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An Automatic Approach for Leaf Disease Detection using Deep Learning Algorithms

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Abstract: *India is an agriculture country and above seventy percent of our population depends on the agriculture. One-third of our national income comes from agriculture. Agriculturalists are facing loss due to various crop diseases and it becomes tedious for cultivators to monitor the crop regularly when the cultivated area is huge. So the plant disease detection plays an important role in agriculture field. Timely and accurate disease detection is important for the loss caused due to crop diseases which affects adversely on crop quality and yield. Early diagnosis and intervention can reduce the loss of plant due to disease and reduce the unnecessary drug usage. Earlier, automatic detection of plant disease was performed by image processing. For disease detection and classification, the machine learning mechanism and image processing tools are proposed. Crop disease will be detected through various stages of image processing such as image acquisition, image pre-processing, image feature extraction, feature classification, disease prediction and fertilizer recommendation.*

Keywords: Classification, Feature Extraction, Image Global Features, Image Processing, Machine Learning

I. INTRODUCTION

Farmers' economic growth depends upon the quality of the product that they grow, which is directly dependent on the plants' growth and yield they get. Plants are attacked by the different diseases that target different parts of plant body such as leaf, stem, seed, and fruit and so on. To solve this problem machine learning seems to be a better option. Various machine learning techniques are recently proposed for identification and classification of plant disease from plant images. Many crops, most importantly cash crops play a dominant role in the Industrial and Agriculture Economy of the country. India provides direct livelihood to 6 million farmers.

Various image processing concepts such as image filtering, segmentation, image feature extraction have emerged to detect the leaf diseases. There are various image segmentation methods available such as k-means clustering, Canny and Sobel segmentation, and Otsu thresholding. Techniques such as Support Vector Machine (SVM), Neural Network (NN), and Homogeneous Pixel Counting technique for Cotton Diseases Detection (HPCCDD) can be used for classification. Features play an important role in the classification process. Previous proposed works for detecting disease have some limitations such as low resulting accuracy and a smaller number of images used to detect disease. The main source for the disease is the leaves of the plant. About 80 to 90 % of disease on the plant is on its leaf. Hence, the study of interest is the leaf of the tree rather than whole plant. The leaves are mainly suffered from diseases like insecticide (*tudtude, mawa*), fungus, foliar leaf, and Alternaria leaf spot.

1.1 Motivation

Farmer's economic growth relies on the quality of the product that they grow, which is directly dependent on the plants growth and yield they get. Plants are attacked by the different disease which target different parts of plant body such as leaf, stem, seed, and fruit and so on.

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Agriculturalist is facing loss due to various crop diseases and it became difficult for cultivators to monitor the crop regularly when the cultivated area is huge (acres). As crop disease affects adversely on crop quality and yield, timely and accurate disease detection may provide proper solution to prevent these diseases.

1.2 Objectives

- To train classifier based on deep learning algorithm.
- To analyses the result of detection and classification Phases.
- To identify the disease with the help of Image Processing.
- Try to improve detection accuracy using deep learning algorithm.

1.3 Problem Statement

The identification and classification of plant diseases using some automatic intelligence approach for leaf disease detection using deep learning algorithms.

II. RELATED WORK

Wan MohdFadzil et al. [1], discussed a disease detection method for orchid plant leaves. The orchid plant leaflet images are received the usage of digital camera. The algorithm makes use of an aggregate of various strategies inclusive of border segmentation method, morphological processing and filtering technique used for categorizing input images into two disease class as black leaf spot and solar scorch. However, the segmentation technique proposed and used in this can only distinguish for two difference type of orchid leaf disease. Thisis because there need many combinations of the processing techniques to find robust for border segmentation techniques.

Aditya Parikh et al [2] authors' primary focus of this work is to detect disease and estimate its stage for a cotton plant using images. Most disease symptoms are reflected on the cotton leaf. The proposed work uses two cascaded classifiers, so using local statistical features, first classifier segments leaf from the background. Then using hue and luminance from HSV colour space another classifier is trained to detect disease and find its stage. However, cascaded classifiers depend on various conditions i.e., border of the leaves are viewable, Leaves are big size for analysis and the probing requires controlled environment.

Bhumika S.Prajapati et al [3], this work 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 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. However, this work describes only general and different approaches for detection and classification of cotton leaf diseases and describe background removal and segmentation techniques.

