They found that our selected image processing operations prepared images suitable for extraction of features. They extracted total 88 features and considered three different models having a different number of features. They used SVM to classify the disease and they achieved 93.33% training accuracy and 73.33% testing accuracy. They also performed k-fold cross validation for k=5 and k=10. They also developed easy-to-use GUI for understanding all intermediate steps performed from image input to disease classification [7].

III. PROBLEM STATEMENT

Farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for plant. Disease on plant leads to the significant reduction in both the quality and quantity of agricultural products. Earlier detection of problems by Adapting to the latest technologies which provide automated processing through machine learning provides a better way for sustainable farming. It is very difficult to monitor the plant diseases manually. It requires tremendous amount of work, expertize in the plant diseases, and also require the excessive processing time. Hence, image processing and machine learning is used for the detection of plant diseases.

IV. PROPOSED SYSTEM

Identifying diseases through naked eye is often prone to high error rates and faulty classification. This method that solves this issue and helps in identifying and classifying the leaf diseases by applying various image processing and neural network algorithms.

1. The input test image is acquired and preprocessed in the next stage and then it is converted into array form for comparison.
2. The selected database is properly segregated and preprocessed and then renamed into proper folders.
3. The model is properly trained using CNN and then classification takes place.
4. The comparison of the test image and the trained model take place followed by the display of the result.
5. If there is a defect or disease in the plant the software displays the disease along with the remedy.

V. SYSTEM ARCHITECTURE

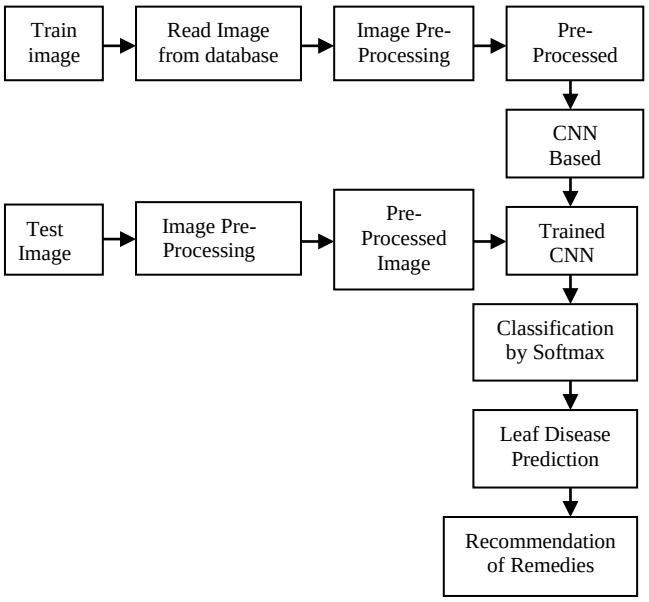

Figure 1: System Architecture.

A. Image Processing

- Image processing is a method to perform some operations on an image, in order to get an enhanced

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image and or to extract some useful information from it. Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality.

- Image processing basically includes the following three steps:
  1. Importing the image.
  2. Analysing and manipulating the image.
  3. Output in which result can be altered image or report that is based on image analysis.

B. Convolution Neural Network

- Convolutional neural network is the special type of feed forward artificial neural network in which the connectivity between the layers is inspired by the visual cortex. Convolutional Neural Network (CNN) is a class of deep neural networks which is applied for analyzing visual imagery.

- Basically, the convolutional neural networks have 4 layers that are:
  1. Convolutional layers
  2. ReLU layer
  3. Pooling layer
  4. Fully connected layer.

- Convolutional Layer: In convolution layer after the computer reads an image in the form of pixels, then with the help of convolution layers we take a small patch of the images. These images or patches are called the features or the filters. By sending these rough feature matches is roughly the same position in the two images, convolutional layer gets a lot better at seeing similarities than whole image matching scenes. These filters are compared to the new input images if it matches then the image is classified correctly. Here line up the features and the image and then multiply each image, pixel by the corresponding feature pixel, add the pixels up and divide the total number of pixels in the feature. We create a map and put the values of the filter at that corresponding place. Similarly, we will move the feature to every other position of the image and will see how the feature matches that area. Finally, we will get a matrix as an output.

