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Plant Leaf Disease Identification and Classification using Deep Learning Technique

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Abstract: *In countries like India, whose important occupation is agriculture, face a huge loss when the crops get affected by any type of disease. These diseases attack the crops in various stages and can destroy the entire production. Since most diseases are transmitted from one crop to another there is an essential requirement to detect the type of disease in the early stage so that farmers can take the required action to "save the crops" and production. However, detection of the kind of disease in a huge amount of crops is very difficult for farmers, and sometimes it becomes more difficult due to lake of knowledge about the disease since there are various kinds of diseases. The automated detection of crop disease with images has been done using many classification techniques, such as k- Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Main Component Analysis, Artificial Neural Network, and Fuzzy Logic. In this paper to improve detection capability, CNN has been used with an available database having sufficient knowledge of the disease. In this simulation, analysis of CNN-based leaf disease detection has been done for different values of learning rate and with different training algorithms. K-fold cross-validation has been used for the validation of the classifier. With this configuration, ~90% accuracy has been achieved.*

Keywords: Image classification, Plant Disease Detection, image Segmentation, deep learning, CNN

I. INTRODUCTION

The mother of all countries is agriculture. The goal of agricultural research is to increase product quality and quantity while spending less money and making more money. Plant diseases may cause the quality of agricultural goods to decline. Pathogens, such as fungus, bacteria, and viruses, are what cause these diseases. As a result, it is important to identify and categorise plant diseases as early as possible. Farmers need professionals to check them constantly, but this might be excessively expensive and time-consuming. Numerous solutions have been developed, depending on the applications, to overcome or at least mitigate the issues by utilising image processing and some automatic categorization techniques. [1-5,17]..

II. RELATED WORK

There are numerous ways to identify plant diseases, and numerous researchers have suggested different approaches for identifying potato leaf diseases in their studies. In this section, a summary of those approaches is presented. P. Badar et al. [10] applied the Back Propagation Neural Network algorithm for identifying and classifying the disease in the leaf image and achieved a classification accuracy of 92%. They used an approach of segmentation using K Means Clustering on various features of Potato leaf image samples such as colour, texture, area, etc. U. Kumariet. al. [11] have employed an image segmentation method to extract several aspects of an image, such as contrast, correlation, energy, homogeneity, mean, standard deviation, and variance. After characteristics are extracted, a neural network is used as a classifier to find and categorise illnesses on the leaves of two different plants, cotton and tomato. They were able to get a classification accuracy of 92.5% using this method. M. Islam et. al. [12] used the concept of image segmentation on potato leaf class of Plant Village dataset and then they applied multiclass Support Vector Machine on that segmented image to classify the diseases in which they obtained 95% classification accuracy. C. G. Li et. al. [13] have identified and categorised fungal infections on the grape leaves dataset using an image segmentation approach. In this study,

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colour, texture, and form features are extracted from the photos using K Means clustering, and SVM (Support Vector Machine) is then used to classify the diseases using the recovered featureschen et. al. [14] haveemployed the DSIFT andLeafNet CNN models for extracting visual characteristics. The photos of tea leaves are then classified using SVM and MLP (multi- layer perceptron) classifiers utilizing a bag of visual words (BOVW) model. For the purposes of picture recognition and classification, a faster R-CNN technique has recently been employed.

III. METHODOLOGY

This system has been developed for farmers and the farming industry. The established system is capable of detecting disease in plants The framework proposed is implemented using MATLAB This code classified the image data set of leaf for identification the healthy and un healthy images of potato leaf in this the CNN method were developed the convolutional neural network base approach provide during the k- fold validation K=1,2,3,4,5. The figure below gives the methodology of the simulation system.

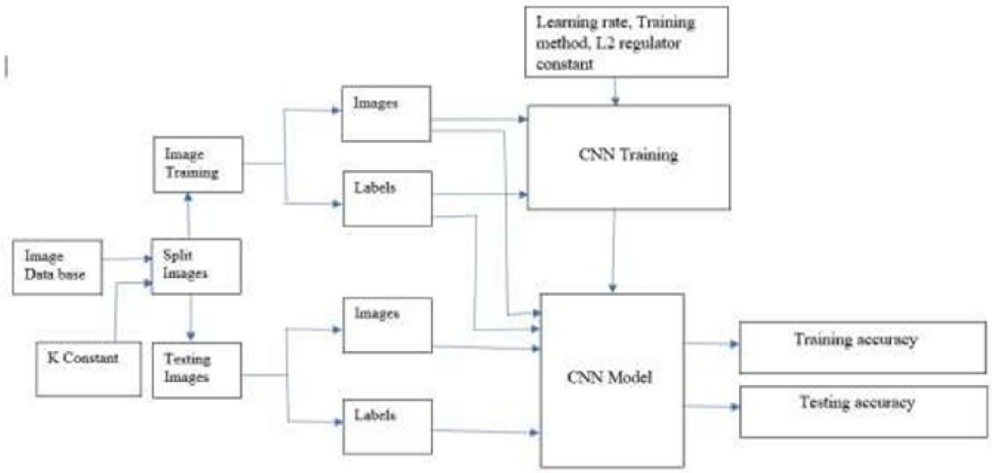

Figure 1 : Proposed Method for leaf disease detection using convolutional neural network

K fold validation: When developing a deep- learning model, accuracy and robustness are priorities. To accomplish this, we require a type of assessment method, or a mechanism to determine whether our model is functioning properly. One method that aids in our model evaluation is the K-fold[15].