P. R. Rothe et al [4], Leaf diseases on cotton plant must be identified early and accurately as it can prove detrimental to the yield. The presented work presents a pattern recognition system for identification and classification of three cotton leaf diseases. The images required for this work are captured from the fields at Central Institute of Cotton Research Nagpur, and the cotton fields in Buldana and Wardha district. Active contour model is used for image segmentation. However, neuro-fuzzy inference neural network depends on the training is performed by extracting seven invariant features from three kinds of diseased leaves images. Neural network classification is depends on invariant features.

MelikeSardogan et al [5], this paper presents a Convolutional Neural Network (CNN) algorithm and Learning Vector Quantization (LVQ) algorithm-based method for tomato leaf disease detection and classification. The dataset contains 500 images of tomato leaves with four symptoms of diseases. They have modelled a CNN for automatic feature extraction and classification. However, one of the main challenges in disease detection and classification for this study is that the leaves with different diseases are very similar to each other. Therefore, this similarity can cause some leaves to be folded into towrongclasses.

NorfarahinMohdYusoff et al [6], this paper proposes a real-time edge detection technique for identifying Hevea leaves diseases (rubber tree leaves) in images and its hardware implementation. Three major Hevea leaves diseases which are Corynespora Leaf Spot, Bird's Eye Leaf Spot and Colletotrichum Leaf Disease used in this study for image

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comparison. The disease on the leaves can be detected through edge detection by using Sobel edge detection algorithm. The real-time edge detection result generated by FPGA Cyclone IV E which is displayed through a monitor is compared to Sobel edge detection algorithm that is generated with MATLAB.

Indhumathi et al [7], this system finds the area of leaf that has been affected and also the disease that attacked the leaf. This is achieved by using Image Processing; there are systems that predict the diseases in the leaf. Our system uses K-Medoid clustering and Random Forest algorithm to produce more accuracy in the detection of disease in the leaf. The image is first pre-processed and then the clustering method is applied to find the affected area of the leaf.However, Random Forest algorithm is decision tree-based algorithm. Accuracy is low compared to other algorithms. Basically, random forest used with text data.

Gayatri Kurichetiet al [8], This paper develops an algorithm for detecting and preventing the spreading of diseases to the whole crop and results in high quality crop production. The data base of different leaf images was created and processed using k-Means image segmentation and leaf images textural analysis was carried out using GLCM. SVM classifier is used to classify the feature extracted images after ranking their attributes using an information gain algorithm. However, the main disadvantage of K mean clustering algorithm is the need to fix the number of clusters. For the extraction of infected part of the leaf, 3 clusters can be ideal. Each cluster will denote background, healthy part and the infected part separately.

ChaowalitKhitthuk et al [9], this paper presents plant leaf disease diagnosis system from colour imagery using unsupervised neural network. Images are processed using both colour and texture features. The system is mainly composed of two processes: disease feature extraction and disease classification. The process of disease feature extraction analyzes feature appearance using statistic-based gray level co-occurrence matrix and texture feature equations. The disease classification process deploys the unsupervised simplified fuzzy ARTMAP neural network to categorize types of disease. Four types of grape leaf disease images are used to test the system's classification performance which are rust, scab, downy mildew and no disease. However unsupervised feature isn't practically suitable in many classifications systems comparing to traditional backpropagation network and machine learning.

III. PROPOSED METHODOLOGY

The methodology for diagnosing leaf diseases involves several tasks, such as Image pre-processing, image feature extraction and leaf diseases classification based on image feature that is colour features, shape features and texture features. The first phase is the image acquisition phase. In this step, image is uploaded from the images of the various leaves dataset. In the second phase image pre-processing is completed. In the third phase, image feature extraction for the infected part of the leaf is completed based on specific properties among pixels in the image or their texture. After this step, certain statistical analysis tasks are completed to classify the features that represent the given image using machine learning to compare image features. Finally, classification result shows the identified leaf disease.

Advantages of Proposed System:

- It consists two algorithms for classification and feature extraction which effectively able to extract disease from image and gives the actual final result.
- This proposed system effectively able to extract all the spatial characteristics of an image.
- Try to improve detection accuracy using deep learning.

1. Input Image:

Here will upload the Input leaf Image.

2. Image Pre-processing:

In this step will applying the image pre-processing methods like grayscale conversion, image noise removal for further processing.

