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Pepper Leaf Disease Detection Using Image Processing Technique

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ABSTRACT: One of the most important tasks in agriculture is identifying and keeping track of plant diseases. Early crop disease detection can increase crop quality and quantity while shortening the time needed for disease identification. The agricultural industry is crucial to the Indian economy. The first step in this technique for detecting pepper plant leaf disease is data collection, which can be accomplished by either scanning nearby agricultural land or gathering information from agricultural universities. Following collection, the photographs are pre-processed to remove undesired distortions and improve aspects of the images including contrast and size. The discrete wavelet transform, in particular the wavelet compression, samples the wavelet at discrete intervals and is used for feature extraction. The image is subsequently classified as being healthy or not by an artificial neural network classifier.

KEYWORDS: DWT2 (2-D Discrete Wavelet Transform), Image Processing, Pepper Plant, Artificial Neural Network (ANN)

I. INTRODUCTION

India is primarily an agricultural nation, with 70% of the population depending on agriculture for their livelihood. India has a large black pepper farming industry, especially in the states of Tamil Nadu, Kerala, and Karnataka. India, also referred to as the "King of Spices," is one of the world's top producers, consumers, and exporters of black pepper. But the presence of plant diseases in farming fields can cost farmers a lot of money. Around 20 to 40 percent of the world's agricultural productivity, according to study, is lost owing to crop losses brought on by diseases, pests, and animals. Hiring qualified agriculturists to diagnose crops can take time, and conventional methods of identifying plant diseases by physically analysing characteristics like leaf texture, colour, and shape are not always effective.

Many automated solutions, particularly those built on image processing, are starting to appear on the market to address these problems. In nations like China, image processing technology has significantly aided the development of agriculture. It is essential for spotting plant diseases and is constantly advancing due to new discoveries. A number of investigations are currently being conducted to detect distinct plant disease types, which not only aid farmers in boosting yields but also support various agricultural techniques.

The algorithmic program for identifying and classifying various pepper plant illnesses using artificial neural network tools is proposed in this research. Image acquisition, pre-processing, feature extraction, and classification are the four processes in the suggested system. Each of these modules is essential in the agricultural industry. The system does image pre-processing after first detecting and recording the polluted area. The image is then classified as healthy or unhealthy after the contaminated area has been located and feature extraction done on it. Enhancing image quality for human perception and analysing the image for autonomous machine perception are the two basic goals of image processing. The suggested system helps farmers to recognize the various diseases that affect pepper plants and decide on the best course of action.

II. RELATED WORK

Kiran S M et al., [1] suggested employing Support Vector Machines (SVM) and Discrete Wavelet Transforms (DWT) to diagnose ailments in tomato plants. The system uses k-means clustering to segment tomato leaf images that were obtained from a database after scaling, enhancing, filtering using the component of colour space, and scaling. The system uses the SVM classifier to extract fourteen image textual attributes from the pictures.

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Nikhil Shah et al., [2], It was recommended to use Artificial Neural Networks (ANN) to detect diseases in cotton plants. The system had a number of functions, such as image pre-processing, image augmentation, and ANN-based categorization. During the system's testing phase, 18 cotton leaf photographs were used to pinpoint six different illnesses.

Gaurav Kandalkar et al., [3] Back-propagation neural networks (BPNN) and deep learning techniques (DWT) were used to classify agricultural pests. To separate specific areas of the image that have special meaning, the system used image processing methods such as image segmentation. DWT already supports extracting features from segmented images such as image energies and these features are then stored in a database with relevant agricultural pest images . BPNN has helped detect certain pests and the system has provided prevention and control techniques to help farmers act responsibly and increase crop yields.

S. Deepika et al., [4], Using artificial neural networks (ANN), a system for the detection of fruit and vegetable illnesses was suggested. The approach required taking a picture of a fruit or vegetable using a camera or any mobile phone camera, and then efficiently extracting the features of the fruit or vegetable from the picture using the attributes of colour, shape, and size. The classification of the crop and the detection of disease both used the ANN methodology.

Sachin D. Khirade [5] used image processing methods and Artificial Neural Networks (ANN) to create a system for the identification and classification of plant illnesses. The system included a number of phases, including the acquisition of images, image pre-processing, segmentation of the images, extraction of picture features, and classification of plant illnesses. The Back-propagation algorithm was used by the system to categorize the plant disease that was discovered.

III. PROBLEM STATEMENT

Field crop disease costs farmers a lot of money in agriculture. Crop output will rise with efficient disease detection and treatment.
Many farmers use the naked eye method of observation, however it is ineffective since they cannot detect certain diseases.
Crop losses will occur if the correct insecticide is not available for a particular disease. This approach aids in recognizing the type of disease in pepper leaves and provides information on appropriate treatment to help resolve these issues.

