DETECTION OF LEAF DISEASE USING CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT

India being an agrarian country, providing a solution to detect the crop disease is the need of the hour today. Infections and diseases in plants are a serious threat to farmers and identifying them, a critical problem.The technology, Deep Convolutional Neural Network (CNN) is used to detect plant diseases from images of plant leaves and accurately classify them based on whether the leaf is healthy or it is affected by disease. Further, the type of disease is identified. This work uses image processing for identification of leaf disease in MATLAB. Gabor filter is used for the extraction of features for the collected leaves and classification of leaf disease is done using pretrained convolution neural network called DENSENET. The experimental result shows the real-time image leave disease classification with accuracy calculation. Around 1000 samples of different plants including pepper bell, potato and tomato are collected from plant village trained dataset to identify the disease. Both real-time and live detection of disease is done for the leaf samples.

I INTRODUCTION

Agriculture is one of the major Occupationin India and is the backbone of the country's economy. Diseases affecting the plants have a serious impact on Indian economy as they reduce the quantity and quality of the crops.Vegetables like tomato,potato and capsicum are largely consumed in India and there is always an increasing demand for food supply.Therefore, it becomes atmost important to protect the crops from various diseases that affect them thereby reducing the yield and as such we cannot afford to lose more of the food supply to crop diseases. These Diseases may be due to pH of soil,moisture content,temperature etc. The lossesdue to diseases can be catastrophic or chronic. Some of the disease include early blight,late blight and leaf mold.In olden days, identification is done manually or spectroscopically or microscopically by the experienced people but this is very time consuming and tedious job. Protecting the plants from disease is crucial, the diseases have high possibility of spreading and destroying other crops too.Hence,it is necessary for early detection and identification of disease so as to help in choosing the correct treatment. Correct identification of disease is required so that apt measures like correct pesticide can be used for curing them. Thus, automation is required. Image processing is widely used in many applications like image recognition, feature extraction,pattern recognition etc.Here,pre-processing is done using gaussian filter and analysis of texture is processed by Gabor filter. Also, Convolutional Neural Network (CNN) which is a part of deep learning technique is employed. CNN is now the go-to model for image related analysis. The major advantage of CNN is that it automatically detects the important features and also exploit directly raw data without using the hand-crafted features. Many architectures are available in CNN. Among them, DenseNet is chosen for our work. The Gabor features and pretrainedDenseNet features are concatenated and the diseases are classified.Results are obtained and analyzed for thousands of images taken from plant village,Real time images taken through mobile camera and also by live detection of leaves

II LITERATUREREVIEW

SantanuPhadikaret al proposed rice disease identification using pattern recognition techniques where four different types of images of infected rice plants are captured and processed using image processing techniques. The images are then classified using a SOM neural network. The algorithm used for extracting the features was zooming algorithm. The last case showed an accuracy of 70% [7].

AngieK. Reyes et al showcased the work on Fine-tuningDeep Convolutional Networks for plant recognition where a CNN with 5 convolutional layers and 2 fully connected layers was pretrained for the images obtained from ILSVRC dataset. The images taken was from a controlled environment as well as natural environment. An average precision of 0.486 was obtained [9].

Sharada P. Mohanty et alused the existing CNN architectures like AlexNet and GoogleNet to classify the plant diseases. Around 54,306 images are collected. The CNN is trained to identify 14 crop diseases. The models achieved an accuracy of 99.35%but dropped to 31.4% when the imagestaken at a different set ofEnvironment are tested [12].

Gao Huang et alintroduced a CNN with dense connectivity and named it DenseNet

Various advantages of the DenseNet like reduced vanishing-gradient problem, strength feature propagation, feature reuse and substantially improving the parameter efficiency was proposed in this work [11].

Suma V et alproposed a work on leaf disease identification using CNN where 5000 image samples of both healthy and unhealthy leaf were collected. The process involved was image processing and concept of neural networks. The accuracy varied from 70% to 80% for different CNN architectures [14].

III METHODOLOGY

The process of image classification is shown below. The images from dataset are pre-processed where the noise was removed and the features were extracted. Then, the extracted features are compared with the features obtained from the pretrained DENSENET201 convolutional neural network. Here, the convolutional neural network is used for classification. Finally, the images were classified. If the leaf has any disease, then the disease was identified.