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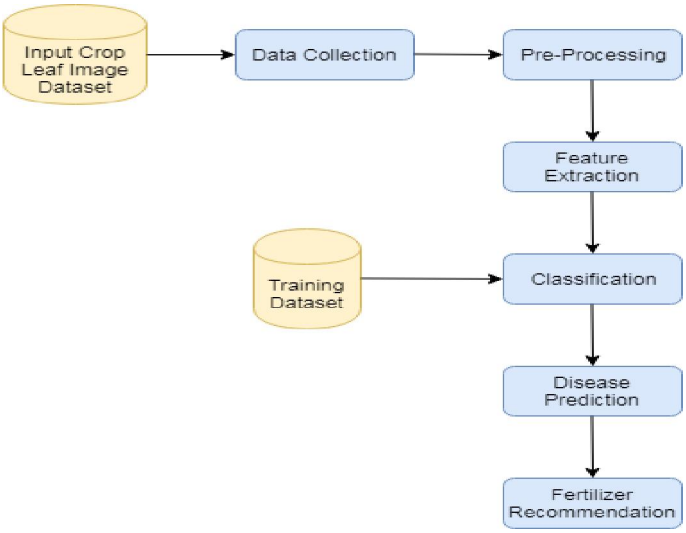

Fig. System Architecture

3. Image Feature Extraction:

In this step will applying the image thresholding and edge detection methods to extract the cell nuclei from leaf image and count that.

4. Image Classification:

In this step will applying the image classification methods like CNN algorithm to classify the diseases.

5. Result:

In this step will show the final leaf disease result.

IV. ALGORITHM

Convolution Neural Network (CNN)

The structure of CNN includes two layers one is feature extraction layer, the input of each neuron is connected to the local ready fields of the previous layer, and extracts the local feature. Once the local features are extracted, the positional relationship between it and other features also will be displayed. The other is feature map layer; each computing layer of the network is collected of an advantage of feature map. Every feature map is a plane, the weight of the neurons in the plane are same. The structure of feature plan uses the sigmoid function as activation function of the convolution network, which makes the feature map have shift in difference. Besides, since the neurons in the same mapping plane share weight, the number of free parameters of the network is decreased. Each convolution layer in the convolution neural network is come after by a computing layer which is used to find the local average and the second extract; this unique two feature extraction structure decreases the resolution.

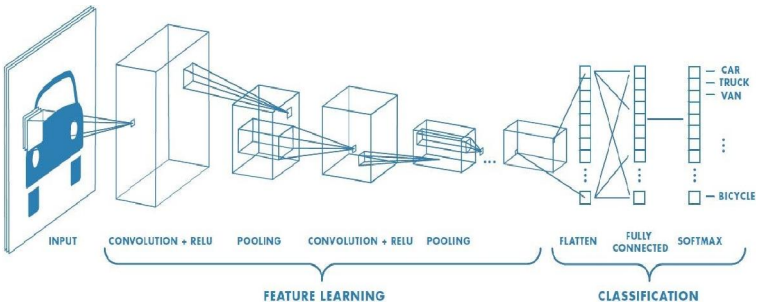

Fig. CNN Layers

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Convolution Layer

Convolution is the first layer to extract features from an input image (leaf image). Convolution preserves the relationship between pixels by learning image features using small squares of input data. Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters i.e. identity filter, edge detection, sharpen, box blur and Gaussian blur filter.

Pooling Layer:

Pooling layers would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or down sampling which reduces the dimensionality of each map but retains important information.