- ReLU Layer: ReLU layer is nothing but the rectified linear unit, in this layer we remove every negative value from the filtered images and replaces it with zero. This is done to avoid the values from summing up to zeroes. This is a transform function which activates a node only if the input value is above a certain number while the input is below zero the output will be zero then remove all the negative values from the matrix.
- Pooling Layer:In this layer we reduce or shrink the size of the image. Here first we pick a window size, then mention the required stride, then walk your window across your filtered images. Then from each window take the maximum values. This will pool the layers and shrink the size of the image as well as the matrix. The reduced size matrix is given as the input to the fully connected layer.

- Fully Connected Layer: We need to stack up all the layers after passing it through the convolutional layer, ReLU layer and the pooling layer. The fully connected layer used for the classification of the input image. These layers need to be repeated if needed unless you get a 2x2 matrix. Then at the end the fully connected layer is used where the actual classification happens.

C. Classification using Convolutional Neural Networks

- In deep learning, a convolutional neural network (CNN) is a class of deep neural network most commonly applied to analysing visual imagery. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics.
- When CNN is used for classification, we don't have to do feature extraction. Feature Extraction will also be carried out by CNN. We feed the pre-processed image directly to CNN classifier to obtain the type of weapon if present. Flowchart for classification using CNN is shown in below figure.

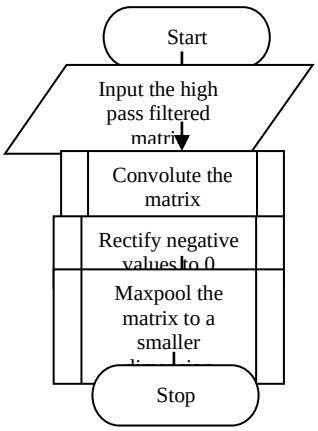

Figure 2: Flowchart for classification using CNN.

- By considering all the features in the output layer which gives the result with some predictive value. These values are calculated by using SoftMax activation function. SoftMax activation provides predictive values. Based on the predictive value the final result will be identified.

a. Click on the Get Photo

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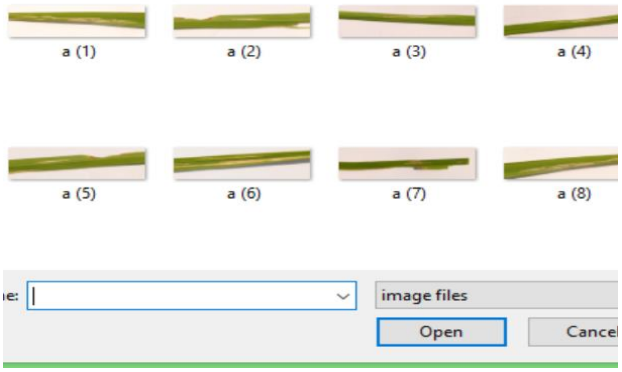
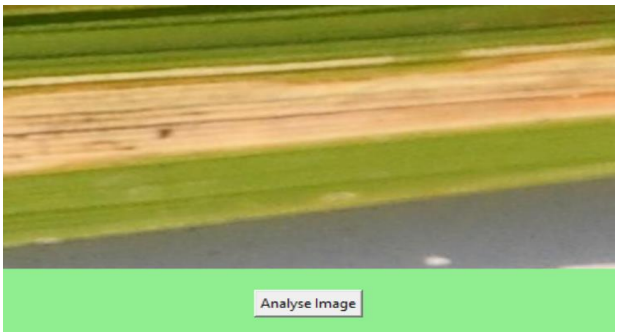
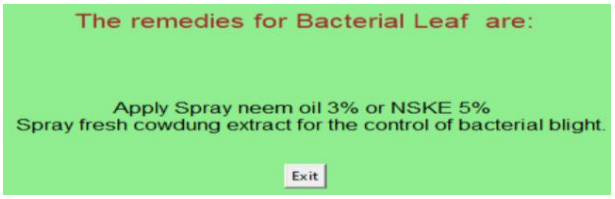


b. Choosing the picture from Test data



c. Click on Analysis image

d. It Displays Disease Click on Remedies to get Remedies



e. It will displays Remedies

Figure 3: Results

VI. CONCLUSION

Farmers are facing the issues with Oryza Sativa plant disease identification and difficult to find effective pesticide or insecticide to control the infected disease. For this problem we develop the software by using image processing with machine learning techniques. This will detects the disease and healthy Oryza Sativa leaf images and provides the remedies as effective insecticide or pesticides in order to control the diseases.

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