Plant Health Monitoring with Photos based on Deep Learning

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***Abstract*—The quality and output of agricultural products can be affected by plant diseases. To safeguard the well-being of everyone on the planet, it is crucial to identify plant diseases as soon as possible. One of the most active research areas is autonomous plant disease detection. Large agricultural fields may be monitored with its help, and it aids in spotting disease signs when they appear on leaves. Finding plant diseases that cause reduced crop loss and, as a result, increase production efficiency is the major objective of this study. With the use of a Deep Learning (DL) approach, our suggested study can identify the first signs of plant diseases and classify them based on those signs. We hope to at most attain a 97percent accuracy in the disease detection with a deep CNN technique in this approach. The model's performance as a warm-up or early advisory tool will be validated by this accuracy rate. (abstract will be updated after the conclusion of the paper)**

***Index Terms*—Plant health monitoring, plant diseases, crop, crop products, deep learning, CNN**

I. Introduction

Finding plant diseases is one of the biggest issues the agriculture business has to deal with. In the past, knowledgeable individuals would identify diseases. It is exceedingly challenging for farmers to get in touch with professionals in remote towns. One of the main causes of plant diseases is climate change. In big farms, there is a significant loss in agricultural output if the illness is not identified at the appropriate time. Because they can't precisely view the farmer's issue at the service center, they occasionally advise farmers on plant diseases in the wrong way. The crop can be destroyed as a result of this.

Artificial intelligence (AI), deep learning (DL), and digital image processing (DIP) methods have all advanced significantly in recent years. It's critical to spot various plant diseases in their early stages in order to assist farmers. Therefore, it is essential to include these latest technology into contemporary approaches. The proliferation of plant diseases will result in a decrease in agricultural productivity. These diseases can harm plants, modify their structure, have an impact on the color and texture of the leaves, and even have an impact on the fruits, among other things. The characteristics of the diseases are quite similar. Therefore, it is very difficult for farmers to detect diseases in plants with their naked sight and they are unable to fully comprehend the severity of the condition, which might occasionally result in incorrect disease detection. Plant infections may be difficult to manage because of the less skilled or inexperienced farmers. Therefore, it is essential to create contemporary techniques that can help farmers spot ailments at an early stage and offer treatments for such diseases. For the recognition of diseases and various classifications of such diseases in plants, several researches [1], [2] have presented several machine learning methods, and image processing approaches. Machine learning algorithms are created for pattern extraction and image processing, which might lower the accuracy of a classification task. Deep learning algorithms are now mainly employed for pattern recognition since they have successfully identified various outlines. DL makes feature extraction automated. The DL delivers a high accuracy rate in the classification job and decreases error rate and computational time compared to other conventional machine learning methods. With the use of the CNN model, the primary goal of our work is to identify plant diseases and offer treatments for them.

The rest of the paper is followed by, Related work, then we introduce the deep learning algorithms, and then introduce the image processing for health monitoring, then the methodology with deep learning, then the implementation, result and discussion, then finally the conclusion.

II. Related Work

Finding plant diseases has mostly been done in the early stages using various machine learning approaches. The following stages are generally followed by all systems. Digital cameras are first used to capture the photographs. The photos are then preprocessed using several preprocessing methods. Then, the experts take the crucial elements out of those photos, and the classifier uses those features as inputs. Here, the method of image processing and feature extraction is what determines the classification accuracy. It takes a long time and is really difficult. Deep Convolutional neural networks (CNN) have recently demonstrated a considerable increase in picture segmentation and classification to improve classification accuracy in several domains, such as the categorization of digits and natural language. Because DL can utilize the picture directly, the computer vision community [16] accepted DL. The characteristics of the photos may be automatically learned by CNN using the datasets. It can be extracted and categorised more quickly with the same architecture.

This section discusses the most current developments in the use of CNN and deep learning architectures in agricultural applications. CNN uses photos of the leaves in [8] to identify diseases in cucumber leaves. Using CNN, they conducted their study and learned that two severe viral viruses are damaging the leaves: Melon Yellow Spot Virus (MYSV) and Zucchini Yellow Mosaic Virus (ZYMV). Their method has a 94.9% accuracy rate when using the Four-Fold Cross-Validation Strategy.

Hulya Yalcin et al. [9] employed a CNN model to identify and categorize the phonological phases of the various plants. He trained and tested the model using photos of leaves. Several plants were classified according to their phonological stage using a pre-trained AlexNet architecture. The accuracy of this model was 87%. This model provides great accuracy when compared to other conventional machine learning algorithms.

The author of study [10] utilized the LeNet architecture to identify diseases in soybean plants. Three various kinds of pictures, including segmented, colorful, and grayscale images, were employed by the author. The colorful picture provides an accuracy of 99.32% after categorization. In contrast to segmented and grayscale pictures, it is quite easy to extract characteristics from colorful images. In study [12], the author employed AlexNet and VGG-16, two common architectures, to recognize the diseases affecting tomato leaves. To make the dataset larger, the author also used data augmentation. In his writing, the author applied transfer learning. The accuracy of these two models was 96% and 97.49%, respectively. The author of this research came to the conclusion that adding more photos directly affects how well the network model performs.

III. Deep Learning

A neural network with three or more layers is essentially what deep learning, a subset of machine learning and AI, is all about. These neural networks attempt to emulate the functioning of the human brain, but they are unable to match the brain's capacity for learning from a massive quantity of data. The accuracy of predictions made by a single-layer neural network may be improved and refined with the help of additional hidden layers. AI has a topic called machine learning that enables a system to learn from concepts and information without having to be explicitly programmed. To prepare for data aspects and patterns and enhance upcoming outcomes and judgements, it starts with observations, such as in-person encounters. In order to represent high-level abstractions in data, a variety of machine learning methods are combined to create deep learning [3]. Deep learning has several benefits, one of which is feature learning, or the automated extraction of characteristics from raw data.

A. *Convolutional Neural Network(CNN)*

B. *Convolutional Layer*

C. *Pooling Layer*

D. *Fully Connected Layer*

IV. Plant Health Monitoring With Photo Based

A. *Image Acquisition*

B. *Image Pre-Processing*

C. *Leaf Annotation*

V. Plant Health Monitoring With Photo Based on Deep Learning

A. *AlexNet*

VI. Implementation

A. *Data Set Collection*

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VII. Result and Discussion

VIII. Conclusion

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