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Plant Diseases Detection Using Deep Learning

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ABSTRACT: ***Deep learning, a subset of machine learning, has shown great potential in plant disease detection in recent years, with the advantages of automatic learning and feature extraction, it has been widely concerned by academic and industrial circles. At the same time, it has also become a research hotspot in the field of agricultural plant protection, such as plant disease recognition and pest range assessment, etc. The application of deep learning in plant disease recognition can avoid the disadvantages caused by artificial selection of disease spot features, make plant disease feature extraction more objective, and improve the research efficiency and technology transformation speed. This review provides the research progress of deep learning technology in the field of crop leaf disease identification in recent years. In this paper, we will present the current trends and challenges for the detection of plant leaf disease using deep learning and advanced imaging techniques.***

Keywords— Rice disease identification, Artificial Intelligence, Deep CNN, Support Vector Machine.

1. INTRODUCTION:

The occurrence of plant diseases has a negative impact on agricultural production. If plant diseases are not discovered in time, food insecurity will increase [1]. Early detection is the basis for effective prevention and control of plant diseases, and they play a vital role in the management and decision making of agricultural production. In recent years, plant disease identification has been a crucial issue. Disease-infected plants usually show obvious marks or lesions on leaves, stems, flowers, or fruits. Generally, each disease or pest condition presents a unique visible pattern that can be used to uniquely diagnose abnormalities. Usually, the leaves of plants are the primary source for identifying plant diseases, and most of the symptoms of diseases may begin to appear on the leaves [1]. In most cases, agricultural and forestry experts are used to identify on-site or farmers identify fruit tree diseases and pests based on experience. This method is not only subjective, but also time-consuming, laborious, and inefficient. Farmers with less experience may misjudgement and use drugs blindly during the identification process. Quality and output will also bring environmental pollution, which will cause unnecessary economic losses. To counter these challenges, research into the use of image processing techniques for plant disease recognition has become a hot research topic.

2. EXISTING SYSTEM:

the current approach for detecting plant disease is simple naked eye observation by plant experts, which can be used to detect and identify plant diseases. In these circumstances, the suggested technique is useful for tracking vast fields of crops. Furthermore, in some nations, farmers lack adequate facilities or are unaware that they can contact experts. As a result, consulting experts is not only more expensive but also more time consuming. In those circumstances, the suggested technique for tracking a large number of plants would be useful.

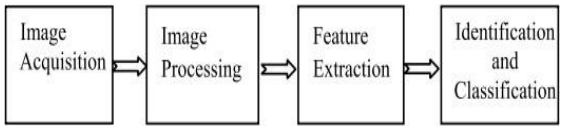

Figure 1: Traditional Method.

2.1 Disadvantages of Existing System.

i) Only humans are capable of predicting diseases.
ii) The procedure is extremely slow.
iii) Consumption of time and space is also very high.
iv) The price is also high.

3. BASIC CONCEPT OF PLANT DISEASE DETECTION:

The general process of using traditional image recognition processing technology to identify plant diseases is shown in Fig. 1.
Plant leaf disease detection includes some basic step of image processing to detect & classify plant leaf disease. These steps are image acquisition, image pre-processing, image segmentation, feature extraction, classification and leaf disease detection. These steps are described as below

3.1 **Image Acquisition:** The first stage of any vision system is the image acquisition. Image acquisition involves the steps to obtain the plant leaf and captured the high quality images through the camera. Images are acquired from the internet or agriculture field. The efficiency of the concept depends upon the quality of

database images. This image is in RGB (Red, Green, and Blue) form.

3.2 **Image Pre-Processing**: Image pre-processing involves the steps of image enhancement, RGB to Lab conversion, filtering etc. Here, image enhancement is carried out for increasing the contrast. Image smoothing is done using the filtering techniques. There are different types of filtering techniques available in image processing like median filter, average filter, Gaussian filter etc.

3.3 **Image Segmentation**: Image segmentation means partitioning of image into various parts of same features or having some similarity. The segmentation can be done using various methods like otsu' method, k-means clustering, converting RGB image into HIS model etc. The K-means clustering is used for classification of object based on a set of features into K number of classes. The classification of object is done by minimizing the sum of the squares of the distance between the object and the corresponding cluster.

3.4 **Feature Extraction:** Feature extraction plays an important role for identification of an object. After performing the image segmentation the disease portion from the image is extracted. In many application of image processing feature extraction is used. Color, texture, shape, edges, morphology are the features which can be used in plant disease detection. Color features are extracted by various methods, such as Color histogram, Color moments and Color structure descriptor. Grey Level Co-occurrence Matrix (GLCM) method is used for extraction of texture features [8].

3.5 **Classification & Detection of Diseases:** Finally, classifiers are used for the training and testing of the datasets. These classifiers may be support vector machine (SVM), k-nearest neighbour, neural network, fuzzy logic based etc. These methods are used to classify and detect the leaf diseases.

4. TYPES OF DISEASES:

4.1 Leaf blast:

Blast is caused by the fungus *Magnaporthe oryzae.* It can affect all above ground parts of a rice plant: leaf, collar, node, neck, parts of panicle, and sometimes leaf sheath.

How to detect: leaf will have marks which is light colored in center and reddish edge.

4.2 **Brown Spot**:

Brown spot is caused by the fungus Cochliobolus miyabeanus, it is one of the most prevalent rice diseases.

How to detect: leaf will have circular brown spot .

4.3 **Hispa**:

Rice hispa is a very serious insect pest of rice. The adult is a small bluish black beetle, measuring 5 mm in length and is recognized

by numerous short spines on the body and forewings.

