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Leaf Disease Detection Using CNN

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ABSTRACT

There is a lack of raw materials and food supply due to the increase in world population. The major and most important source to get around this particular problem is now the agricultural industry. Nevertheless, pests and numerous agricultural diseases are a problem that the sector itself must deal with. However, the identification issue can now be easily handled because to the development of technologies like drones, IOT devices, and faster processing speeds in combination with data analysis and machine learning. In the agricultural industry, it can be quite challenging to identify plant diseases. Ifidentification is wrong, there will be a significant loss in crop output and market value. Detecting leaf disease needs asignificant amount of study, understanding of plant diseases, and may call for longer processing times. In order to identify leaf illness, we can process images using convolutional neural networks (CNN). As convolution neural networks (CNNs) havedemonstrated outstandingachievements in the field of machinevision, CNN models are used to detect and diagnose problems in plants from their leaves.

INTRODUCTION

Almost 70% of the population in India is dependant on agriculture. An important part of how the Indian economy developedwas through agriculture. Farmers today aredealing with a lot of issues related to bacterial or fungal disease. For the purpose of preventing crop losses, it is crucial to identify plant diseases. It's quite difficult tokeep track of plant illnesses, and it also takes a lot of time. Plant diseases now have a key role in the crops' quality being significantly reduced. An essential job in leaf detection is the identification and classification of illness. The detection of disease is crucial for raising the quality of agricultural output and stopping the overallplant extinction.

The process of learning the observable patterns of plants is through study on plant alignment. Plants that are exposed to the outside environment can contract illnesses as a result. In the past, identification was done manually by knowledgeableindividuals, but with the numerous environmental changes nowadays,prediction is becoming more difficult.

The suggested technique works well in these circumstances for keeping an eye on vast fields of crops. Automated disease identification is both simpler and less expensive when done by just observing thesymptoms on plant leaves.

EXISTING METHOD

The system used to construct the implementation model had more stringent system requirements. Users are required to provide leaf photos in thiscase, and this model specifies that users must install a number of different packages, including TensorFlow, OpenCV, Keras, etc. Plant leaf disease is found by many other by using

different
techniques. Yet, it does not offer any solutions for addressing the shortcoming. Each model having some drawbacks.

A pixel colour in an image is a combination of three colours Red, Green, and Blue (RGB). The grey scale conversion is a methodology which converts the RGB image into the grayscale image. In the edge detection boundaries of object within an image is found through Canny Edge detection is a technique used to extract the useful structural information from different objects.

After the segmentation the feature extraction and comparison is done. In the existing system techniques like K-means clustering, Lidar and vision based, Video streaming and used Matlab for Processing Finally the output is displayed on the Screen. They are less accurate andhaving cost related issues.

PROPOSED METHOD

The stages and approaches for implementing identification and classification techniques are included in this topic. Here, we employ the effective convolutional neural networks (CNN) technique for classification. Two folders, titled train and test, are present. training that is used to develop system on plant leaves and test include putting the system to the test and assessing the work's accuracy.Import the required packages first, such as OpenCV, NumPy,TensorFlow, tqdm, matploatlib, etc.Here, the first function for label images is defined. The created model consists offour classification classes. Create a method to load the training data next.

Training data resize images after loading them from our folder. The image is resized with a resolution of 50*50 here. Add the photos and associated labels to the list after resizing. testing data created using the same as previously indicated.

Dataset: We use a dataset called Plantvillage that consists of 38 classes that can detect upto 38 diseased plant leaves.

Image Acquisition: The sampled photos of the diseased and healthy leaves are obtained and utilised in training the system for acquisition in order to place the desired leaf image from the dataset or real-time source from Google is also established.

Image preprocessing: it reduces all image sizes to a uniform 50*50 resolution during the preprocessing of leaves. This step's primary goal is to clearthe image of any noise or extraneous elements.

Image Segmentation: Segmentation is a stage of image processing that divides the leaves into different components and extracts information from the data that is both helpful and meaningful. Based on the leaf perimeter, shape, region edge, threshold, feature, and model, it derives the leaves. We use neural network-based segmentation, while there are other types of segmentation approaches available.

Feature Extraction: CNN has a number of layers that allow for the feature extraction and further classification of images. The automatic learning of the characteristics is the main function of feature extraction in the diagnosis of plant diseases. At this step, the fundamental geometrical features are derived. retrieved features based on dimensions like diameter, width, leaf area, leaf perimeter, morphological characteristics, form, texture, rectangular,etc.

Image Classification: Classification is the process of categorising each image into a particular class. To build an effective relationship between analysts' usage of data, the classification stage compares various values obtained after the feature extraction and categorises the input leaf as healthy or diseased. In this section, we group leaf photos into four groups. If the resultant condition of the leaf is diseased, it offers the cures for shortage.

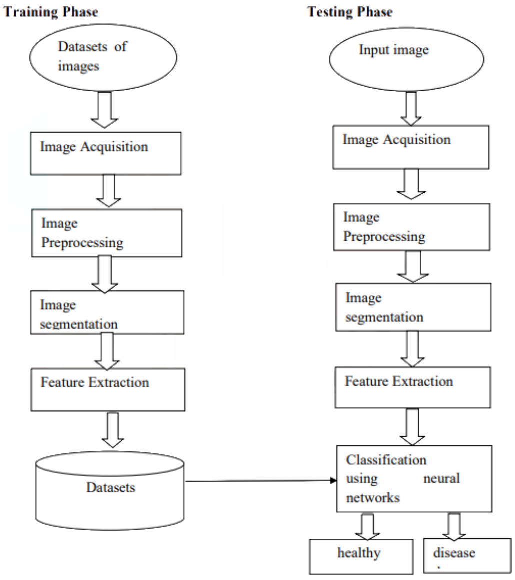

Figure Working of CNN model

WORKING

Convolutional neural networks (CNN)can be used to detect Plant leaf disease using CNNs are a class of deep learning neural networks designed specifically for image processing tasks and are widely used in various computer vision applications such as object detection, image recognition, and Multi class recognition.

