Plant Leaf Disease Detection Using CNN and Fertilizer Predictor

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Abstract*—For many different nations, agriculture is the most important and fundamental source of domestic income. Plant diseases brought on by a variety of pathogens, including bacteria, fungi, and viruses, can cost agribusiness companies a significant amount of money worldwide. Crop security in terms of both quantity and quality is essential for tracking plant disease. Therefore, identifying plant diseases is crucial. Different plant components exhibit the symptoms of the plant disease syndrome. However, the infection is typically seen in different plant leaves. Several researchers use computer vision, deep learning, few-shot learning, and soft computing techniques to automatically identify plant diseases from photos of its leaves. These methods also help farmers take prompt and appropriate action to prevent a decline in crop quality and quantity. Through careful feature extraction and selection, the use of these techniques in disease recognition can prevent the disadvantage of origin and increase research efficiency and technological speed. Additionally, specific molecular methods have been developed to stop and lessen the chance of infection.

***Index Terms*— Plant diseases, Crop security, infection, etc**

I. INTRODUCTION

India's economy depends heavily on the agricultural sector, and plant diseases can seriously affect crop yields and the livelihoods of millions of people. Significant drops in agricultural productivity have been caused by a growing variety of plant diseases and shifting weather patterns in India in recent years. To stop the disease's spread and reduce crop losses, early detection of plant leaf diseases is essential. However, it can be difficult to visually identify diseases with the unaided eye, and incorrect identification can result in inefficient treatment and additional losses. Thus, it is essential to develop precise and effective techniques for identifying plant diseases. Plant diseases affect crop productivity and quality, posing a serious danger to world agriculture. Conventional disease diagnosis techniques frequently depend on eye examination and skill, which can be laborious and arbitrary. The emergence of deep learning presents a revolutionary chance to improve the precision and effectiveness of plant disease identification.

II. MOTIVATION

The primary sector of the Indian economy is agriculture, and if the agricultural sector improves, it will undoubtedly boost the country's growth. One of the main issues that farmers face is their inability to identify crop diseases that could affect their livelihood. To address this issue, a device that detects leaf diseases has been developed, and images of the diseased leaves are used as a guide.

III. LITERATURE REVIEW

Marwan Adnan Jasim, Jamal Mustafa AL-Tuwaijari, "Plant Leaf Diseases Detection and Classification Using Image Processing and Deep Learning Techniques" [1], Every nation's top priority is agricultural products. Diseases that affect plants have an effect on the nation's agricultural output and financial resources. In this paper, a deep learning-based system for the classification and detection of plant leaf diseases is presented. The Plant Village dataset website provided the photos that were used. Since tomatoes, peppers, and potatoes are the most prevalent plant species worldwide and in Iraq specifically, we have used them in our study. There are 20636 photos of plants and their illnesses in this data set. We employed a convolutional neural network (CNN) in our proposed system to classify plant leaf diseases. A total of 15 classes were identified, comprising 3 classes for healthy leaves and 12 classes for plant diseases identified by bacteria, fungi, etc. With an accuracy of 98.29 percent for training and 98.029 percent for testing across all data sets

examined, we were able to achieve exceptional accuracy in both training and testing.

Poojan Panchal, Vignesh Charan Raman, Shamla Mantri, "Plant Diseases Detection and Classification using Machine Learning Models" [2], Finding plant illnesses is very important in the agricultural industry since they impair the health and strength of the plants, which are essential for agricultural output. Plants frequently experience these issues, and cultivation may suffer greatly if appropriate preventative measures are not implemented. In the actual world, the current method of disease detection involves physical analysis and expert judgment, which is time-consuming and expensive. Computer-based detection is now required as a result. This work includes an overview of feature extraction using GLCM and picture segmentation using K-means clustering and HSV dependent classification for identifying infected leaf parts. When the Random Forest classifier is used, the suggested methodology's efficiency allows it to correctly detect and categorize plant illnesses with an accuracy of 98%.

Melike Sardogan, Adem Tuncer, Yunus Ozen, "Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm" [3], In agriculture, early illness identification is critical to a productive crop. Tomato crop quality is impacted by bacterial spot, late blight, septoria leaf spot, and yellow curved leaf diseases. After identifying the symptoms of leaf diseases, automatic techniques for classifying plant diseases can assist in taking appropriate action. In this paper, a technique for the detection and classification of tomato leaf disease based on the Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm is presented. There are 500 photos of tomato leaves with four disease symptoms in the collection. For automatic feature extraction and categorization, we have modelled a CNN. Research on plant leaf diseases actively uses colour information. Three channels based on RGB components get the filters in our concept. The convolution part's output feature vector was input into the LVQ in order to train the network. The outcomes of the experiment confirm that the suggested approach successfully identifies four distinct tomato leaf disease types.

