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Leaf Disease Detection Using CNN

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Abstract: Plant disease detection manually is exceedingly challenging, expensive, and time-consuming. An enormous loss in output and market value may result from inaccurate plant disease identification. It may take a significant amount of research and knowledge to identify plant diseases. As a result, we apply an image processing technique to identify plant leaves. The suggested system offers functions including feature extraction, data analysis, and plant disease identification in an effort to avoid the drawbacks of the current system. The CNN technique is then used to get the result, which includes the disease name with precision.

Keywords: Plant Disease Detection, Image Processing, Feature Extraction, CNN Technique.

1. Introduction

Agriculture must complete a huge effort that involves finding plant diseases. This is something that the economy is extremely dependent on. Due to the prevalence of plant illnesses, finding infections in plants is a crucial task in the agriculture industry. It takes constant examination of the plants to spot infections in the leaves. This ongoing examination of the plants requires a lot of human labor and takes a lot of time. To examine the plants simply, some type of programmed technique is needed [1]. Traditional techniques of leaf disease identification frequently depend on manual inspection by skilled professionals, which can be time-consuming, subjective, and prone to mistakes. By providing a reliable and automated way to evaluate the health condition of leaves, deep learning-based approaches present a possible option.

Utilizing precise or automatic detection methods, early diagnosis of plant diseases can improve food production quality and reduce financial losses. Deep learning has significantly increased the identification accuracy of picture categorization and object detection systems in recent years. The project's primary goals are to identify Paddy leaf disease and provide the user with correct information about the condition.

2. Literature Survey

An algorithm for picture segmentation that is utilized for automatic diagnosis and categorization of plant leaf diseases is presented by Vijai Singh and A.K. Misra. It also includes an overview of various disease categorization methods that can be applied to the identification of plant leaf diseases. Utilizing a genetic algorithm, image segmentation, a crucial component of disease detection in plant leaf disease. Plant leaf disease identification using computer vision and machine learning techniques is presented by Sunil S. Harakannanavar et al. [3]. To enhance the quality of the tomato samples, the samples of tomato leaves are first downsized to 256 256 pixels and then subjected to histogram equalization. Using machine learning techniques like Support Vector Machine (SVM), Convolutional Neural Network (CNN), and K-Nearest Neighbour (K-NN), the retrieved characteristics are finally categorized. On tomato disordered samples, SVM (88%), K-NN (97%) and CNN (99.6%) are used to test the proposed model's accuracy.

In order to identify the type of sickness, G. Geetha et al. [4] describe four sequential stages. The pre-processing stage is followed by leaf segmentation, feature extraction, and classification. Using image segmentation, we may separate the leaves damaged or affected areas while also removing noise from the image. In order to solve the challenges associated with classification and regression, the k-nearest neighbors (KNN) algorithm, a directed, supervised, and advanced machine learning technique, is used. Convolutional neural networks and Deep Neural Networks are used in the method presented by Kowshik B et al. [5] to identify and recognize crop disease signs precisely and effectively. The DL models used to visualize crop diseases are thoroughly described in this paper. Additionally, a number of research holes are found that can provide more clarity for identifying plant diseases even before symptoms appear. With the proposed approach, a convolution neural network-based method for identifying plant leaf disease will be created.

K.Muthukannan and colleagues discovered spot infections in leaves and categorized them according to the diseased leaf categories using various machine learning algorithms. LVQ - Learning Vector Quantization, FFNN - Feed Forward Neural Network, and RBFN - Radial Basis Function Networks were utilized to diagnose diseased plant leaves by analyzing the collection of form and texture data from the afflicted leaf picture. The simulation showed that the proposed system is effective. With the support of this work, a machine learning-based system for improving crop quality in the Indian economy can be developed.

[1] The study of plant leaf disease detection by Malvika Ranjan and colleagues starts with image capturing. Color data, such as HSV features, are retrieved from the segmentation results, and an artificial neural network (ANN) is then trained by selecting feature values that can effectively discriminate between healthy and sick samples. Using a combination of image data processing methods and ann, the current study suggests a method for identifying cotton leaf illnesses early and reliably.

[2] Network is to acquire and analyze data from leaf photos in order to determine healthy or diseased leaves of medical plants using image processing methods. To extract pictures and get data, an algorithm of adjusted contrast, segmentation, and features extraction is employed from the image processing approach. The Artificial Neural Network was used to analyze the findings of the experiment. The architecture of the network used to classify healthy or unhealthy leaves is multilayer feed-forward Neural Networks, which are multilayer perceptron and radial basis function RBF. The end outcome of the experiment demonstrates that the RBF network outperforms the MLP network.

[3] Srdjan Sladojevic and colleagues present Deep Convolutional Neural network Supported Identification of Crop Diseases by Plant Image Classification, a new method for the construction of a crop diseases recognition model based on plant image classification and deep convolutional networks. The methodology employed and the novel technique of training allow for a quick and painless system set up in practice. With the ability to identify crops from their surroundings, the built model can recognize thirteen types of plant illnesses from healthy leaves. All of the necessary processes for applying this diseases recognition model are detailed throughout the study, beginning with the collection of photographs in order to establish a database that is evaluated by agricultural experts. Caffe, a deep learning framework developed by Berkley Vision and Learning Centre, was used to perform the deep CNN training. The experimental results on the developed model achieved precision between 91% and 98%, for separate class tests, on average 96.3%.

