Plant Disease and Medical Characteristics Identification System

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Abstract—**Plants has vital role in organism's life as they turn out to have numerous important factors that are required for survival such as oxygen, shelter, food, medication, fuel and natural assurance. A few plants involve rich restorative qualities and furthermore contain dynamic elements for therapeutic use. Manual identification of healthful or unhealthful plants could be a long method and would want the assistance of consultants for the identification of the plants. So as to do this, a programmed recognizable proof System is required for bigger benefit to man. Recognition of plant diseases and its medicinal values is done by using image- processing techniques and machine-learning algorithms which involves process steps such as acquiring of image, processing of image, segmenting of image, extraction of features, and plant classification. The proposed goal of this project is to provide an efficient and cheaper identification system of plant diseases and its medicinal characteristics which would benefit the farmers in many ways and help them in the decision making. This paper presents digital image processing methods which are deployed in the identification and classification of medicinal plants also disease of the infected plants. It also shows the important edge of medicinal plants in the recent years.**

Keywords**:** ***Machine Learning, Leaf Disease Detection, Convolution Neural Network***

I. INTRODUCTION

Digital Image Processing is the use of digital computer to process the digital images by means of an algorithm. It's also explained as a use of computing algorithms, as a result to get enhanced image either to extract some useful information. In digital image processing this can be applied to wider range of algorithms which helps in removing several distortions such as noises and signal distortion during processing.

Applications of Image processing for agriculture sector have following uses:

1. To identify diseases, present in plant
2. Affected area shape is determined
3. Affected area color is determined
4. Morphology of the plant is determined

A Country's economy development depends on the agricultural land mass and productivity. Majority of the population are depended on the agriculture. Visual patterns present on the plants are used for identifying and studying the plant diseases. Detection of plant disease at an early stage will be favorable since the disease that affects the plant can be controlled. In few countries the farmers don't have any idea or facility for contacting the experts. Traditional method for disease detection is visual observation of the leaf patterns by experts which the farmers aren't able to afford due to its high cost. In such situation an automated plant infection or disease monitoring system will be very useful. By comparing the plants leaf's in the agricultural farm land with the stored plant disease symptoms by automation will be cheaper.

II. RELATED WORK

In the paper [1],"Disease Detection and Classification in Agricultural Plants Using Convolutional Neural Networks-A Visual Understanding", Convolution Neural Network which is a deep learning model and is widely applied in recognition of objects and faces. The process in the detection is explained here, where it starts with first, the layers of convolutional neural network which are the convolution layer, number of filters, stride and padding. Second, the activation layer which is used to hit the neuron and can use variety of activation functions such as tanh, sigmoid and RELU and finally classification is done using the CNN algorithm to predict the plant being infected or health.

In the paper[2],"Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight", raspberry-pi is used to detect blight in pomegranate which consists various process, to start with the image is acquired from the source and is passed to pre-processing where the image acquired is processed and undergoes segmentation where the image is segmented. After segmentation it is sent to feature extraction where the properties are obtained and gathered in image data. This image data is compared with current permanent database for disease detection and is displayed on the screen.

In the paper [3], "Deep Learning Based Plant Disease Detection for Smart Agriculture", a deep learning model along with a transfer learning model which are used for disease detection and its classification. Unlike the traditional deep learning models, the submitted model is significantly lighter and has more accuracy. With the use of data augmentation which has various benefits such as prevention of overfitting, better adjustment to unseen data and increase its accuracy.

In the paper [4], "Image-Based Plant Disease Detection: A Comparison of Deep Learning and Classical Machine Learning Algorithms", classical machine algorithms are matched with deep learning method and concludes that the deep learning method is the ideal way for classification of images with large datasets. Already the accuracy of deep learning method is optimum and any attempt to improve it on the same dataset is of very little benefit. Machine learning algorithm also gave high accuracy but its region of error is of much higher order compared to deep learning method.

In the paper [12], "Multilayer Convolution Neural Network for the Classification of Mango Leaves Infected by Anthracnose Disease", convolutional multilayer network is used with different layer. So once the image acquisition step is over, image is put into the model to classify the model by using maximum number of epochs. So, the accuracy will be increased with the different layers and depends on the number of neurons.

In the paper [14], "Detection of plant leaf diseases using image segmentation and soft computing techniques", an automated technique is proposed to recognize the disease which affects the plant to reduce the loss in the productivity by detecting the affected plant in the early stages. Digital camera is used to collect the plant pictures of different types to identify the affected area of the leaf this stage is known as image acquisition. Next stage is termed as preprocessing stage where in the authors refine the status of the image to get rid of the unwanted deformity from the selected or collected leaf image also, they obtained the interested region of the image. Image enhancement is done here to increase the contrast. Green pixels are masked here and for these pixels, threshold value will be calculated. After performing many different enhancement techniques, the required region of the leaf is obtained which is then used in the generic algorithm. An MXN size leaf image is taken and different pixels are grouped into **k** clusters. In fitness computation step the datasets are grouped into different clusters. In next stage new cluster center will be calculated. Euclidean distance will be calculated for all the pixels. In the feature extraction method color co-occurrence technique has been used which considers the texture and color of the image to get the distinct features of the image.

