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Plant Leaf Disease Detection and Classification Using CNN

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***Abstract* - Crop disease diagnosis is very crucial task for every farmer and individual in order to prevent various losses like less productivity, less quality and quantity or it can also lead to defective yield. Therefore, early identification and early detection can help to save the crop yield. Agricultural productivity is something on which economy highly depends. This is one of the reasons that diseases detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. Manual diagnosis of plant diseases needs expert knowledge along with awareness. So, automatic diseases detection and identification of plants by application of computer vision approaches is of utmost importance. In this system, different computer vision approaches for plant diseases detection are analyzed. The results demonstrate the effectiveness of various methods in leaf disease detection.**

Keywords: Leaf disease detection, Image processing, Segmentation, Feature extraction, Convolutional Neural Networks, CNN.

I. INTRODUCTION

India is an agricultural country and depends on agriculture for around 70% of the total population. Farmers can select various crops for cultivation and also pesticides for them. Any disease to anything makes it weak. In the same way plant becomes weak when leaf has diseases and plant growth is also affected. Therefore, monitoring plants is an important role in cultivation of plants. In early days, this was performed manually by the person with expertise in this area. This requires a huge amount of effort and considerable processing time as well.

We propose image processing methods for detecting plant disease. Firstly, the Symptoms of the disease in the plants are observed on the leaves, stem and fruit. The disease can detect by using the plant leaf. In our project we have implemented image processing technique for the identification of plant disease and to increase the yield in agriculture production. Plant disease identification is a key in preventing yield losses. Plant disease studies signify the study of patterns is seen on the plant visually. Health monitoring and identification of diseases on plants is very important for sustainable farming. Manual control of the plant diseases is very difficult. It requires huge amount of work and an expertise to detect the disease. This process also requires more processing time. Therefore, image processing technique is used for detection of plant disease.

Traditionally, plant disease detection relied on manual inspection by experts, which is time-consuming and subject to human error. The emergence of computer vision and artificial intelligence has opened up new possibilities for automating the detection process and providing accurate and timely recommendations for pesticide treatments.

The primary objective of this project is to leverage image processing and deep learning techniques to build a robust and efficient system that can accurately identify plant leaf diseases and suggest appropriate pesticides. By utilizing the power of CNNs, which have shown remarkable performance in image classification tasks, the project aims to overcome the limitations of traditional methods and provide a reliable and automated solution for disease detection in plants.

The project's methodology involves several key stages, including data collection and preprocessing, disease detection model training, image processing and feature extraction, disease classification, and pesticide suggestion. To train the disease detection model, a comprehensive dataset of plant leaf images representing both healthy and diseased states will be collected. These images will undergo preprocessing to remove noise and enhance relevant features, ensuring optimal input for the deep learning model.

The heart of the system lies in the CNN-based disease detection model, which will be trained on the labeled plant leaf images. The model will learn to identify patterns and features indicative of various diseases. Through an iterative

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process of training and validation, the model's accuracy and generalization capabilities will be improved.

In addition to the CNN model, the project will incorporate image processing techniques for feature extraction from plant leaf images. This step will involve extracting disease-specific characteristics, such as edges, colors, and textures, to enhance the accuracy of disease detection. Once the system accurately detects the plant leaf diseases, an intelligent algorithm will be implemented to suggest appropriate pesticides based on the identified disease. The algorithm will take into account factors such as the severity of the disease, the type of crop, and environmentally friendly pesticide options, ensuring responsible and effective treatment recommendations.

To provide a user-friendly interface, a graphical user interface (GUI) will be developed to facilitate interaction with the system. Users will be able to upload plant leaf images, and the system will provide real-time disease detection results along with recommended pesticides. User feedback will be encouraged to continually improve the accuracy and performance of the system.

II. LITERATURE REVIEW

Vishnu S, A. Ranjith Ram [1], In this review paper we discuss the various methodologies for plant disease detection. Studies show that relying on pure naked-eye observation of experts to detect and classify diseases can be time consuming and expensive, especially in rural areas and developing countries. So we present fast, automatic, cheap and accurate image processing based solution. Solution is composed of four main phases; in the first phase we create a color transformation structure for the RGB leaf image and then, we apply color space transformation for the color transformation structure. Next, in the second phase, the images are segmented using the K-means clustering technique. In the third phase, we calculate the texture features for the segmented infected objects. Finally, in the fourth phase the extracted features are passed through a pre-trained neural network.

Pawan P. Warne, Dr. S. R. Ganorkar, [2] This paper presents an approach for careful detection of diseases, diagnosis and timely handling to prevent the crops from heavy losses. The diseases on the cotton are critical issue which makes the sharp decrease in the production of cotton. So for the study of interest is the leaf rather than whole cotton plant because about 8595% of diseases occurred on the cotton leaves like Alternaria, Cercospora and Red Leaf Spot. In this proposal initially preprocessing the input image using histogram equalization is applied to increase the contrast in low contrast image, K-means clustering algorithm is used for segmentation which classifies objects based on a set of features into K number of classes and finally classification is performed using Neural network. Thus image processing technique is used for detecting diseases on cotton leaves early and accurately. It is used to analyze the cotton diseases which will be useful to farmers.

