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Plant Disease and Pests Control System

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Abstract: *India is an agricultural nation, with over 70% of the population relying on agriculture. Agriculture provides one-third of our national GDP. Numerous crop illnesses are costing farmers money, and when the cultivated area is large, it becomes tiresome for growers to frequently check the crop. Therefore, the detection of plant diseases is crucial in the sphere of agriculture. The loss resulting from crop diseases that negatively impact crop quality and output depends on timely and precise disease detection. Plant loss from illness and needless medicine use can both be decreased with early identification and action. Previously, image processing was used for automatic plant disease identification. The machine learning mechanism and image processing tools are suggested for the detection and categorization of diseases. Several phases of image processing, including picture capture, pre-processing, feature extraction, classification, illness prediction, and fertilizer suggestion, will be used to identify crop disease.*

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

I. INTRODUCTION

The quality of the product that farmers produce, which is mostly reliant on the development and output of their plants, determines their economic success. Numerous diseases attack plants, focusing on various plant elements like leaves, stems, seeds, fruits, and so forth. Machine learning appears to offer a better solution to this issue. Recently, a number of machine learning methods have been put out to identify and categorize plant diseases using plant photos. The nation's industrial and agricultural economies rely heavily on a variety of commodities, chief among them cash crops. Six million farmers in India make their living directly.

To identify leaf diseases, a number of image processing techniques have been developed, including image filtering, segmentation, and feature extraction. A number of picture segmentation techniques are available, including Otsu thresholding, Canny and Sobel segmentation, and k-means clustering.For classification, methods like the Homogeneous Pixel Counting technique forCotton Diseases Detection (HPCCDD), Support Vector Machine (SVM), and Neural Network (NN) might be employed. In theclassification process, features are crucial. Some of the drawbacks of earlier proposed illness detection methods include low accuracy and a limited number of photos used. The plant's leaves are the primary source of the illness.Approximately 80–90% of plant diseases are found on the leaves.

II. RELATED WORK

A disease detection technique for orchid plant leaves was covered by Wan MohdFadzil et al. [1]. Digital cameras are used to capture the photographs of orchid plant leaflets. The system uses a combination of several techniques, including as morphological processing, boundary segmentation, and filtering, to classify input photos into two disease classes: solar scorch and black leaf spot. However, only two distinct types of orchid leaf disease can be distinguished by the segmentation technique that was suggested and employed in this study.It is necessary to develop new segmentation techniques in order to classify various types of orchid leaf disease. This is due to the fact that finding effective border segmentation algorithms requires a variety of processing technique combinations.

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The main goal of the work by Aditya Parikh et al. [2] is to use photos to identify disease and determine its stage in cotton plants. The cotton leaf exhibits the majority of disease symptoms. Because the proposed approach employs two cascaded classifiers, the first classifier splits leaves from the background based on local statistical variables. Another classifier is then trained to identify the disease and determine its stage using hue and brightness from the HSV color space. Since the created algorithm can be used for any ailment, it is generic. However, cascaded classifiers rely on a number of factors, such as the leaves' viewable borders, their size for analysis, and the need for a controlled environment for probing.

A survey on the identification and categorization of cotton leaf diseases is presented in this article by Bhumika S. Prajapati et al. [3]. The precise form of leaf disease that affects a plant's leaf is difficult for humans to see. Therefore, the use of image processing and machine learning techniques can be beneficial in properly identifying cotton leaf diseases. Using a digital camera, the cotton field provided the photos utilized in this piece. The image's background is eliminated during the pre-processing stage by applying a background removal technique. The otsu thresholding approach is then used to further process the background-removed images for image segmentation.

P. R. Rothe and associates [4], Cotton plant leaf diseases must be detected early and precisely since they can reduce productivity. A pattern recognition system for the identification and categorization of three cotton leaf diseases—Bacterial Blight, Myrothecium, and Alternaria—is provided in this paper. The cotton fields in Buldana and Wardha districts, as well as the Central Institute of Cotton Research Nagpur, are the sources of the photographs needed for this project. Hu's moments are extracted as features for the adaptive neuro-fuzzy inference system's training, and the active contour model is utilized for picture segmentation. Nevertheless, the neuro-fuzzy inference neural network relies on the extraction of seven invariant features from three types of images of sick leaves in order to accomplish training.

In this paper, Melike Sardogan et al. [5] describe a method for tomato leaf disease detection and classification based on the Convolutional Neural Network (CNN) algorithm and the Learning Vector Quantization (LVQ) algorithm. There are 500 photos of tomato leaves with four disease symptoms in the collection. For automatic feature extraction and categorization, they have modeled a CNN.However, the fact that leaves with various diseases are so similar to one another presents a significant obstacle to disease identification and categorization for this study. As a result, certain leaves may fold into the wrong classes due to this resemblance.