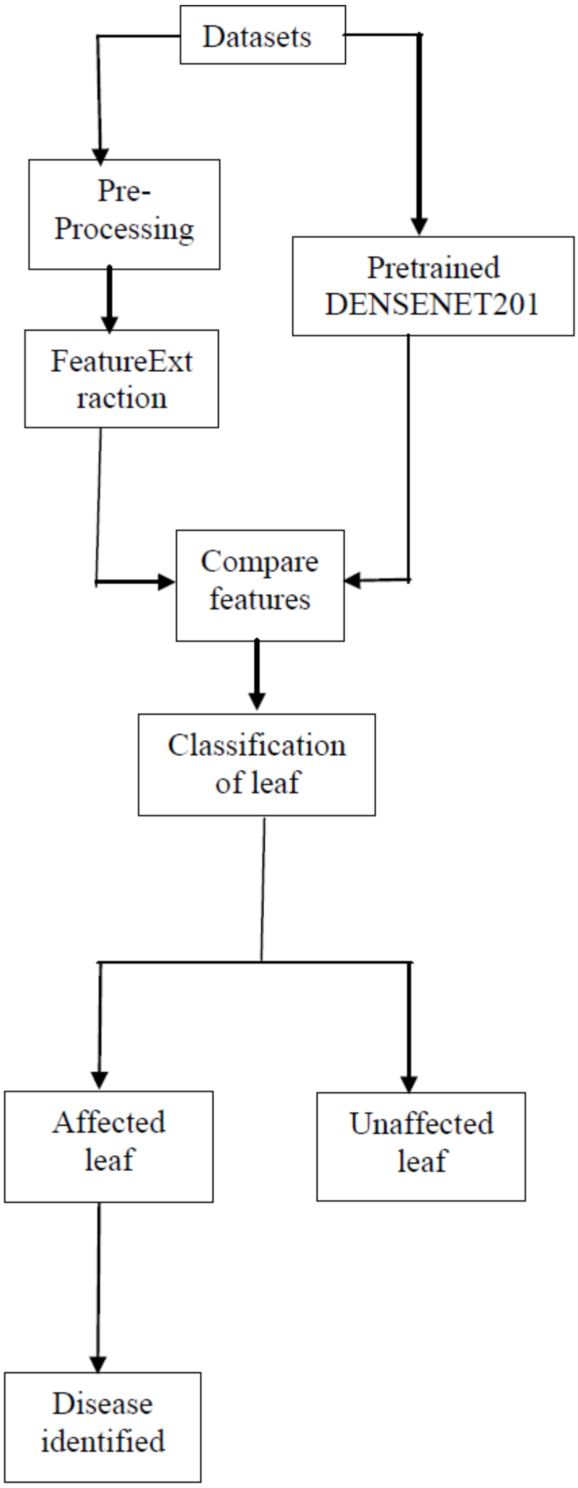

Fig 1 Block diagram of proposed method

A DATASETS

The dataset is collected from plant village for three plants including tomato, potato and bell pepper.For training the CNN(Convolution Neural Network) we use an already curated set of leaf images for the training process.

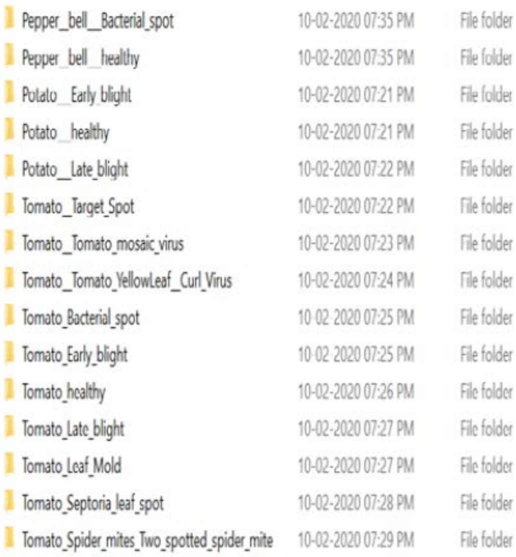

Fig 2 Dataset

B PRE-PROCESSING

Pre-processing is done to improve or enhance the image quality. The image may contain unwanted distortion or noise which must be removed to get accurate results. Gaussian filter is used to remove the gaussian noise present in the samples collected for different plants. A gray level image is also obtained along with its histogram.

C FEATURE EXTRACTION

The features like magnitude and frequency at different orientation and scales are obtained using Gabor filter.

D DENSENET201

DenseNet is a type of architecture in convolutional neural networks.DenseNet consists of dense blocks which are densely connected together. Each dense block consists of a convolutional layer, max pooling layer and a ReLu activation layer. In densenet, each layer obtains additional inputs from all preceding layers and passes on its own feature-maps to all subsequent layers.It connects each layer to every other layer in a feed-forward fashion. It then concatenates all the feature maps. The feature maps of each layer have the same size. There is also a transition layer which is essential for down-sampling. The transition layer consists of the convolutional layer, average pooling layer and batch normalization layer.

The densenet consists of the following layers:

Convolutional layer: This layer applies sliding convolutional filters to the input. The input is convolved by moving the filters along the input verticallyand horizontally anddot product of the weights and the input is computed, and a bias term is added.The filter size and number of filters given is (5,16).

