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PLANT DISEASE DETECTIONANDRECOVERYUSING DEEP LEARNING

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Abstract
Though farming is drowning these days, many people show great concern in the agriculture field. Due to pests, fungal diseases in the crops, plants, and vegetables, the productivity is greatly affected. To suggest a solution to these problems, disease diagnosis in the crop plants is made via Machine Learning. With the help of image processing, the plant is classified by the disease and the solution is provided. By analyzing the patterns of the affected plant parts, we perform feature extraction and train the model. The affected plant is tested for the disease diagnosis and the solution for those diseases is suggested. Thus without any confusion, this system predicts the disease and provides appropriate recovery information for it.
Keywords: *Plant Disease , Deep learning ,Detection ,Recovery*

1. Introduction

India is one of the developing countries in the world with nearly 1064 million population. It' s quarter economy is based on agriculture. In that situation, the yield rates of India were decreasing due to infections/diseases. The different parts of plants (i.e. leaves, fruits, stem) indicates the goodness of the plant. They get infected in numerous ways through bacteria, virus, fungus and so forth.

Once if the plant is infected, it is clear to the eye sight of humans by analyzing the leaves and/or fruits of the plant. At most cases the cultivator could predict the disease and knows the steps/methods to save the life of
that plant.

To the other side, the cultivator might not aware of it. To overcome this, plants are in need of special care and that requires more efforts and time of human beings. In order to minimize human efforts and to maximize the cultivation, the early prediction of diseases is made by training the machine to suggest solutions.Here it is dealing with multi class image classification, in which each class, functions with different plant diseases. The significance of this system is to improve the healthy lives of plants and humans. This leads to the enhancement of quality in agricultural food.

2. LITERATURE REVIEW

Sachin D. Khirade[1] proposed his idea in plant disease prediction using image processing by analyzing the patterns in the leaves. With the help of Artificial Neural Network(ANN), the images are trained through different nodes from input to output layer. In each layer, the weights of the image are calculated and added to the model.

While testing if it matches the patterns of the trained image, the disease in the plant leaves is detected by the system. But not only the leaf is a part of the plant. The fruits and vegetable are meant to beneficiary of a plant. We should also analyze the fruits or vegetables of the plants to achieve complete detection of disease.

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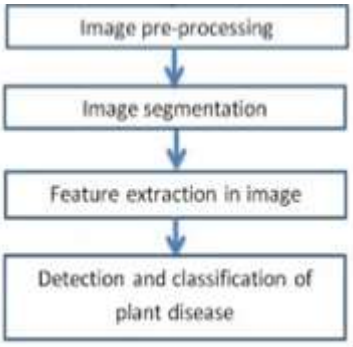

Figure.1. Flow of Image Processing

RagulDas[2-3], identified the plant disease using image processing techniques with the help of SVM classifiers. This is a machine learningalgorithm that stays apart from the neural networks of deep learning. By analyzing and classifying the patterns of the leaves, disease affected plants are identified and detected through multi layered approach. The infected parts of the leaves are processed with K-Means clustering.

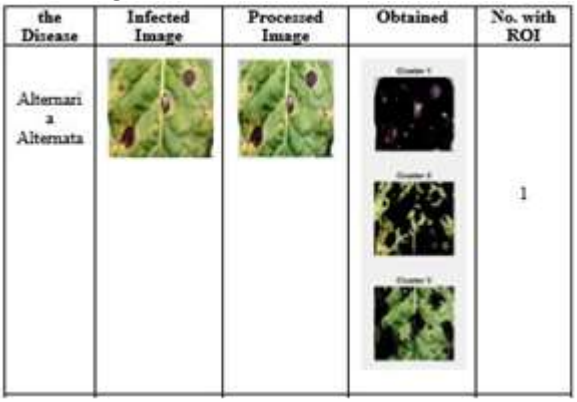

Figure.2. Disease detection using leaf data

W.A. Ezat[4-7], published the idea of Multi-class Image classification where more than two different labels or classes is available for classification. Similarly, we can place different plant diseases under different class labels and proceed with the classification. He used Convolutional Neural Network model that are pre-trained using Image-Net for the PASCAL VOC 2007 dataset. It is stated that CNN algorithm is more accurate for the multi-class image classification than the super-vector coding of local image descriptor.

Sanjiban[8-11] gave the deep explanation for multi-class image classification with Convolutional Neural Network which was stated more accurate algorithm for the image classification using deep learning. CNN processing steps involves convolutional layers where the datasets are initially passed which is followed by the ReLU activation function.

Then comes the pooling layer where the images are numerically processed. This is done iteratively and a fully connected layer connects every layer to every other layers. Finally the probabilistic class prediction isdone.

JihoonSeo[12-15], Suggested the activation function for the deep neural networks. There are several activation function that can be applied tothe algorithm at the end of the session. Out of that softmax is more suitable Activation function for the CNN algorithm.