[4] CNN and Modeling Adversarial Networks were used to classify plant diseases. Others, like Emanuel Cortes A deep neural network and semi-supervised algorithms were trained to distinguish crop species and disease status of 57 different classes using a publicly available dataset of 86,147 photos of ill and healthy plants. rs-net was the unlabeled data experiment that functioned successfully. With a detection rate of 1e-5, it was able to score more than 80% in the training phase in less than 5 epochs.

[5] Plant disease identification and treatment using neural network models, Konstantinos P. Ferentinos and colleagues built CNN models to conduct crop disease identification and diagnosis using basic leaf pictures of healthy and sick plants. The models were trained using an open collection of 87,848 photos, which included 25 kinds of plants in 58 various classes of [plant, illness] pairs, including non-affected plants. Multiple model architectures were developed, with the topperforming one achieving a success rate of 99.53 percent. The model's high success rate makes it a valuable or early detection tool.

[6] In the study Soybeans, Crop Disease Detection Using Cnns, Serawork Wallelign, and the others The viability of CNN for crop diseases identification in leaves pictures captured in the natural surroundings is presented in this study. To accomplish the soybeans plant disease classification, the model is built using the LeNet architecture. The PlantVillage collection yielded 12,673 samples tested green photos from four types, including healthy leaf images. The

photos were taken in an unstructured setting. The built model obtains an accuracy of classification of 99.32 percent, demonstrating it a Convolutional neural network effectively extract significant features and diagnose plant diseases from photos captured in the wild.

[7]A Deep-Learning-Based Detection for Real-Time Recognition of Tomato Plant Pest and Diseases Alvaro Fuentes and colleagues look at three types of detectors: the Faster Region-based Cnns (Faster R-CNN), the Area Convolutional Neural Network (R-FCN), and the Single Action Multibox Detector (SSD), all of which are referred to as "deep learning meta-architectures" in this paper. We use "deep feature extractors" like VGG net and Residual Network to merge every one of these meta-architectures (ResNet). We show how deep morpho and feature extractors perform, and we also suggest a way for locally and globally category labeling and feature extraction to improve accuracy and reduce false positives throughout training. We train and test our systems end-to-end on our large Tomato Diseases and Pests Dataset, which contains challenging images of diseases and pests, including several inter-and extra-class variations, such as infection status and location in the plant.

[8] This paper outlines a method for accurately identifying apple leaf diseases. Building enough unhealthy photos and unique architecture of a deep CNN based on AlexNet are required to identify apple leaf infections. Using a database of 13,689 pictures of sick apple leaves, the suggested deep CNN model is meant to detect four common apple leaf disorders. The total accuracy of the suggested illness detection model is 97.62 percent. When compared to the AlexNet model, the parameters of the suggested model were reduced by 51,206,928 and the model's accuracy was enhanced by 10.83 percent with produced pathological pictures. According to this research, the deep learning model for disease management may be more accurate and have a faster convergence rate, therefore enhancing disease control.

[9] Prasanna Mohanty and colleagues developed a deep convolutional neural network using deep learning to detect 14 different crops and 26 illnesses. On a held-out test set, the training set model obtained an accuracy of 99.35 percent, illustrating the practicality of this strategy. The model still obtains a 31.4 percent accuracy when tested on a collection of photographs acquired from reputable web sources - i.e. images shot under settings distinct from those used for training. While this accuracy is substantially greater than the one based on random selection 2.6%, a larger collection of training data is required to increase overall accuracy.

[10] To diagnose plant leaf illnesses, Ashwin Dhakal and colleagues created a model that includes feature extraction, segmentation, and classification of collected leaf patterns. Yellow Leaf Curl Virus, Bacterial Spot, Late Blight, and Healthy Leaf are the four classifier labels employed. With 20 epochs, the retrieved characteristics are fitted into the neural network. Various neural networkbased topologies are used, with the greatest accuracy of 98.59 percent in predicting plant disease.

3. System Architecture

A typical Deep Learning neural network architecture in computer vision is the convolutional neural network (CNN). A computer can comprehend and analyze visual data or images thanks to the field of artificial intelligence known as computer vision. Traditional techniques of diagnosing leaf disease frequently rely on manual inspection by skilled professionals, which can be laborious, subjective, and prone to mistakes. Using automated and precise methods, deep learning-based systems offer a possible answer by determining the state of leaves' health.

The first step in the procedure is to gather a broad dataset comprising pictures of both healthy leaves and leaves with various pathologies. Then, these photographs are preprocessed to improve their quality and get rid of any undesirable artifacts. Every image is labeled with the appropriate class, indicating whether it is healthy or unhealthy, and if it is, what type of disease it is.