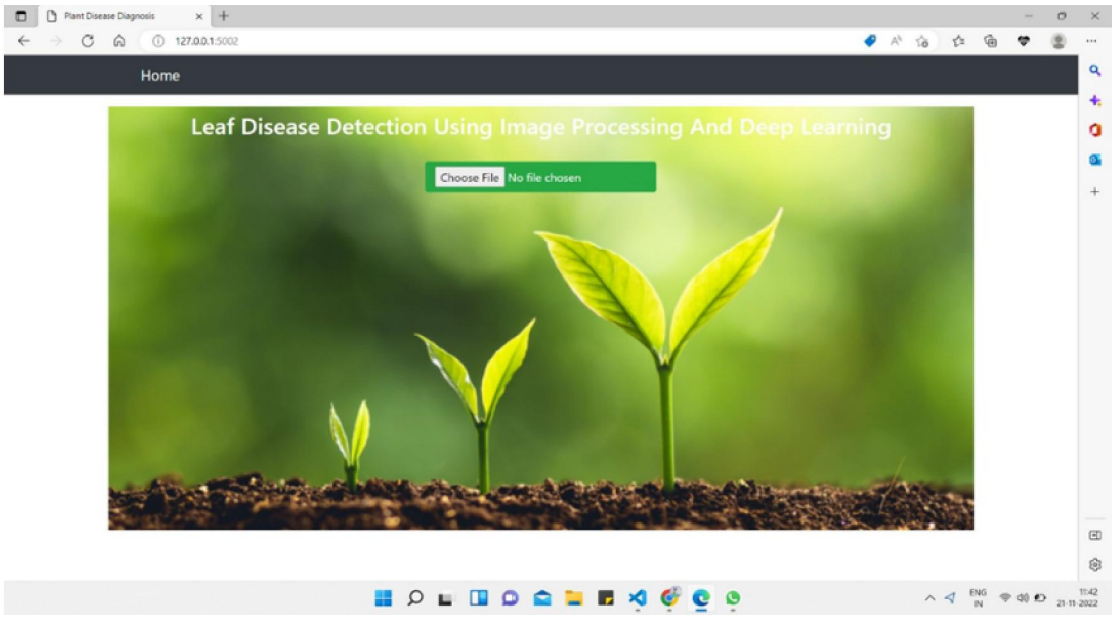
Fully Connected Layer:

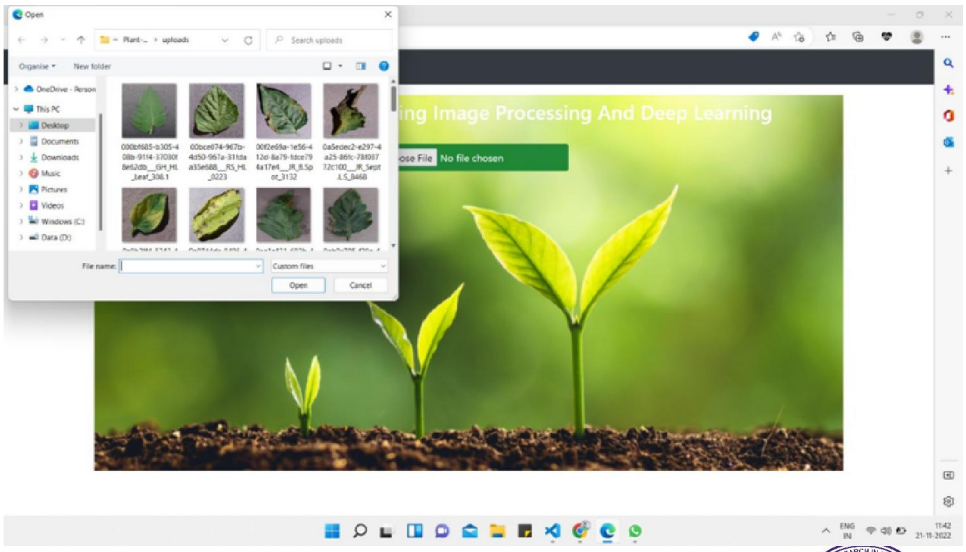
In this layer Feature map matrix will be converted as vector (x1, x2, x3, …). With the fully connected layers, we combined these features together to create a model.

SoftMax Classifier

Finally, we have an activation function such as SoftMax or sigmoid to classify the outputs i.e.,classify leaf disease.

V. RESULT AND DISCUSSION





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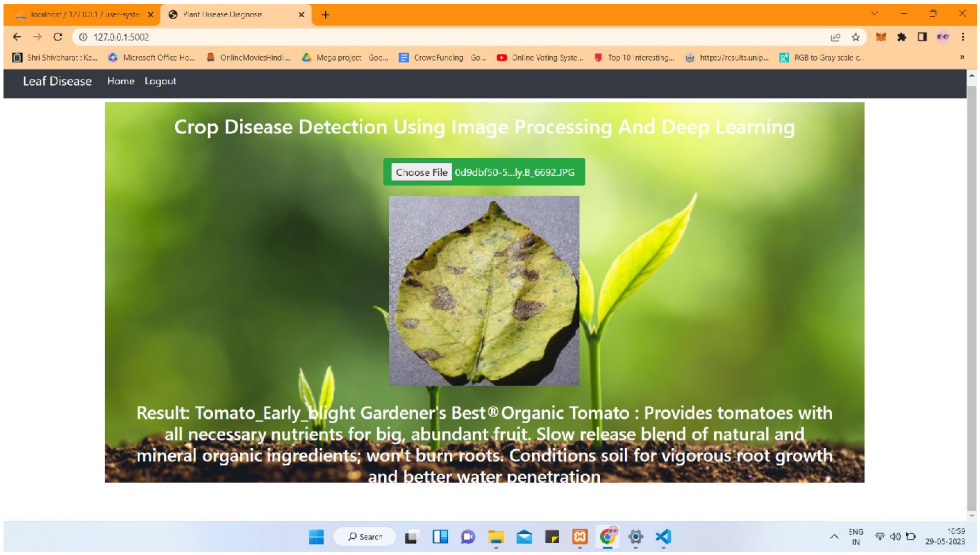