A real-time edge detection method for detecting Hevea leaf diseases (rubber tree leaves) in photos and its hardware implementation is proposed in this study by Norfarahin Mohd Yusoff et al. [6]. The three main illnesses of Hevea leaves used in this study for picture comparison are Collectotrichum Leaf Disease, Bird's Eye Leaf Spot, and Corynespora Leaf Spot. Using the Sobel edge detection technique, edge detection can be used to identify the illness on the leaves. The Sobel edge detection algorithm created with MATLAB is contrasted with the real-time edge detection result produced by the FPGA Cyclone IV E and shown on a monitor. MATLAB and FPGA hardware are required for the Sobel edge detection method to run, and the VGA monitor displays the results.

According to Indumathi.R et al. [7], this technique determines the illness that attacked the leaf as well as the afflicted leaf area. Image processing is used to accomplish this; there are systems that can forecast leaf diseases. Our approach employs the Random Forest algorithm and K-Medoid clustering to increase the accuracy of leaf disease diagnosis. After pre-processing the image, the clustering method is used to identify the leaf's impacted area. On the other hand, the Random Forest method is based on decision trees. When compared to other algorithms, accuracy is low. Basically, text data is used with random forest.

Kuricheti Gayatri et al. [8], In order to produce high-quality crops, this study creates an algorithm for identifying and stopping illnesses from spreading to the entire crop. GLCM was used to do textural analysis on the leaf images, and k-Means image segmentation was used to construct and analyze the database of various leaf images. Once the feature extracted images' properties have been ranked using an information gain approach, the SVM classifier is utilized to classify them. However, the requirement to fix the number of clusters is the primary drawback of the K mean clustering approach. Three clusters may be the best for removing the diseased portion of the leaf.Each cluster will independently indicate the background, healthy portion, and sick portion.

In this paper, ChaowalitKhitthuk et al. [9] describe an unsupervised neural network-based color imagery-based plant leaf disease diagnosis system. Color and texture attributes are both used in image processing. The two primary

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procedures that make up the system are disease categorization and disease feature extraction. Gray level co-occurrence matrix and texture feature equations based on statistics are used in the disease feature extraction method to examine feature appearance. The unsupervised simplified fuzzy ARTMAP neural network is used in the disease classification process to classify different disease kinds. The system's ability to classify grape leaf diseases is tested using four different sorts of images: rust, scab, downy mildew, and no disease. In contrast to machine learning and conventional backpropagation networks, unsupervised features aren't practically appropriate in many classification systems.

The apple leaf disease dataset (ALDD), which consists of both complex photos taken in the field and laboratory settings, was provided by PENG JIANG et al. [10]. First, the dataset is created using technologies for image annotation and data augmentation. In light of this, the Google Net Inception structure and Rainbow concatenation are introduced in a novel deep-CNN-based model for detecting apple leaf disease.Lastly, the suggested INAR-SSD (SSD with Inception module and Rainbow concatenation) model is trained to identify the five common apple leaf diseases, including Alternaria leaf spot, Brown spot, Mosaic, Grey spot, and Rust, using a dataset of 26,377 photos of diseased apple leaves under the hold-out testing dataset. Nevertheless, detection errors are noted in this instance.For instance, a mistaken identification of Grey spot and Alternaria leaf spot.

III. PROPOSED METHODOLOGY

A number of tasks are involved in the diagnosis of leaf illnesses, including picture capture, preprocessing, feature extraction, and classification of leaf diseases using color, shape, and texture information. The image acquisition phase is the initial stage. This stage involves uploading an image from the dataset of different leaves. Image preparation is finished in the second stage. The third step involves extracting features from the image of the diseased leaf based on certain characteristics of the pixels or their texture. Following this stage, specific statistical analysis tasks are finished in order to use machine learning to compare picture attributes and classify the features that represent the supplied image.Lastly, the classification result displays the leaf disease that was found.

Advantages of proposed system:

• It includes two feature extraction and classification algorithms that efficiently extract disease from images and provide the actual outcome.

• All of an image's spatial features can be efficiently extracted by the suggested system.

• Attempt to use deep learning to increase detection accuracy.