Batch Normalization layer: This layer stabilizes the learning process and speeds up the training process.

Fully connected layer: In fully connected layer, the input is multiplied by a weight matrix and a bias vector is added. The output size is given as 4 in the fully connected layer.

Max pooling layer:Down-sampling is done by the max pooling layer. It divides the input into rectangular pooling regions, and computes the maximum of each region. A pooling layer of pool size (2,2) was created. Max pooling is done to reduce the spatial domain.

ReLu layer: ReLu stands for Rectified linear unit which is an activation function. ReLuis a piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero.

Average pooling layer: Down-sampling is performed in this layer by dividing the input into rectangular pooling regions and average values are computed for each region. Average pooling layer of pool size (2,2) was created.

Softmax layer: The purpose of the softmax layer is to transform all the net activations in the final output layer to a series of values that can be interpreted as probabilities. It converts the output sum to one for probability analysis. It is used to convert the scores to probabilities.

IV RESULTS AND ANALYSIS

The images are classified and following results are obtained for dataset images, real time images and live detection of leaves. The results are obtained for 15 classifications for the plants tomato, potato and pepper bell.

Dataset Image:

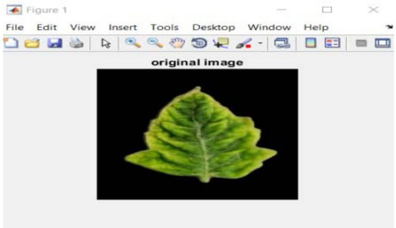

Fig 3 Input image- Tomato yellow curl virus

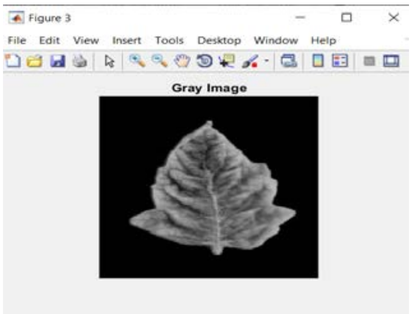

Fig 4 Gray image for fig 3

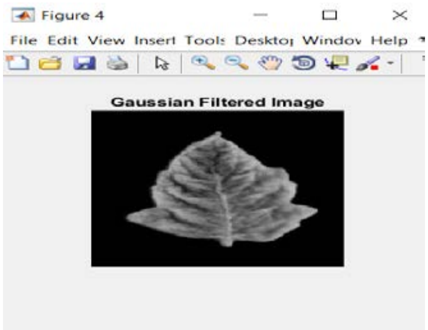

Fig 5 Gaussian filtered image for fig 3

```
predictedLabel =

  categorical

     Tomato___Tomato_Yellow_Leaf_Curl_Virus
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Fig 6 Predicted output for fig 3

Realtime Image:

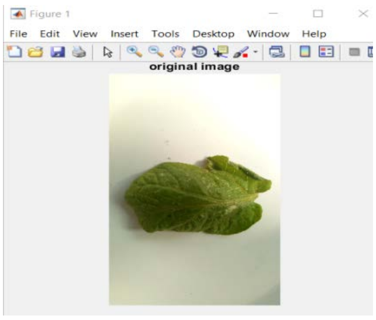

Fig 7 Input image 1 – Potato

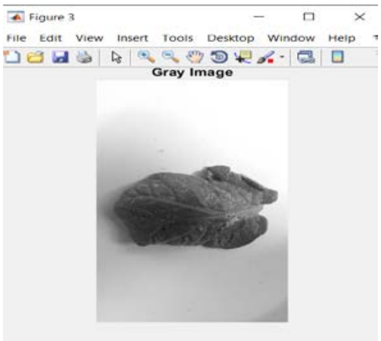

Fig 8 Gray image for fig 7

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predictedLabel =

  categorical

     Potato___Early_blight
```

Fig 9 Predicted output for fig 7

Live Image:

Fig 10 Live input image – Bell pepper

Fig 11 Gray image for fig 10

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predictedLabel =

  categorical

     Pepper__bell___Bacterial_spot
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Fig 12 Predicted output for fig 10

V CONCLUSION AND FUTURE SCOPE

In this study, DenseNet is used to detect and classify various leaf diseases in three plants i.e. tomato, potato and bell pepper. The identification is done for the dataset obtained from plantvillage, real-time data captured through mobile camera and also live detection. The identification of leaf disease is performed in MATLAB.The proposed method is found to be better as compared to existing studies since detection of diseases for real-time images are involved. Our results show that deep models and particularlyCNNs outperform the previously used models.

In the future, our objective is to improve the accuracy of the model, reduce the computation for small machines like mobiles and develop a mobile application so that it will be more user-friendly and can be used instantly.

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