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APPLICATIONS OF CNN FOR THE PLANT DISEASE DETECTION

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ABSTRACT

Insects and other organisms that feed on plants and crops can have a negative effect on a nation's overall agricultural output. In most cases, farmers or other specialists will keep a constant check on the plants in order to detect and diagnose any infections that may be present. Nevertheless, this method typically requires a significant amount of time, monetary investment, and lack of precision. A spot on the leaves of a diseased plant can be examined to determine whether or not the plant is afflicted with a disease. The objective of this study is to develop a Disease Recognition Model that makes use of leaf image categorization as its primary data source. Image processing combined with a convolution neural network (CNN) is what we're employing in our efforts to identify plant illnesses. Image recognition makes use of a type of artificial neural network known as a convolutional neural network (often abbreviated as CNN). This type of network was developed expressly for the purpose of processing pixel input.

1. INTRODUCTION

The cultivation of crops is one of India's most important contributors to the country's overall yield. It is a matter of advancing the state of the art of technology in areas that are relevant to the production of crops. In this region, farmers strive to grow as many different kinds of plants and crops as possible. More research is being conducted in the significant field of quality and efficient farming, with the goal of maximizing the amount of yield and food crop output in the shortest amount of time possible, in order to get the greatest possible result. It is a more challenging task, and at the same time, it is less efficient, since it is done with a limited number of leaf photos and takes more time. In addition, the identification of plant disease by human visualization is a more time-consuming process. On the other hand, the automatic identification method will need significantly less work and time while also producing a more reliable program. Image processing is utilized in this context for the purpose of disease diagnosis. We are able to load the image into a system, and from there, the computer may carry out the various steps of the identification process and determine the associated classes to which the image belongs. The purpose of this work is to develop a method for recognizing leaves based on the specific properties that are extracted from digital photographs.

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First of All, here you need to import the packages such as OpenCV, NumPy, tqdm, TensorFlow, matploatlib, etc., construct the functions for labeling images, and load training data. We divide the photographs into these four groups according to the abbreviations of the various plant illnesses. In preparation for training, phase loads a wide range of photos and then resizes them to a resolution of 50 by 50. The list is then supplemented with photographs and the labels that relate to them. The data will be tested using the processes that were just discussed. The CNN algorithm is what we employ here for categorization purposes. It is composed of multiple layers in order to ensure effective execution. Convolutional layer building and pooling are added at each phase in the process. In order to obtain the output, the regression layer is inserted at the very end. Another crucial parameter is known as the learning rate (LR), and it describes the rate at which the model is being learned. Here 1.e-3 set as LR. After the model has been built, the next step is to feed the data into it. In this case, we make use of the variable that is a model name and denotes whether the subject is healthy or diseased. The next step is to insert the data into this model, save the model to the folder with the name of this variable, and then detect it.

The symptoms of common diseases such as viral, bacterial, and fungal infections can be difficult to differentiate. These symptoms can be depicted in the variation in color, function, and shape that the plant replies with in response to the pathogen. A model's performance can be negatively impacted by having to work with a smaller dataset. A model's overall performance can be improved by training it using a big data set, which can also help lessen the risk of overfitting. The quality of the training dataset as well as the type of dataset have a significant impact on the capabilities of the model. Because the training data contain noise, the accuracy of the classifier is going to depend on the nature of the noise. This subject of early detection is investigated since there are just a few datasets available, and as a result, it has a lower level of accuracy and detection. Because this method uses extant photos and datasets to diagnose plant illnesses, it eliminates the need for the collection of additional leaf inputs for the purpose of examining them in the laboratory.It provides a feasible operating method that can be used without being expensive or complicated to implement. It works by utilizing CNN to detect whether the leaf is healthy or diseased, and if it is unhealthy, it identifies the illnesses, including fungi, viruses, bacteria, black spots, powdery mildew, downy mildew, blight, and canker, among others, and it also provides cures for the recoverability of these diseases.

2. RELATED WORK

The application of appropriate methods to differentiate between healthy and sick leaves contributes to the reduction of crop loss and the enhancement of agricultural output. In this section, we will examine the many different machine-learning approaches that are currently available for diagnosing plant diseases.

2.1. Shape- and Texture-Based Identification

The authors of [1] used photographs of tomato leaves to diagnose a variety of illnesses. In order to classify the segmented diseased parts, they used a variety of different geometric and histogram-based characteristics, and they applied an SVM classifier using a variety of different kernels. S.Kaur et al. [2] were able to differentiate between three distinct soybean illnesses by employing a variety of color and textural characteristics. P Babu et al. used a feed-forward neural network and backpropagation in their study [3], which identified plant leaves and the diseases that affected them. A bacterial-foraging-optimization-based radial-basis-function neural network (BRBFNN) was utilized by S.