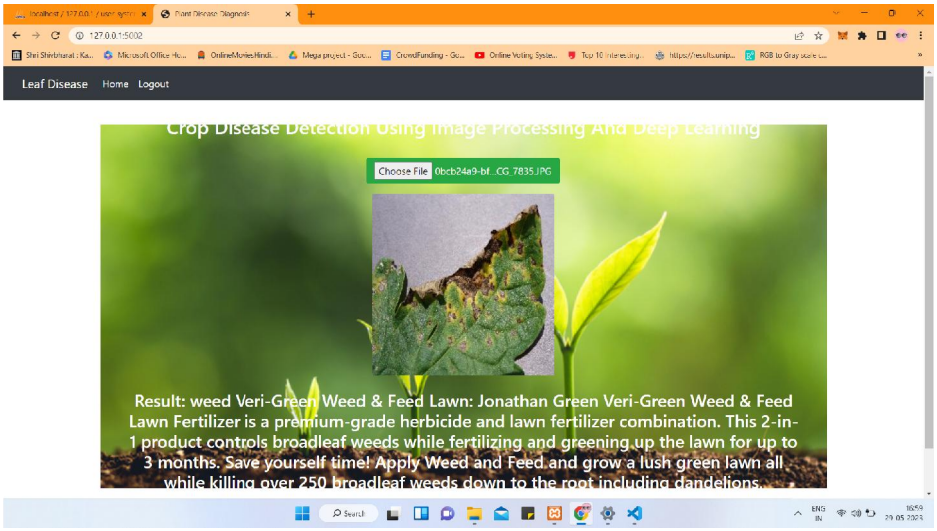

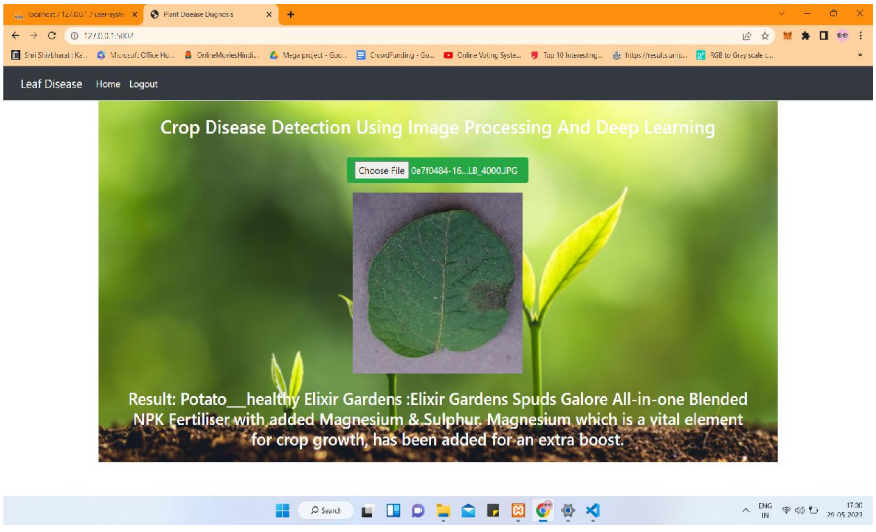

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VI. CONCLUSION

In this paper, addressed how the disease analysis is possible for the leaf diseases detection, the analysis of the various diseases present on the leaves can be effectively detected in the early stage before it will damage the whole plant. Here the technique presented can able to detect the disease more accurately, we can say that, we can archive good productivity by preventing the various diseases present on the leaves of plant using weather dataset and image processing. The usage of classification and feature extraction processes has enhanced the performance of the system which provides better results.

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