Dimitri A. Lisin, Marwan A. Mattar, Matthe w B.Blaschko,[3] Object recognition is a central problem in computer vision research. Most object recognition Systems have taken one of two approaches, using either global or Local features exclusively. This may be in part due to the difficulty of combining a single global feature vector with a set of local features in a suitable manner. In this paper, we show that combining local and global features is beneficial in an application where rough segmentations of objects are available. We present a method for classification with local features using non-parametric Density estimation. Subsequently, we present two methods. For combining Local and Global features. The first uses a “stacking” ensemble technique, and the Second uses a hierarchical classification system. Results show the superior performance of these combined methods over the component classifiers, with a reduction of over 20% in the error rate on a challenging marine science application.

P.R. Rothe * and R. V. Kshirsagar, [4] Feature extraction is a significant constituent of a pattern recognition system. It carries out two assignments: converting input parameter vector into a feature vector and or reducing its dimensionality. A distinct feature extraction algorithm makes the classification process more effectual and efficient. The allocation and recognition of cotton leaf diseases are of the major importance as they have a cogent and momentous impact on quality and production of cotton. In this work we present a snake based approach for the segmentation of images of diseased cotton leaves. We extract Hu’s moments which can be used as shape descriptors for classification. A theory of two-dimensional moment invariants for planar geometric figures is also presented. Three diseases have been considered, namely Bacterial Blight.

P.Revathi, M.Hemalatha, [5] This Proposed Work exposes, an advance computing technology that has been developed to help the farmer to take superior decision about many aspects of crop development process. Suitable evaluation and diagnosis of crop disease in the field is very critical for the increased production. Foliar is the major important fungal disease of cotton and occurs in all growing Indian regions. In this work we express new technological strategies using mobile captured symptoms of cotton leaf spot images and categorize the diseases using HPCCDD Proposed Algorithm. The classifier is being trained to achieve intelligent farming, including early Identification of diseases in the

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groves, selective fungicide application, etc. This proposed work is based on Image RGB feature ranging techniques used to identify the diseases (using Ranging values) in which, the captured images are processed for enhancement first. Then color image segmentation is carried out to get target regions (disease spots). Next Homogenize techniques like Sobel and Canny filter are used to identify the edges; these extracted edge features are used in classification to identify the disease spots. Finally, pest recommendation is given to the farmers to ensure their crop and reduce the yield loss.

III. PROPOSED SYSTEM

Image Acquisition:

It is the process of taking an image out of a source—usually one that is hardware-based—in order to process it. The hardware-based component of our concept is WebCamera. It is the initial stage in the workflow sequence since a picture is necessary for all processing to be done. The resulting image has not undergone any kind of processing.

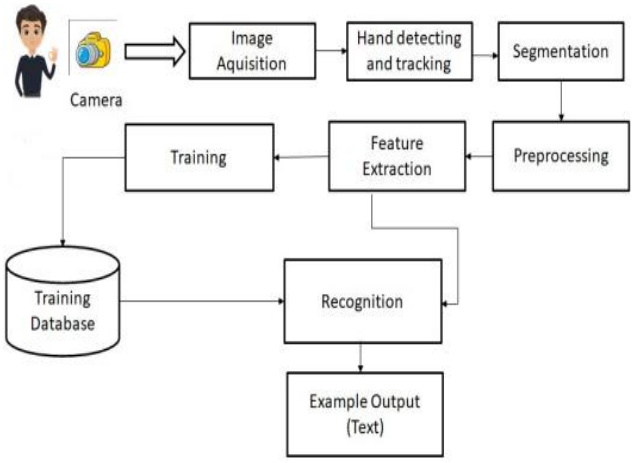

Figure 1: Proposed Methodology

Segmentation:

Segmentation is the process of taking items out of the background of an image that has been taken. The segmentation process makes use of edge detection, context subtraction, and skin-color detection. Recognizing gestures requires the detection and segmentation of hand motion and location.

Features Extraction:

Preprocessed images are used to extract predefined features, such as form, contour, geometrical feature (position, angle, distance, etc.), color feature, histogram, and others, which are then utilized for sign identification or classification. A step in the dimensionality reduction process that separates and arranges a sizable amount of raw data is feature extraction. Lowered to more manageable, smaller classrooms Processing would be easier as a result. The most significant aspect is the sheer quantity of variables present in these enormous data sets. This data requires a significant amount of processing power to process. So, by choosing and combining variables into functions, function extraction helps to extract the optimal feature from enormous data sets. These features accurately and uniquely describe the actual data collection process, and they are also very user-friendly.