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S. Chouhan and colleagues [4] in order to identify fungal illnesses in plants and the leaves that were affected by them. In their methods, they made use of a region-growing algorithm to extract features from a leaf by basing the process on seed points that possessed comparable characteristics. The optimization method known as bacterial foraging is used to boost the accuracy of classification while also increasing the speed of a network.

2.2. Deep-Learning-Based Identification

The AlexNet and GoogleNet CNN architectures were utilized by Mohanty et al. in order to identify a total of twenty-six distinct plant diseases. Ferentinos et al. identified 58 distinct plant illnesses by employing a variety of CNN architectures, and they were successful in obtaining high levels of classification accuracy. They used real-time photos in their testing of the CNN architecture, which was part of their strategy. Sladojevic et al. developed a DL architecture in order to differentiate between 13 distinct plant diseases. They were able to train CNN by making use of the Caffe DL framework. In the sphere of agriculture, Kamilaris et al. conducted comprehensive research on several DL techniques and the limitations associated with them. The authors of developed a nine-layer CNN model that might be used to recognize plant illnesses. In order to conduct experiments, scientists made use of the PlantVillage dataset as well as strategies for data augmentation in order to enhance the data size. Finally, they examined performance. The authors reported an accuracy that was higher than that of a conventional strategy that was based on machine learning.

Pretrained versions of the AlexNet and GoogleNet neural networks were used in an experiment to identify three distinct soybean diseases based on healthy-leaf photos. The experiments involved modifying various hyperparameters, including the minibatch size, the maximum epoch, and the bias learning rate. KR Aravind et al. used a total of six distinct pre-trained networks (AlexNet, VGG16, VGG19, GoogleNet, ResNet101, and DenseNet201) to identify ten distinct diseases that can affect plants. The researchers found that GoogleNet had the greatest accuracy rate of all of the networks, coming in at 97.3%. In order to categorize the various diseases that can affect eggplant, a pretrained VGG16 was utilized as the feature extractor, and a multiclass SVM was utilized. The performance of the algorithm was evaluated using a variety of color schemes, including RGB, HSV, YCbCr, and grayscale. The best level of classification accuracy, 99.4%, was reached while using RGB images. Using methods appropriate for deep-forest environments, the authors of separated maize-leaf illnesses from healthy leaves. In their method, they experimented with different values for the deep-learning hyperparameters that control the number of trees, forests, and grains. Then, they compared their findings to those obtained by more conventional machine-learning models like SVM, RF, LR, and KNN. Lee et al. investigated and contrasted a variety of deep-learning architectures for the purpose of diagnosing plant diseases. Ghazi et al. used a transfer-learning-based strategy on pretrained deep-learning models in order to increase the accuracy of the model they were working with.

3. PROPOSED SYSTEM

The development of a neural network model for picture classification is now underway. This model is going to be implemented on the android application so that it may do live detection of plant leaf diseases using the camera on an android phone. Figure 1 presents a visual representation of the recognition and classification processes.

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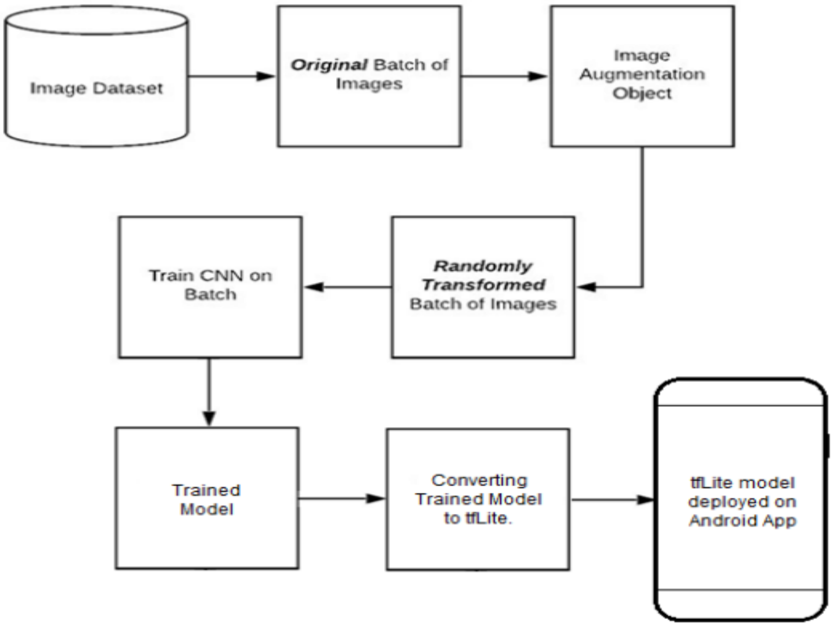

Fig. 1. Block Diagram Of Proposed System

(1) The first thing that needs to be done is data collection. We are making use of the publicly accessible PlantVillage Dataset in our research. crowdAI is the entity that made this dataset available.