Images Database: means all images of any type and all information derived from or which can be read or decoded so as to form an image of any type held in any medium (including on paper, on an electronic device, or on a storage medium intended to be read by an electronic device) used by the Company for potential or actual commercial exploitation[6,7].

Training data (or a training dataset):is the initial data that machine learning models are trained on. Machine learning algorithms are taught how to generate predictions or complete a specified task using training datasets[8,9].

Accuracy: One metric for measuring classification model performance is accuracy. Informally, accuracy is the percentage of predictions that our model correctly predicted. Accuracy is defined as follows in formal language:

Accuracy =No of correct predictions /Total number of predictions

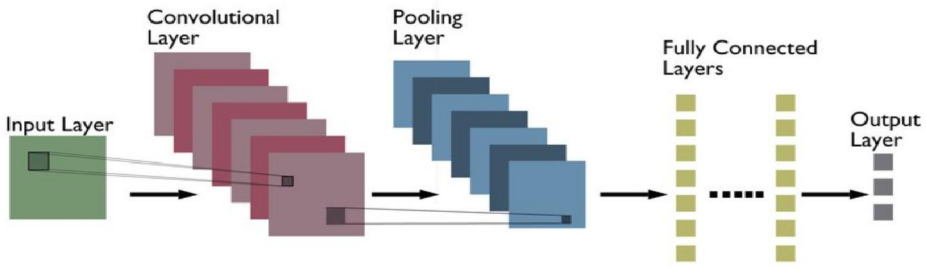

Figure 2. CNN model

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In order to handle data having a grid-like layout, CNNs are a subset of deep learning algorithms. CNNs are a subset of deep learning algorithms that are employed to process spatially or temporally related data. While CNNs are comparable to other neural networks, they use a number of convolutional layers, which adds another level of complexity. An integral part of convolutional neural networks are convolutional layers (CNNs). The image below shows a typical CNN building. The following are definitions of different layers shown in the above architecture:

Convolutional layer: Convolutional layers are made up of a set of filters (also called kernels) that are applied to an input image. The output of the convolutional layer is a feature map, which is a representation of the input image with the filters applied. Convolutional layers can be stacked to create more complex models, which can learn more intricate features from images.

Pooling layer:Convolutional layers of the pooling layer variety are utilised in deep learning. By pooling layers, the input's spatial dimension is reduced, which facilitates processing and uses less memory. Pooling speeds up training and also contributes to a decrease in the number of parameters. Max pooling and average pooling are the two primary types of pooling. While average pooling uses the average value from each feature map, max pooling uses the maximum value. In order to minimise the size of the input before it is fed into a fully connected layer, pooling layers are often utilised after convolutional layers[15].

Fully connected layer: One of the most fundamental varieties of layers in a convolutional neural network is the fully-connected layer (CNN). Each neuron in a completely connected layer is entirely connected to every other neuron in the layer below, as the name suggests. In the final stages of a CNN, when it is desired to leverage the features discovered by the prior layers to make predictions, fully linked layers are frequently employed. For instance, the final Fully connected layer of a CNN may use the properties discovered by the earlier layers to categorise an image as containing an animal such as a dog, cat, bird, etc[14].

For image identification and classification applications, CNNs are frequently utilised. For illustration, CNN's[16].

IV. RESULT AND DISCUSSION

This system has been developed for farmers and the farming industry. The established system is capable of detecting disease in plants The framework proposed is implemented using Matlab This code classified the image data set of leaf for identification the healthy and unhealthy images of potato leaf in this the CNN method were developed the CNN base approach provide the k-fold validation. Training accuracy has been achieved ~98.28% for K=2 and the testing accuracy is 86.19, Training accuracy has been achieved ~98.70% for K=3 and the testing accuracy is 86.12, Training accuracy has been achieved ~99.62% for K=5 and the testing accuracy is 87.13.

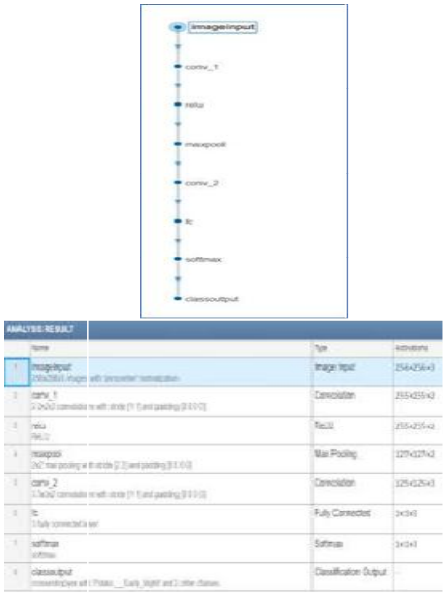

Figure 3. Convolution Neural Network

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Figure 4. Training progress k=2

Figure 5 Training & testing graph when apply k=2

Label	Category	Number	Training sample	Test sample
1	Early Blight	927	464	363
2	Late Blight	919	460	459
3	Healthy	127	64	63

Table 1: Showing the number of samples in the training and testing set of our model K=2

Figure 6. Convolution Neural Network

V. CONCLUSION

This system has been developed for farmers and the farming industry. The established system is capable of detecting disease in plants The framework proposed is implemented using Matlab. This code classified the image data set of leaf for identification of the healthy and unhealthy images of potato leaf in this the CNN were developed the CNN base approach provide the good result and gives approximately 87 % accuracy during the k-fold validation. Training accuracy has been achieved ~99% for K=5. In the future, knowledge of the disease and the cure to improve the plant's health Can be integrated along withIoT.

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