In the context of Plant leaf disease detection, CNNs can be trained to recognize specific features and patterns in different Plant disease images that belong to a specific class. Model is trained with these images so that model can identify Disease name of unknown Disease, since itwas previously trained with a same type ofimages that points towards actual disease class.

To train a CNN to detect Disease, you can use a dataset which consists of different types of images that belong to different classes, CNN uses this dataset to learn its ability to distinguish between different Plant leaf diseases. In this data set it consists of 38 classes i.e. it can predict up to 38 different diseases after the model was trained.

CNN has been used in various research studies to detect and classify plant Disease with promising results. However, it is important to note that the effectiveness ofa CNN in detecting Plant leaf disease depends on the quality of the dataset used for training and the robustness of the characteristics learned by the network.

RESULTS

The Performance of a CNN-based Plant leaf disease detction is evaluated based on various metrics such as precision, recall, F1 score, accuracy, and mean average precision (mAP). These metrics provide a quantitative measure of the system's performance, indicating how well it candetect plant leaf disease and how many false detections it produces.

```
[ ]  path = "/content/PlantVillage/validation/Apple__A

     prediction(path)

     1/1 [==============================] - 0s 35ms/st
      the image belongs to Apple___Apple_scab
```

Figure: Output of the Model after training

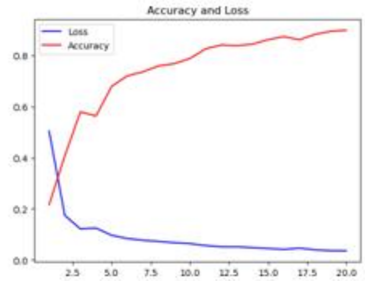

Figure: Graph of Accuracy vs Validation Accuracy.

	precision	recall	f1-score	support
Apple___Apple_scab	0.02	0.02	0.02	126
Apple___Black_rot	0.00	0.00	0.00	125
Apple___Cedar_apple_rust	0.01	0.02	0.02	55
Apple___healthy	0.01	0.01	0.01	329
Blueberry___healthy	0.03	0.04	0.03	300
Cherry_(including_sour)___Powdery_mildew	0.02	0.02	0.02	210
Cherry_(including_sour)___healthy	0.01	0.01	0.01	170
Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot	0.03	0.03	0.03	103
Corn_(maize)___Common_rust_	0.02	0.03	0.02	239
Corn_(maize)___Northern_Leaf_Blight	0.03	0.03	0.03	197
Corn_(maize)___healthy	0.02	0.02	0.02	233
Grape___Black_rot	0.01	0.01	0.01	236
Grape___Esca_(Black_Measles)	0.02	0.03	0.02	276
Grape___Leaf_blight_(Isariopsis_Leaf_Spot)	0.02	0.02	0.02	215
Grape___healthy	0.03	0.02	0.02	84
Orange___Haunglongbing_(Citrus_greening)	0.10	0.10	0.10	1102
Peach___Bacterial_spot	0.03	0.03	0.03	459
Peach___healthy	0.00	0.00	0.00	72
Pepper,_bell___Bacterial_spot	0.02	0.03	0.02	200
Pepper,_bell___healthy	0.03	0.03	0.03	295
Potato___Early_blight	0.01	0.01	0.01	200
Potato___Late_blight	0.01	0.01	0.01	200
Potato___healthy	0.00	0.00	0.00	31
Raspberry___healthy	0.00	0.00	0.00	74
Soybean___healthy	0.09	0.09	0.09	1018
Squash___Powdery_mildew	0.02	0.02	0.02	367
Strawberry___Leaf_scorch	0.02	0.02	0.02	222
Strawberry___healthy	0.00	0.00	0.00	92
Tomato___Bacterial_spot	0.05	0.04	0.05	425
Tomato___Early_blight	0.02	0.03	0.03	200
Tomato___Late_blight	0.03	0.03	0.03	382
Tomato___Leaf_Mold	0.01	0.01	0.01	191
Tomato___Septoria_leaf_spot	0.02	0.02	0.02	354
Tomato___Spider_mites Two-spotted_spider_mite	0.02	0.03	0.02	335
Tomato___Target_Spot	0.02	0.02	0.02	281
Tomato___Tomato_Yellow_Leaf_Curl_Virus	0.10	0.10	0.10	1071
Tomato___Tomato_mosaic_virus	0.00	0.00	0.00	74
Tomato___healthy	0.03	0.03	0.03	318
accuracy			0.04	10861
macro avg	0.02	0.03	0.02	10861
weighted avg	0.04	0.04	0.04	10861

Figure: Classification Report

CONCLUSION

Convolutional neural networks (CNNs) have many benefits over conventional computer vision techniques and have proven to be very effective when used for Plant Leaf Disease detection. CNNs are a good option for creating efficient and effective plant leaf disease detection systems because of their scalability and real-time performance, as well as their capacity to identify Plant disease in a variety of lighting, weather, and viewing angles. Furthermore, CNNs are effective at generalizing to previously unobserved data, which makes them useful for identifying potential future changes in Plant Diseases.

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