(2) Utilizing the pre-processing and Image-data generation API provided by Keras, the acquired dataset is augmented before being processed using those two tools.

(3) In order to classify a variety of plant illnesses, a CNN (Convolutional Neural Network) Model with a Vgg-19 architecture is currently being constructed.

(4) TensorFlow lite will be used to assist in the development of the Android application's deployment of the developed model.

4. CONVOLUTIONAL NEURAL NETWORK ARCHITECTURE (VGG-19)

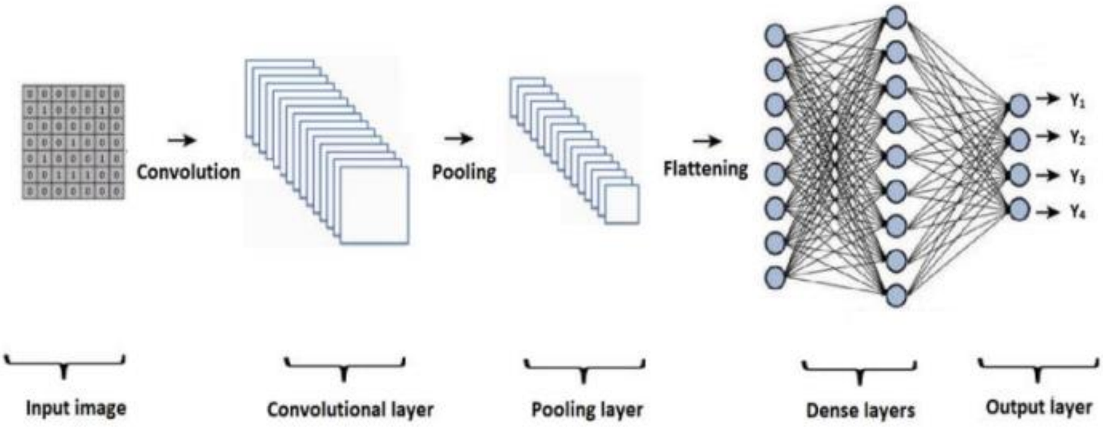

Fig. 2. CNN Architecture

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One can find the following layers in a Convolutional Neural Network: the convolutional layer, the pooling layer, and the fully connected layer. All of the strata are depicted in Fig. 2.

4.1 Convolution Layer

The convolutional layer creates an activation map by iteratively scanning the images multiple pixels at a time with the use of a filter. The inner workings of the convolution layer are seen in Figure 3, below.