How to detect: it crapes the upper surface of the leaf blades leaving only the lower epidermal.

5. TYPES NUTRIENT-DEFICIENCY

5.1 Nitrogen (N) Deficiency:

Nitrogen deficiency is one of the most common problems in rice in Asia. It is common in all rice-growing soils where modern varieties are grown without sufficient mineral N fertilizer. It often occurs at critical growth stages of the plant, such as tillering and panicle initiation, when the demand for nitrogen is large. Nitrogen deficiency may also occur where a large amount of N fertilizer has been applied but at the wrong time or in the wrong way.

How to detect: yellowing of the older leaves.

5.2 Phosphorus (P) Deficiency:

Phosphorus deficiency is widespread in all major rice ecosystems and is the major growth-limiting factor in acid upland soils where soil P-fixation capacity is often large. Soils particularly prone to P deficiency include the following types: Coarse-textured soils containing small amounts of organic matter degraded lowland soils (e.g., North Vietnam) calcareous, saline, and sodic soils volcanic soils with high P-sorption capacity (e.g., Andisols in Japan and parts of Sumatra and Java) peat soils (Histosols) acid sulfate soils in which large amounts of active Al and Fe result in the formation of insoluble P compounds at low pH.

How to detect: older leaves turn into dark Reddish, reddish-violet, or violet color.

5.3 Potassium (K) Deficiency:

Potassium deficiency in rice is more common under the following crop management practices: excessive use of Nitrogen (N) or N and P fertilizers with insufficient K application direct seeded rice during early growth stages, when the plant population is large and root system is shallow cultivar differences in susceptibility to K deficiency and response to K fertilizer. Soils, which are particularly prone to K deficiency.

How to detect: older leaves turn into thick green color, with burning leaf margins /edge

6. LITERATURE REVIEW:

Naik, M.R. et al[2], neural network is used to detect the disease. If leaf is infected, further processing is done to identify the disease. Genetic algorithm is used along with SVM to optimize loss and identify the type of disease. This paper states method for optimization of loss function using genetic algorithm, which is similar to theory of natural selection where only strong parameters survive. Proper analysis of color and the texture of the plants will increase the accuracy of disease identification. S. Bashir et al proposed a method to identify the diseases in apple trees. Kmean clustering is the method used in their research, which mainly deals with plant color and texture. The proposed methodology follows a step by step procedure as image for detection, separation of RGB components, image analysis and finally matching threshold. They also mentioned that a Bayes classifier can be used to classify various plant diseases working upon the resultant images [3].A. Rastogi et al conducted a study using image processing techniques to classify the lack of nutrition in oil palm leaves by examining the leaf surface.

Images of oil palm leaves were taken using high-end digital imaging equipment to examine the surface of the leaves. Their results can be used as a fertilizer guide, as the tree reacts quickly for the suggested fertilizers. The authors mentioned that the main concern is to ensure the right amount of fertilizer, as extreme fertilizer intake can cause toxicity to the tree and ultimately increase the cost of fertilizer. Also, feature extraction algorithms are based on the shape, color, and texture of the disease type [4].Many authors have used different techniques of deep learning for leaf disease detection. Robert G. de Luna et al.[5]has developed the Convolution Neural Network to identify which of the tomato diseases is present on the monitored tomato plants and compare CNN with F-RCNN, and use Transfer Learning for disease recognition of the tomato plant leaf diseases. Geetharamani G et al.[6]has applied Deep CNN model is trained using an open dataset with 39 different classes of plant leaves and background images and Six types of data augmentation methods that were used for image flipping, gamma correction, noise injection, principal component analysis (PCA) color augmentation, rotation, and scaling and observed that using data augmentation can increase the performance of the model and Compared with popular transfer learning approaches. Transfer learning is a knowledge- sharing method that reduces the size of the training data, the time and the computational costs when building deep learning models [7] . Transfer learning helps to transfer the learning of a pre-trained model to a new model. Transfer learning has been used in various applications, such as plant classification, software defect prediction, activity recognition and sentiment classification. In this research, the performance of the proposed Deep CNN model has been compared with popular transfer learning approaches, such as AlexNet, VGG16, Inception-v3 and ResNet. Balakrishna K et al.[8]In the first stage, the tomato leaf is classified as healthy or unhealthy using the KNN approach. and the second stage, they classify the unhealthy tomato leaf using PNN and the KNN approach. The features are like GLCM, Gabor, and color are used for classification purposes. Omkar Kulkarni et al.[9] has developed Deep Convolutional Neural Networks that have been formulated with the goal of classifying both crop species and the identity of disease on images. The proposed methodology was tested on five classes of crops and three types of crop diseases for each class. The experimental results show that the InceptionV3 model performs better than the MobileNet model in terms of accuracy and validation loss. Peng Jiang et al.[10] has performed convolution neural networks (CNNs) for the real-time detection of apple leaf diseases and use the apple leaf disease dataset (ALDD), deep-CNNs is proposed by introducing the Google Net Inception structure and Rainbow concatenation. Alternaria leaf spot, Brown spot, Mosaic, Grey spot, and Rust are five common types of apple leaf diseases that severely affect apple yield.

7. CONCLUSIONS:

Identification & classification of rice disease is quite impossible for farmers by naked-eye. It needs a large quantity of time and human effort besides professional knowledge. Hence, an effective approach has been taken in order to computerize the procedure of classifying and identifying disease from rice plants image. In this paper, the proposed method was aimed to develop an automated system to classify images of rice plant disease through the execution of DCNN and support vector machine to classify rice disease images. Inception V3 model was intended for the instinctive extraction of features. SVM classifier with RBF kernel has been adopted for the image classification of rice disease.

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