After that, the labeled dataset is used to train a deep learning model. The model gains the ability to separate pertinent elements from the leaf image data and recognize patterns linked to certain diseases. Transfer learning, a method that makes use of models that have already been trained on huge picture datasets, can be used to speed up training and boost precision. After the model has been trained, its effectiveness is evaluated using a different validation dataset. The model's capacity to properly categories leaves as healthy or diseased is measured using metrics like accuracy, precision, recall, and F1 score. Fig. 1 depicts the system architecture.

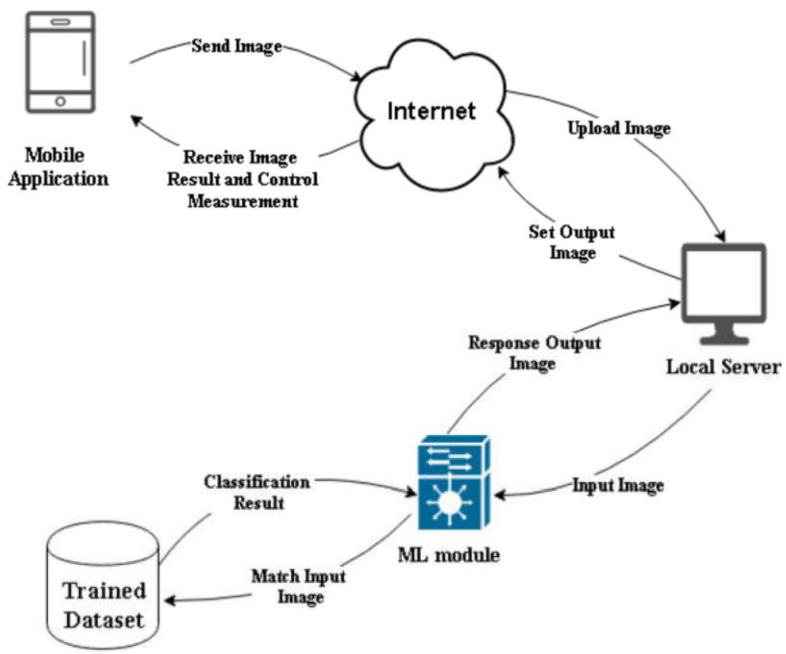

Fig. 1 System Architecture

4. Performance Analysis

In this research, we used training photos to build the model and predicted the dataset of test images. We divided the train dataset into the train, val, and test datasets for better understanding. We use the train and val datasets to train the model, predict the test dataset, and assess the model's accuracy and fscore. This can make it easier to examine a certain test image with both the actual and projected disease. The vgg-19 custom model has greater accuracy with 95% than the other two models we produced.

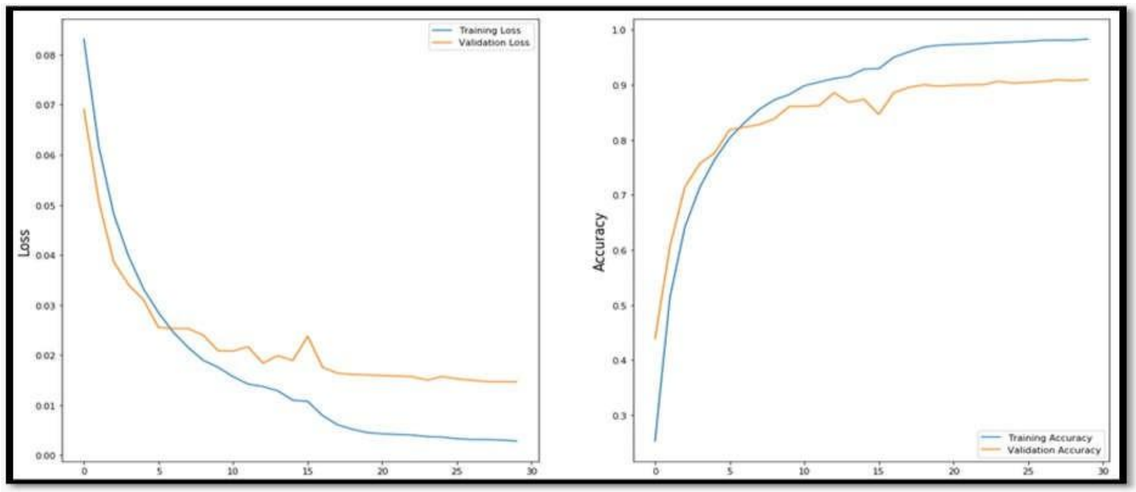

Figure 2 Training and validation accuracy

Table 1. Accuracy of system

Types of Diseases	No. of Images	Area of affected region	Accuracy (%)
Healthy	18	15.0062	95.16
Bacteria Effect	22	15.303	96.17
Viral Effect	23	15.5600	90.6
Late blight	19	15.3035	95.19

5. Conclusion

When choosing a transfer deep learning model, the following three considerations are paramount: The proposed framework is used to categories illnesses across the various crop species. The proposed framework made use of the deep learning idea. In order to create a more effective model, the suggested framework also incorporated a popular research idea known as transfer learning. Neglecting any one of these three will lead to an over fitting or negative transfer issue. With more categories, machine learning models are less effective at diagnosing diseases from leaf photos.

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