IV. DESIGN AND IMPLEMENTATION

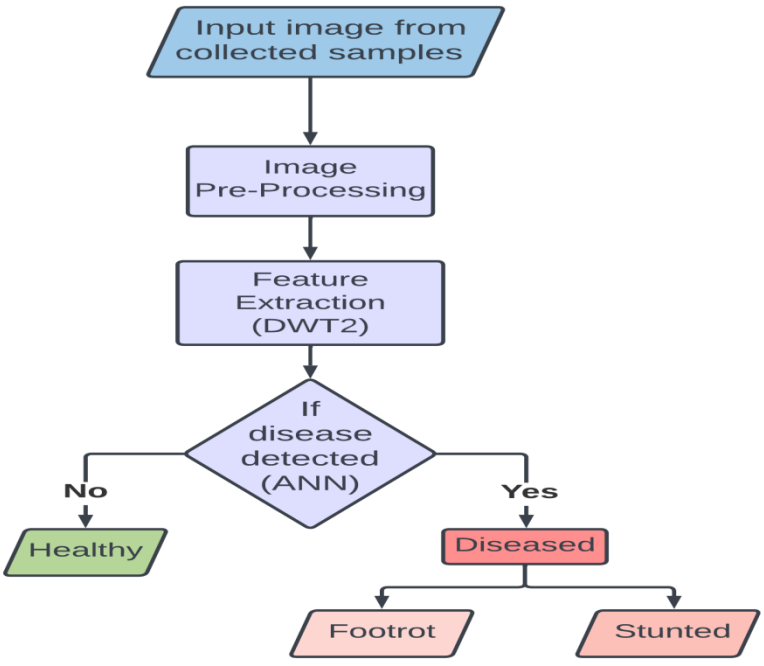

Fig 1 : System Architecture of Pepper leaf Disease Detection System

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- **Data Collection :** The methodology's initial phase entails gathering a broad and representative dataset of pictures of pepper plants, each of which either shows a healthy plant or one that has one or more diseases. This dataset is necessary for accurately training and testing the ANN model.

- **Image Pre-processing :** include shrinking, cropping, and normalizing pixel values to a defined size once the photos have been gathered for the dataset. The background noise is reduced while the main areas of interest are brought into sharper focus. The photos are then labelled using a multi-label classification strategy after pre-processing. In this method, each image is given a number of labels, each of which corresponds to a disease that is visible in the image. For the ANN model to effectively learn and differentiate between various types of diseases, this labelling is essential.

- **Feature Extraction:** Utilizing the Discrete Wavelet Transform (DWT) technique, feature extraction is carried out. The pre-processed photos are used by this approach to extract features, which are then used to train the ANN model. The visual qualities that can be used to discriminate between healthy and sick pepper plants are represented by the extracted features. In conclusion, this methodology offers a structured strategy for identifying illnesses of pepper plants using artificial neural networks. The ANN model can detect diseases in pepper plants with high accuracy by gathering a broad dataset, pre processing the photos, labelling the images with various diseases, and extracting pertinent features using DWT.

- **Classification:** An example of a machine learning method used in image processing for classification tasks is the Artificial Neural Network (ANN). They are made up of numerous layers of connected nodes or neurons and are modelled after the biological structure of the human brain. A labelled dataset is utilized to train the network and modify the weights between the neurons in ANNs using a supervised learning approach. This results in accurate classification. ANNs can extract characteristics from an input image and utilize those features to categorize the image into various illness categories. The input layer of the ANN is fed with the features that were extracted from the input image during pre-processing, such as colour, texture, and form. One or more of the input layers are connected to a hidden layer or layers, which do calculations to extract features at a higher level. The categorization outcome is produced by the output layer, the final layer. As a result of its capacity to recognize intricate patterns and correlations between images, ANNs have demonstrated to be quite successful in picture categorization tasks. They can interpret high-dimensional image data because of their ability to handle numerous input variables. Additionally, ANNs are advantageous for applications where the input data fluctuates greatly since they can adapt to new and unexplored data.
  Recent studies have concentrated on developing various methods, such as convolutional neural networks (CNNs) and deep learning, to enhance the performance of ANNs in image classification tasks. Convolutional layers are used by CNNs, a form of ANN designed specifically for image processing tasks, to extract features from an input image. ANNs with several layers are used in deep learning to extract extremely complicated characteristics and achieve great accuracy in classification tasks.