Prof. Madhavi Patil, Gaurav Langar, Purvi Jain, Nikhil Panchal, "Tomato Leaf Disease Detection Using Artificial Intelligence and Machine Learning" [4], The majority of emerging nations rely on agriculture as their primary source of national income, as we have learned in recent years. Therefore, as disease is the primary cause of rotting fruits, vegetables, or crops, this is one of the most significant and primary reasons to be taken into consideration for the detection of plant disease. As a result, we may presume that there will be a loss of money, time, quality, quantity, etc. if this matter is not handled properly. In order to produce a decent crop and boost output, the primary goal is to use less pesticides. Using image processing, plant disease can be identified. Disease detection involves a number of processes, including picture pre-processing, feature extraction, classification, and disease prediction. Therefore, developing a recognition system can aid in assessing high-precision plant images for appropriate treatment and future prevention.

Halil Durmus, Ece Olcay Guneş, Murvet Kirci, "Disease detection on the leaves of the tomato plants by using deep learning" [5], The purpose of this project is to identify plant diseases that arise in tomato greenhouses or fields. In order to identify the different illnesses on tomato plant leaves, deep learning was employed. The study's goal was for the robot to execute the deep learning algorithm in real time. As the robot roams the field or greenhouse, either manually or automatically, it will be able to identify plant illnesses. Sensors incorporated into artificial greenhouses can also identify diseases from close-up photos of plants. The illnesses this study looks at alter the tomato plant's leaves physically. RGB cameras can see these changes on the leaves. Standard feature extraction techniques have been applied to plant leaf photos in earlier research in order to identify illnesses. Deep learning techniques were applied in this work to identify illnesses. The implementation's primary challenge was choosing a deep learning architecture. As a result, AlexNet and SqueezeNet, two distinct deep learning network topologies, were tried first. The Nvidia Jetson TX1 was used for both of these deep learning networks' training and validation. Images of tomato leaves from the PlantVillage dataset were used in the training process. Healthy images are utilized in ten different classes. The online photos are also used to test trained networks.

IV. PROBLEM STATEMENT

To develop and build a system which will help farmer that will tell exact which disease the plant has based on the leaf images can suggest best fertilizer.

V. OBJECTIVE

1. Improve agricultural productivity

2. To provide user a platform where he could upload his affected leaf image.
3. To tell which disease the plant has based on the leaf images.
4. To provide accurate services in less time.

VI. METHODOLOGIES

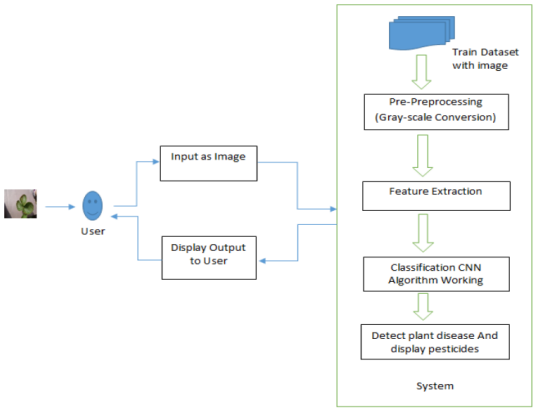

Figure 1. System Architecture

Data Collection and Preprocessing Image Acquisition: Collect a diverse dataset of plant images, including both healthy and diseased specimens. Ensure the images cover a variety of plant species, disease types, and environmental conditions.

Data Cleaning: Remove any low-quality or irrelevant images from the dataset

Data Augmentation: Apply techniques like rotation, flipping, zooming, and cropping to increase the dataset size and improve model generalization, Labeling: Assign appropriate labels to each image, indicating the disease category or "healthy."

Model Selection and Architecture: Convolutional Neural Networks (CNNs): Choose a suitable CNN architecture, such as ResNet, VGG, or Inception, based on the complexity of the task and available computational resources.

Transfer Learning: Consider using pre-trained models (e.g., ImageNet-trained) as a starting point, especially for limited datasets. Fine-tuning: Adjust the final layers of the pre-trained model to adapt it to the specific plant disease detection task.

VII. CONCLUSION

Accurate and timely detection of plant diseases is crucial for maintaining agricultural productivity and ensuring food security. Traditional methods are often labor-intensive and prone to errors. Deep learning offers a promising approach to automate and improve plant disease detection. By analyzing images of plants, deep learning models can accurately identify various diseases. Gather a diverse dataset of plant images, preprocess them, and label them with corresponding disease categories. Choose a suitable deep learning architecture, such as a convolutional neural network (CNN), and consider transfer learning for faster training.

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