Sun Zhixin[16-20], researched on improved back- propagation in neural network. As deep learning holds the collection of different layers of neural nodes, the datasets are passed through these nodes as feed forward and back-propagation. This put forward the concept of gradient descent factor.

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Sharath D M, Akhilesh[21-25], developed a disease detection system for the pomegranate plant by processing the images of the bacterial blight disease affected plants. The steps involved are image acquisition, preprocessing, segmentation, feature extraction, data comparison, disease detection and display of results.The image acquisition shows the dataset collection which is in the RGB forms and preprocessing tells about the data cleaning, transformation and so on to reduce the noise and unsupported formats available in the data collected.

Segmentation refers to the classification of datasets based on the similar labels. Here it is done with grab cut segmentation by performing 2D segmentation. This is also referred as graph cut segmentation.

The background pixels are identified with the help of masking and the foreground pixels are identified with Gaussian Mixture Model(GMM). This model creates new pixels based on the relationship with the neighbor pixels. The similarities are identified by calculating the weights and in some case, it is done by masking the edges.
Feature extraction is then done with properties like color, size, mean, edges etc.., This is followed by data comparison and detection of disease which provides appropriate outcome.

3. PROPOSED SYSTEM

A. Multi Class Image Classification

In these days, there are uncountable plant diseases. This system deals with major and widely spreading diseases of plants. There the multi class image classification plays a role. It is the process of creating classes for each disease.
Different diseases of various plants are labeled with different classes. Then it is proceed with algorithm working steps. Initially, we need to import all necessary packages like pandas, numpy, keras, sklearn, matplot etc., and to upload the required datasets.

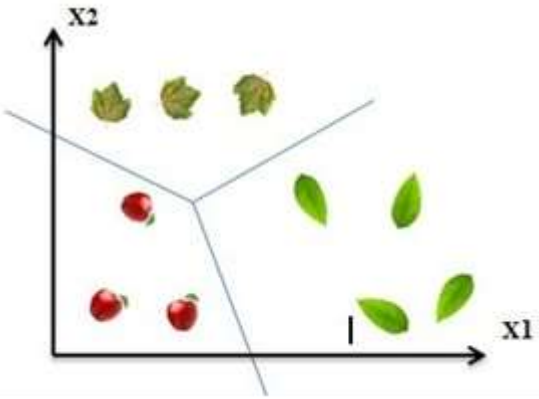

Figure.3. Multi-class image Classification According

According to the dataset images alter the dimensions of the images and create bottleneck file. This file will convert all image pixels in to their number correspondent (numpy array) and stores in our storage system. It will take half an hour to several hours and it varies with number of classifications and images per classification.

Then we convey our program where the images are located in our system, so the machine could know the information about location of the images.

Finally, this system sets epoch and batch size which is the key step of neural network. According to the number of images we train, they need to be altered.

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B. Convolutional Neural Network

The CNN(Convolutional Neural Network) algorithm help to process the image by breaking them into different convolutional layer. The CNN layer consists of several independent filters. These filters are also referred as the feature identifiers. Each layer is the extension of a small subfield of the image made into a full entire image.

By performing max pooling for the pixels of the image, each layers are categorized into different layers.

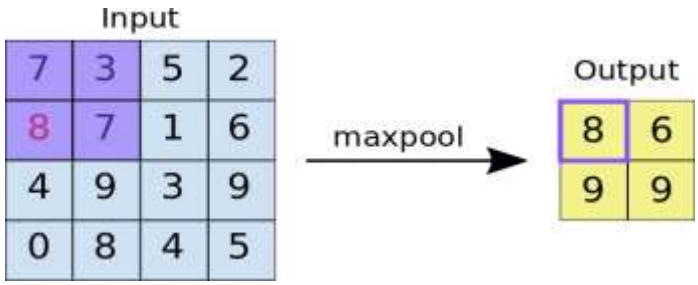

Figure.4. Example of Max Pooling

Pooling:Next comes the process Pooling. There are many functions involved in pooling. One such most essential operation is max pooling. Colors of the images are extracted with max pooling technique. Pooling also offers advantage that the object would be detected irrespective of its position.

C. **Max Pooling**:
The max pooling helps for efficient feature extraction of the image by choosing the maximum color value present in the image and making them into next convolutional layer.

D. **Feature Map**:
A feature map is created by convolving the image with the help of filters. And it is not constant. It may vary for different convolutional layer.

E. **VGG16**:
In CNN, the transfer learning plays important role by bringing pre-made neural network. There are many transfer learning models say VGG16, resnet50. This system uses VGG16 that works with 11 convolutional layers whereas the resnet has 50 convolutional layers.
Parameter sharing and Local connectivity helps to reduce the parameter values for our developing model. Kernel, stride, padding are the most essential parameter used in the CNN algorithm.
The process of converting the image pixels to numbers is done only once. For this operation the numpy package plays a vital role for this conversion. Then it need to proceed with bottleneck file for training, validation, testingdatasets.