  ANNs are effective tools for image classification tasks, and continuing research is aimed at enhancing their functionality and broadening their applications. Future developments in image processing and classification are anticipated to be significantly aided by the use of ANNs, particularly when combined with CNNs and deep learning.

V. RESULTS AND DISCUSSION

The suggested approach outlines a novel method for identifying illnesses in pepper plant leaf photos using Wavelet characteristics and an artificial neural network. To train the sick and healthy images, a different training network is being considered. The results of the recognition tests on the photos are satisfactory. Both the healthy and two different sick photos may be easily identified. Table 1 lists all of the sample photos that were taken into account for the training and testing of the input data for the three conditions of healthy, foot rot, and stunted. The correctness of the tested data is displayed

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TABLE 1: TRAINING AND TESTING DATA

Images	Training	Testing	Total
Healthy	80	20	100
Foot-rot disease	80	20	100
Stunted disease	80	20	100
Total	240	60	300

TABLE 2: ACCURACY OF THE TESTED DATA

Classification	Healthy	Foot-rot	Stunted	Accuracy
Healthy	19	0	1	95
Foot-rot disease	0	20	0	100
Stunted disease	1	0	19	95
Average				96.67

Result Snapshots:

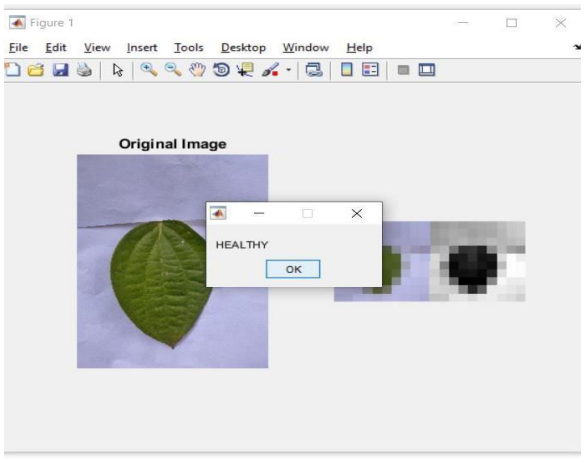

FIG 2: Snapshot of healthy output which represents the image of trained data is getting correct output as healthy.

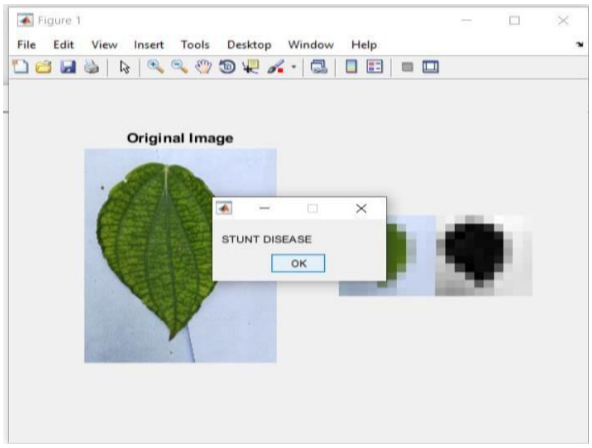

FIG 3: Snapshot of stunted disease output which determines that the sample input leaf as stunted disease

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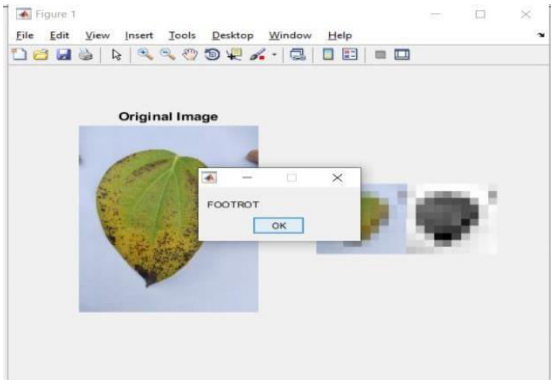

FIG 4 Snapshot of Foot-rot disease output which represents that given input sample have foot-rot disease

VI. CONCLUSION

A possible method for identifying various diseases in pepper plants is to employ image processing. It provides a low-cost, non-destructive way to diagnose diseases. Pre-processing, feature extraction, and classification are just a few of the image processing techniques that can be used to accurately identify and separate various illnesses in pepper plants. In order to provide a thorough diagnosis of the health of the plant, these techniques can also be utilized to analyze various plant components, such as leaves, stems, and fruits. To improve the precision and effectiveness of the image processing algorithms, more study is required. With 96.67% accuracy, the detecting system labels an image as healthy, foot-rot illness, or stunted disease. Furthermore, the advancement of automated disease detection and diagnosis technologies can substantially reduce labour costs and boost crop yields to the advantage of the agricultural sector.

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