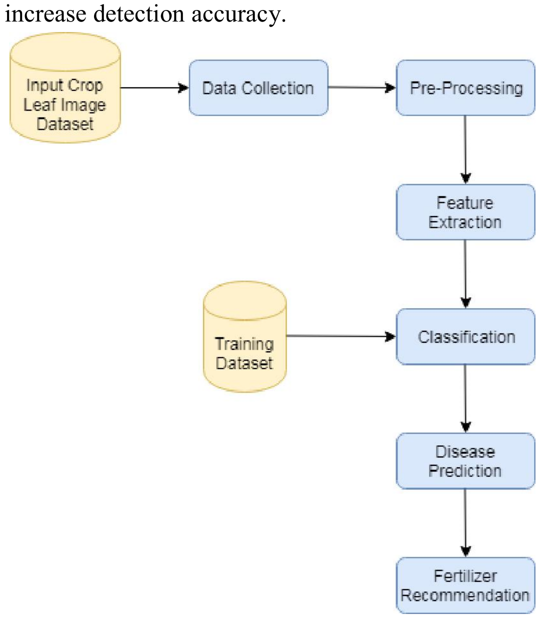

Fig. System Architecture

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1. Input Image: The input leaf image will be uploaded here.
2. Image Preprocessing: In order to prepare the images for subsequent processing, this stage will apply image preprocessing techniques such as grayscale conversion and image noise removal.
3. Image Feature Extraction: In this step, the cell nuclei from the leaf image will be extracted and counted using edge detection and image thresholding techniques.
4. Image Classification: To categorize the disorders, this stage will use image classification techniques such as the CNN algorithm.
5. Outcome: The final leaf disease outcome will be displayed in this phase.

IV. ALGORITHM

Convolution Neural Network(CNN)

CNN's structure consists of two tiers. The first is the feature extraction layer, which extracts the local feature by connecting each neuron's input to the local ready fields of the layer before it. The spatial link between the local features and other features will also be shown when they have been retrieved. The other is the feature map layer; every network computing layer gathers a feature map advantage. Each feature map is a plane, and each neuron in the plane has the same weight. The feature map has a shift in difference because the feature plan structure uses the sigmoid function as the convolution network's activation function.

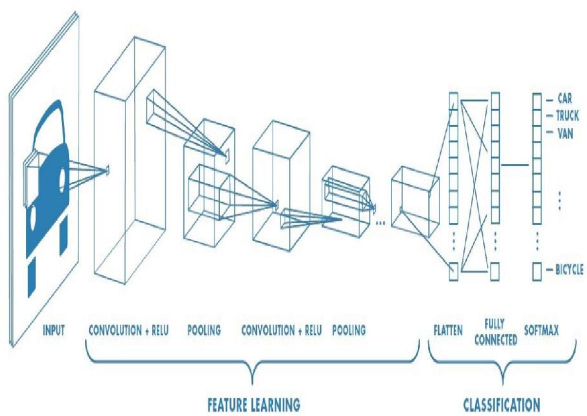

Fig. CNN Layers

Layer of Convolution

The first layer to extract features from an input image (a leaf image) is called convolution. Convolution uses tiny squares of input data to learn visual attributes while maintaining the link between pixels. By adding filters, such as identity, edge, sharpen, box, and Gaussian blur filters, convolution of an image with various filters can accomplish tasks like edge detection, blur, and sharpening.

Layer of Pooling

When the photos are too big, pooling layers would lower the number of parameters. Spatial pooling, also known as down sampling or subsampling, lowers each map's dimensionality while preserving crucial data.

Completely Interconnected Layer

The feature map matrix will be transformed into a vector (x1, x2, x3, …) in this layer. We created a model by combining these attributes with the fully connected layers.

Classifier Softmax

Lastly, we have an activation function, such sigmoid or softmax, to categorize the outputs, such as classifying leaf illness.

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V. RESULT AND DISCUSSION

The section shows overall accuracy of CNN classification technique . So this works gives better leaf disease prediction compare to existing method.

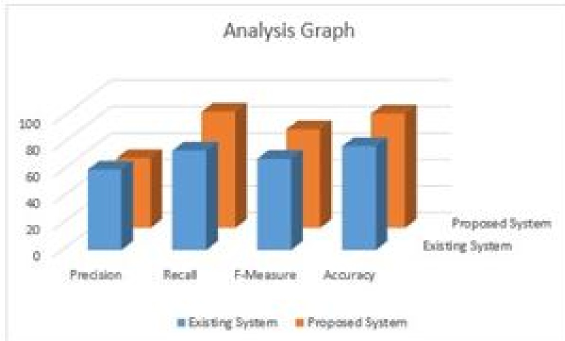

Fig. 2. CNN Classification Accuracy Graph

Table No 1.Method Comparison

	Existing System	Proposed System (CNN)
Precision	60.6	52.70
Recall	75.1	87.64
F-Measure	68.8	74.31
Accuracy	78.29	86.26

VI. CONCLUSION

In order to successfully identify the many diseases that are present on the leaves before they cause damage to the entire plant, this research discussed how disease analysis is possible for the identification of leaf diseases. With the help of meteorological data and image processing, the method here can more precisely identify the disease, which means that we can preserve high productivity by avoiding the different diseases that are present on plant leaves. Utilizing classification and feature extraction procedures has improved the system's performance, leading to improved outcomes.

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