In the paper [15], "Deep learning for image-based cassava disease detection", the image processing techniques and deep learning is employed to spot the disease that affects the cassava plant which is thirds largest fount of carbohydrates for human in the world. The cassava images were captured using a digital camera in the fields. A 2756 cassava images has been collected and these were cropped to make a second form of dataset. Convolutional Neural Network (CNN) model is used for processing of cassava leaf image datasets. Inception model has been implemented using the tensor flow in the final layer of the CNN algorithm. Also, 90% of the datasets for the priming purpose whereas the remaining 10% datasets were used to validate the results. The disease that affects the cassava plants have classified into 5 different classes and they achieved the accuracy of over 95% while validating the results.

III. PROPOSED WORK

The proposed work involves three main processes. They are as follows: data acquisition, data pre-processing and classification. High level diagram is shown in the below figure and the following section discuss about the same.

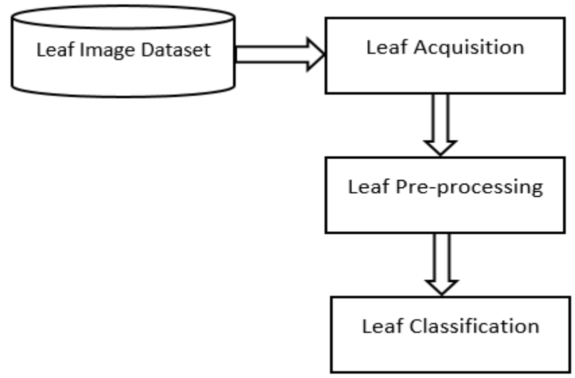

Fig. 1. High level design

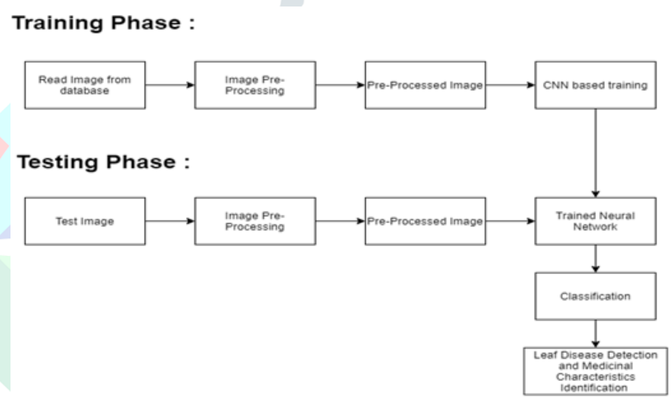

Fig. 2. System Architecture

A. *Data Acquisition*

The plant disease image has been taken from the Leaf Image Dataset. The image is selected from the dataset using python script which enables the user to select the specified image from a group of images available in the dataset.

B. *Data Pre-processing*

The selected image from the dataset consists of minimal noise, so enhancing the image to remove noise was not needed. The selected image from the dataset is resized to 50X50 resolution in order to maintain uniformity and in turn speed up the training stage. This is done with the functionality provided by OpenCV.

C. Classification

The selected image then undergoes classification with the help of CNN. Convolutional Neural Network consists of the following layers: Convolution, ReLU

Layer, pooling and fully Connected Layer are shown in Fig.3.

CNN compares the leaf images part by part. The small pieces called features are obtained first. By finding similar features in different images, in similar position in two images, CNN provides efficient results comparing to whole-image matching schemes.

ReLU also called as Rectified Linear Unit transform function only activates a node if the input is above a certain quantity, while the input is below zero, the output will also be zero. But when the input is greater than the mentioned threshold value, there exists a linear relationship with the dependent variable. In ReLU layer every input value which is below zero will get filtered and they'll be replaced with zeros.

In Pooling Layer the image will be reduced to lesser size where the window-size is usually taken as 2 or 3 and stride will be 2 generally.

Fully Connected Layer is the last layer in the process. Classification of the image will be obtained after this step. Shrinked leaf images and filtered leaf images are put together into a single list.