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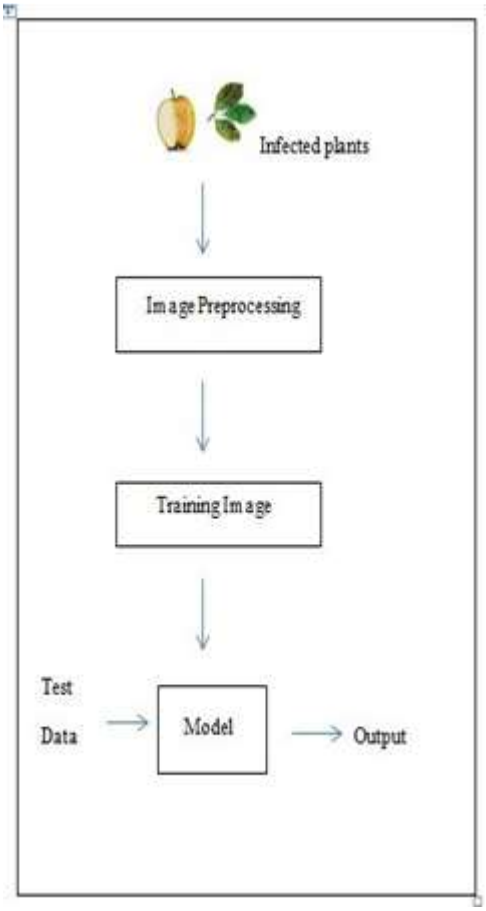

Figure.5. Workflow of algorithm

F. Model Creation:

We will initiate with the sequential() method for the model creation. To create the model, we first flatten our data and add the hidden layers. More models are created with different hidden layers and activation. The activation function used here is 'softmax', as it is based on labeled classification.

model=Sequential ()

Then the model is compiled and evaluation steps were made to check the accuracy of the model. Every comparison during the validation and testing is made with this model file. The model will be updated for every iteration in the epochs.

G. Epochs And Batch Size:

An epoch refers to the number of times the datasets would be trained. The entire datasets will not be passed as a whole to the network layers. Rather it is split into several batches.

$$Iterations\_per\_epoch = \frac{Total\_dataset}{Batch\_Size}$$

If there are 1000 datasets which are split into batches of 200, then there will be 5 iterations would be made for each and every epoch. More memory space is required when the batch size is relatively high. The batch size refers to the number of batches split with the datasets. More the number of epochs, more will be the possibility of getting accurate prediction ofoutcome.

Accuracy and loss are identified for thetraining and validation set. The loss must be as low as possible to obtain a better performance. For the initial training the loss of the outcome will be huge and this will be decreased with further more training of data.

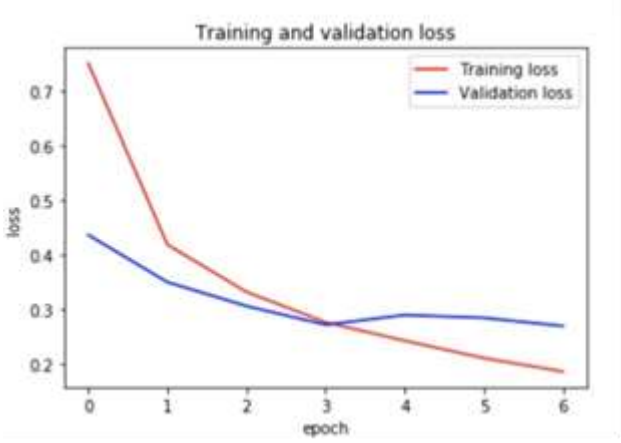

Figure.6. Graph on training and Validation loss

H. Testing Phase:

The dataset are classified into number form Matrix using numpy array for testing phase. The block of codes will run the model with classification metrics. A probabilistic outcome is obtained as a class prediction which is an array of different classes formed. The accuracy of the prediction depends upon the quality and number of datasets fed for the training process.

The numpy matrix and the confusion matrix work very efficient on the dataframes. They offer multiple iterative codes for color visualization. So far we could able to create a simple character user interface. A GUI based application can be developed for this Machine learning model using Flask web application framework.

4. CONCLUSION

This paper delivers a simple disease detection process and solution providence for those diseases. Thus to cultivate good healthy crops, disease detection in the plants is very beneficial. The image processing with convolutional neural network helps to achieve this.

5. FUTUREWORKS

Further new implementation in existing object is always interesting. Here as a future work, this system will be embedded in an application and provide facilities like expert advice, information about crops in demand and their live price rates. Deducing the diseases and suggesting solution to those diseases, increase the crop production and economically, the farmers would be benefitted from it.

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