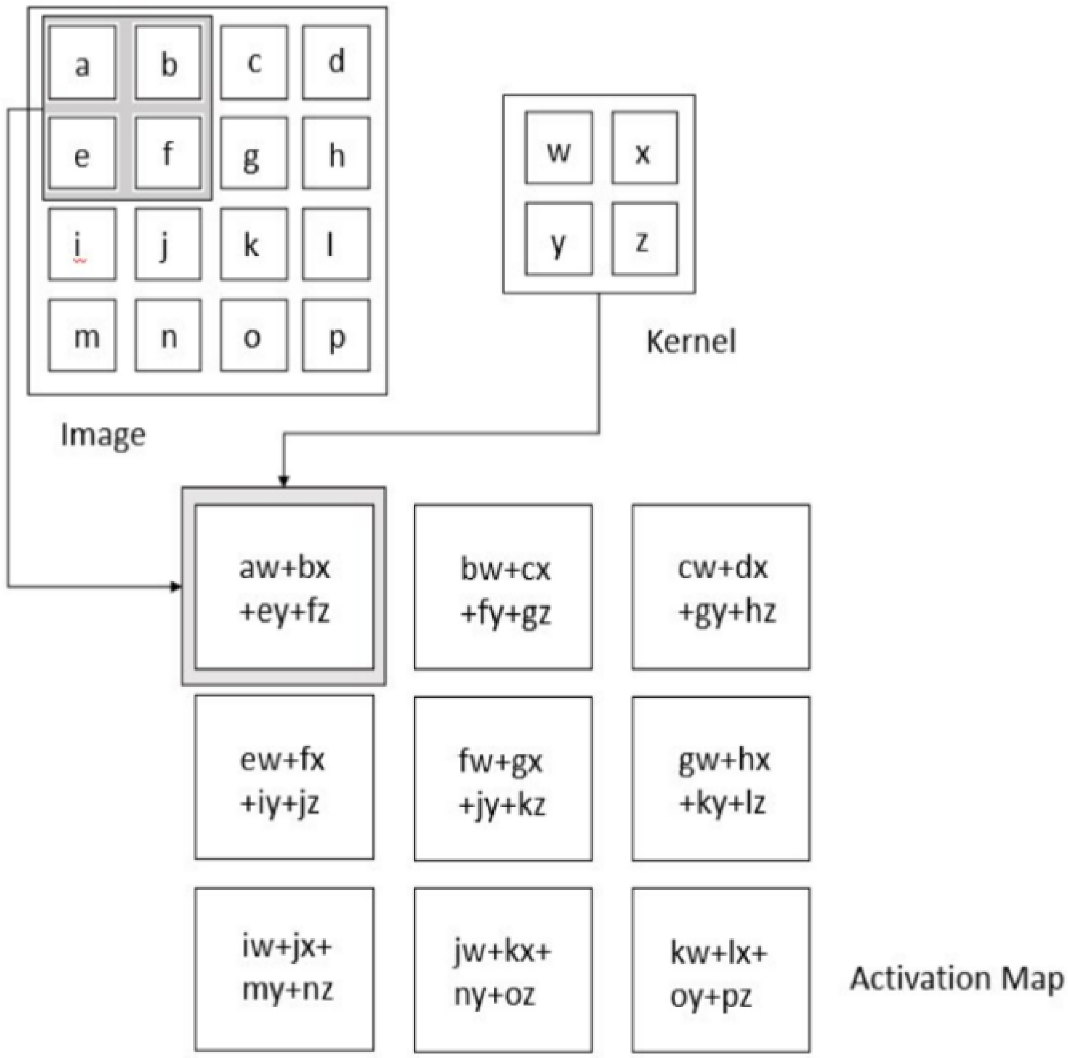

Fig. 3. Convolution Layer

Dataset: This is a collection of photos that can be used for a variety of reasons. We employ a dataset consisting of plant leaves, and each one is segmented for preprocessing and classification purposes. The Leaf dataset includes over a thousand different plant photographs of varying types. This has both healthy leaves and leaves with a sickness on them. The afflicted class includes the name of the ailment that has been specified and offers treatments that can be used to overcome the deficiency. In this step, we train the big dataset and look for signs of the disease on each individual leaf.

Image preprocessing: The preprocessing of leaves involves reducing all of the image sizes to a uniform, smaller size, such as 50 by 50 pixels in resolution. The elimination of noise and any other distracting elements from the image is the primary goal of this stage of the process.

Segmentation: The phase of image processing known as segmentation divides the leaves into their component sections and extracts information that is both helpful and significant from the resulting data. It does this by basing the leaves on the leaf perimeter, form, the region edge, the threshold, the feature, and the model. Although there are other approaches to segmentation that can be used, the one that we employ here at this site is based on neural networks.

Feature extraction: CNN is comprised of multiple layers, each of which contributes to the extraction of features and the further classification of images. Learning the features in an automatic manner is the primary function of feature extraction in the process of identifying plant diseases. In this stage, the fundamental geometrical characteristics are developed. Feature extracted based on the parameters such as diameter, width, leaf area, leaf perimeter, morphological features, shape, texture, rectangular, etc. Feature extracted based on the parameters such as diameter, width, leaf area, leaf perimeter, etc.

Classification: The process of arranging each of the photographs into their respective categories is referred to as categorization. The classification is a stage in which it compares various values acquired after the feature extraction, and it classifies the input leaf as either unhealthy or healthy, in order to develop an efficient relation between analysts and their data. In this section, we divide photographs of leaves into four distinct categories. If the condition of the leaf as a result of the process is diseased, it offers solutions that may be used to eliminate the shortage.

CONCLUSION & FUTURE WORK

Our efforts to develop disease categorization methods that can be used for the identification of plant leaf diseases have been successful. The goal of this project is to develop a deep learning model that can be put to use for the automatic identification and categorization of plant leaf diseases. Thirteen different species, including tomatoes, strawberries, soybeans, raspberries, potatoes, maize, bell peppers, peaches, oranges, grapes, cherries, blueberries, and apples, are used to evaluate the proposed model. In the course of this effort, identifications were made for thirty-eight different plant classes. Working with the picture data generator API provided by Keras was a smooth and productive experience for us. Because of this, we were able to carry out activities involving image processing. In addition to this, we were able to develop the vgg-19 model, which is a sophisticated convolution model, and train it using the data in order to make predictions. The prediction that was made by our model is quite close to being accurate. We have been able to successfully deploy these models onto the androidapp, and we are currently working to improve the accuracy of both the model and the android app.

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