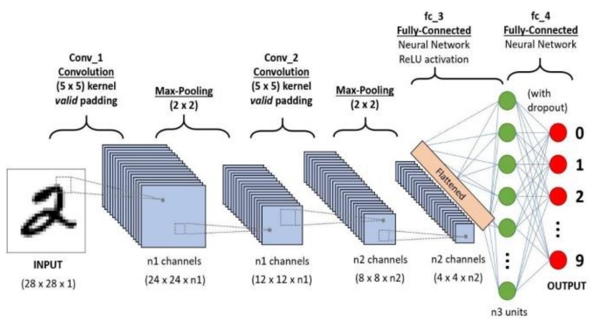

Fig. 3. Convolution Neural Network Layer

In the proposed model, it consists of GUI that enables the user to choose between two set of functions:

1. Leaf detection:
   Task is to identify the selected image is healthy or unhealthy
2. Its remedies:
   Task is to identify the selected image remedies

The CNN algorithm is configured to 7 layers which gives an optimized result of high accuracy.

IV. EXPERIMENTAL RESULTS

The performance of the proposed model is assessed, where a quantitative metrics set comprising of accuracy, total loss, value loss and value accuracy have been used. The metric results are recorded in Fig. 4. They show the highest values of the quantitative metrics obtained with the corresponding epoch number.

Model fit parameter which is present in python is used to determine the accuracy with respect to its no. of epochs along with its loss.

The syntax is as following:

"model.fit({'input': x}, {'targets' : y}, n_epoch=8, validation_set= ({'input' : test_x}, {'targets': test_y}), snapshots_step=40, show_metric= True, run_id= MODEL_NAME)"

No. of Epochs	Accuracy	Total-loss	Val-Loss	Val-Acc
10	0.9594	0.14135	0.55322	0.8333
20	0.9635	0.12771	0.9449	0.8500
30	0.9671	0.11496	0.9481	0.8000

Fig. 4. Metric Results

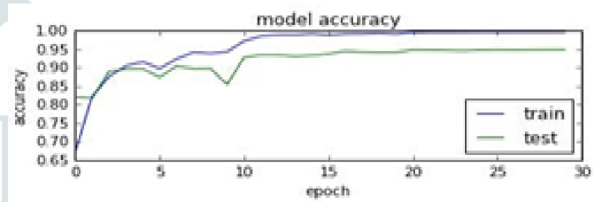

Fig.5. Accuracy vs Epoch

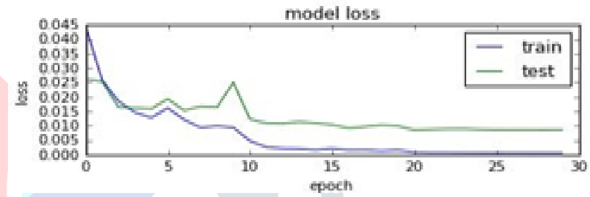

Fig. 6. Model Loss vs Epoch

In order to understand quantitative metrics recorded above using model fit. A visual representation of Model Accuracy vs Epoch and Model Loss vs Epoch in plotted in Fig.5 and Fig.6 respectively, as above, where they give a rough idea of accuracy increasing with respect to increase in no of epoch. Which is vice versa in model loss where it decreases with increase in no of epoch.

After observing the recorded data, a high accuracy validation of 96.7% was obtained over training of 30 epochs, while a higher 99.3% of training accuracy was also obtained. An accuracy validation of 94% has been reported on an average. This is an effective measure of the classification made by the deep learning model. The graph has been plotted with variables as train and test accuracy and loss against the epochs in the above figure which gives a visualizing indication of the speed of model convergence. It can also be seen that with around 20 epochs the model has been stable and hasn't had a major improvement in the final 10 epochs.

The long neural networks which has huge demand for computational resource requirement or the presence of G.P.U (Graphics Processing Unit), whereas the implementation process it requires minimum hardware requirements. This is due presence of low training parameters caused to the presence of much lesser layers with lesser filter sizes and smaller train size images. Thus, the model provides a simple solution towards the issue of detecting disease of a plant. With the presence of less resource constraints and less data, the model gives effective results compared to the traditional techniques.

V. CONCLUSION

The objective of this study was to reduce manual work and increase the efficiency by the automatic identification of medicinal plants using image processing techniques. From the literature survey the majority of the researchers used leaf features for the classification of medicinal plants and less research work was done in classification of medicinal plants using flowers and fruits/seeds. The main work was to enhance the process in identification and classification of medicinal plants using fruits/flowers or seeds features which also includes leaf. Automatic identification and classification of medicinal plants will provide medicinal knowledge to common people and farmers which help in increasing production of such essential plants.

History of Ayurveda [19], says every plant has a medicinal value, so the identification of which part of the plant has medicinal value and for which disease this medicine is going to use is very essential to mankind. Through these plants parts botanists and herbal practitioners are identifying the medicinal plants manually which is time consuming process. So, this automatic classification system also helps botanists, consumers, forestry services, taxonomists, pharmaceutical companies and Ayurveda practitioners to identify and classify the medicinal plants without any human assistance.

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