Preprocessing:

Preprocessing techniques such as erosion, dilation, and Gaussian smoothing are applied to each image frame in order to remove noise. Converting a color image to grayscale results in a smaller image. Grayscale picture conversion is a popular way to minimize the quantity of data that needs to be processed. Preprocessing goes through the following phases:

a) Morphological Transform (Morphological Transform):

To produce an output image with a comparable size, morphological processes employ a structural feature on the input image. To find the value of each pixel in the output image, it compares the matching pixel in the input image with its neighbors. Morphological alterations come in two flavors: erosion and dilation.

Dilation: The output pixel's value is the maximum value of all the nearby pixels. If every pixel in a binary image has the value 1, then that pixel is set to 1. Morphological dilatation closes tiny gaps and makes artifacts more visible.

Erosion: The value of the o/p pixel is the lowest of all the nearby pixels. In a binary image, a pixel is set to 0 if every one of its neighbors is also 0. Morphological erosion removes minor artefacts, leaving behind larger objects.

b) Blurring:

Blurring occurs when an image is passed through a low-pass filter. In computer vision, the term "low-pass filter" describes a technique for removing noise from an image while preserving the integrity of the remaining portion. Before moving on to more complex tasks, including edge detection, a blur is a basic process that needs to be finished.

c) Thresholding:

Thresholding is a type of image segmentation where an image's pixels are altered to facilitate picture interpretation. The act of turning a grayscale or color image into a binary—basically, black and white—is known as thresholding. Thresholding is most frequently used to choose regions of

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interest in an image while disregarding the parts we don't care about.

d) Recognition:

In this instance, classifiers will be used. The techniques or algorithms used to interpret the signals are called classifiers. The Hidden Markov Model (HMM), K-Nearest Neighbor classifiers, Support Vector Machine (SVM), Artificial Neural Network (ANN), and Principle Component Analysis (PCA) are a few popular classifiers that recognize or comprehend sign language. CNN will be used as the classifier in this research, nevertheless. CNNs are utilized for picture recognition and classification due to their high precision. Utilizing a hierarchical paradigm, the CNN creates a network akin to a funnel before producing a fully-connected layer that processes the output and connects all of the neurons.

e) Text output:

Recognizing and translating into text different body postures and movements, as well as comprehending human behavior.

IV. RESULTS AND DISCUSSIONS

It can be inferred from the results that the validation test of the Plant Leaf Disease Detection using CNN was considered legitimate that the system is a valuable tool for detecting plant leaf disease.

The whole process is divided into three stages:

1. Input images are first created by an Android device or uploaded to our web application by users.
2. Segmentation pre-processing includes the process of image segmentation, image enhancement and color space conversion. First, the digital image of the image is enhanced with a filter. Then convert each image into an array. Using the scientific name for Binarizes Diseases, each image name is converted to a binary field.
3. CNN classifiers are trained to identify diseases in each plant class. Level 2 results are used to call up a classifier, which is trained to classify various diseases in that plant. If not present, the leaves are classified as "healthy".

When we provide the system with input, we need new light for the system to function at its best. 90% of the data were utilized for training, and 10% were used for testing. More data might be used for testing and training, which would improve the accuracy and output of the system.

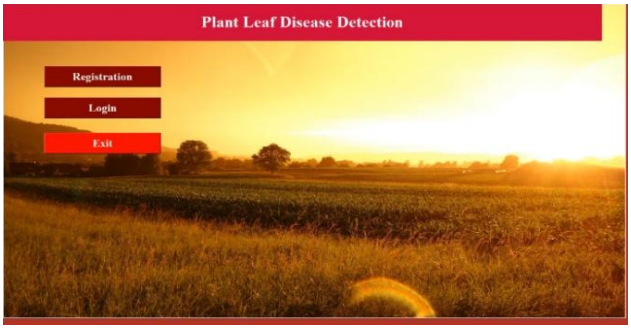

Figure 2: Home Page

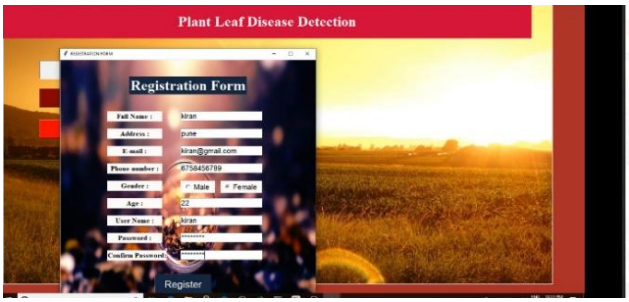

Figure 3: Registration

Figure 4: Result

V. CONCLUSION

This proposed system focuses on developing automated leaf diseases. It saves time and effort. In this system, we have proposed a new method for measuring the leaf diseases of the leaf object. This enabled us to process all the images from the same scale and further enabling us to determine the diseases value of the leaf object. Using deep learning we were able to extract the features of the leaf object and further classify it accurately. Study involved collecting leaf samples from different regions. Work was carried out to investigate the use of computer vision for classifying maize leaf diseases. Algorithms based on image-processing techniques, feature extraction and classification, were deployed. The feature extraction process used color co-occurrence methodology, which uses the texture of an image to arrive at unique features, which represent that image.

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