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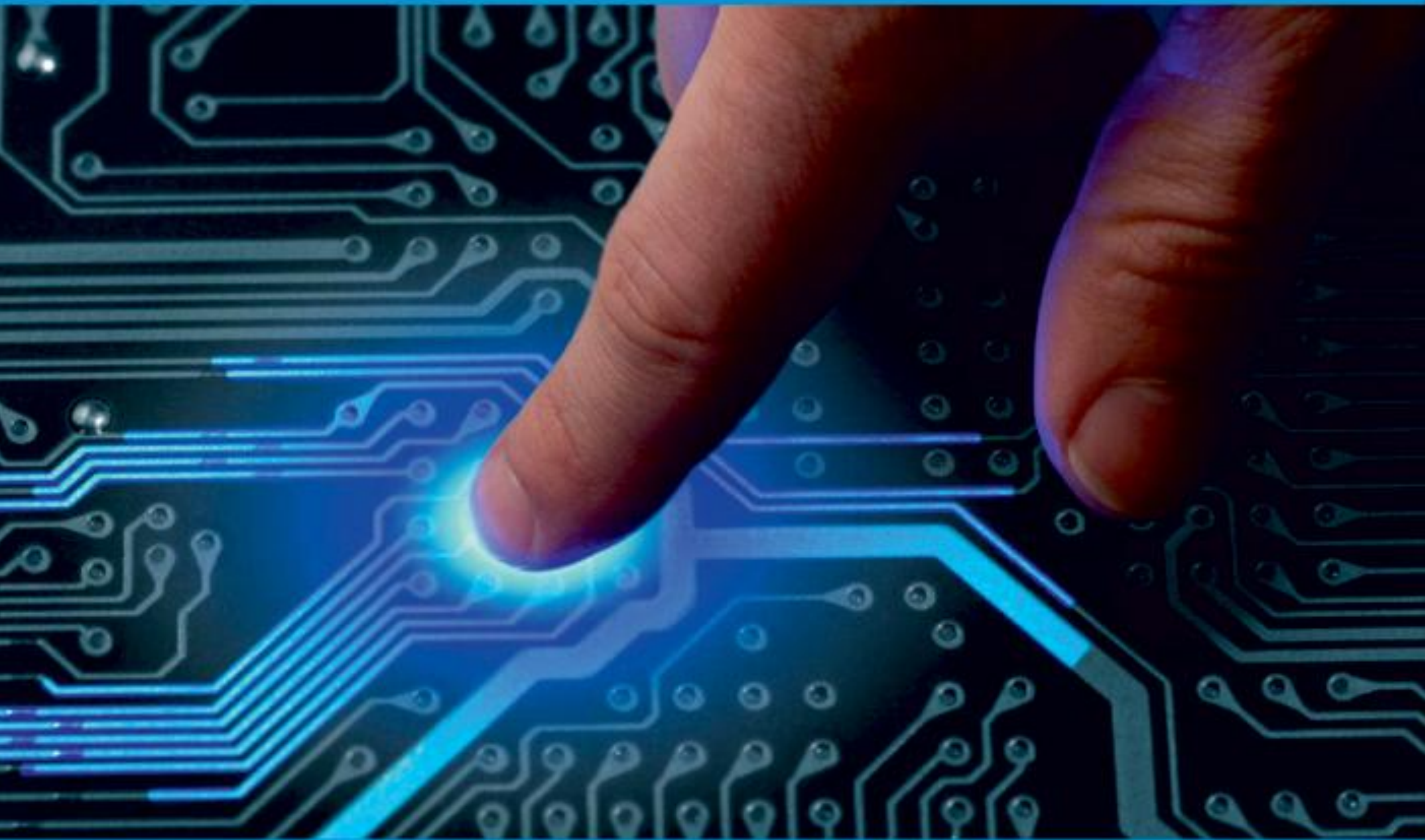

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Plant Leaf Disease Recognition Using Deep Learning Approach

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ABSTRACT: Smart farming system using necessary infrastructure is an innovative technology that helps improve the quality and quantity of agricultural production in the country. Plant leaf disease has long been one of the major threats to food security because it dramatically reduces the crop yield and compromises its quality. Accurate and precise diagnosis of diseases has been a significant challenge and he recent advances in computer vision made possible by deep learning has paved the way for camera-assisted disease diagnosis for plant leaf. It described the innovative solution that provides efficient disease detection and deep learning with Convolutional Neural Networks (CNNs) has achieved great success in the classification of various plant leaf diseases. A variety of neuron-wise and layer-wise visualization methods were applied using a CNN, trained with a publicly available plant disease given image dataset. So, it observed that neural networks can capture the colors and textures of lesions specific to respective diseases upon diagnosis, which resembles human decision-making.

KEYWORDS: Disease Detection, Deep Learning, Tensor Flow.

I. INTRODUCTION

DEEP LEARNING: Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain. It's on hype nowadays because earlier we did not have that much processing power and a lot of data. The flow of operations is explained in Figure1.A formal definition of deep learning is- neurons Deep learning is a particular kind of machine learning that achieves great power and flexibility by learning to represent the world as a nested hierarchy of concepts, with each concept defined in relation to simpler concepts, and more abstract representations computed in terms of less abstract ones. In human brain approximately 100 billion neurons all together this is a picture of an individual neuron and each neuron is connected through thousands of their neighbors. The question here is how it recreates these neurons in a computer. So, it creates an artificial structure called an artificial neural net where we have nodes or neurons. It has some neurons for input value and some for output value and in between, there may be lots of neurons interconnected in the hidden layer.

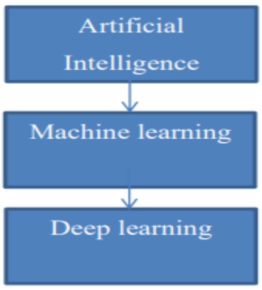

Figure1: Flow of Operation

It need to identify the actual problem in order to get the right solution and it should be understood in Figure 2,for the feasibility of the Deep Learning should also be checked (whether it should fit Deep Learning or not). It needs to identify the relevant data which should correspond to the actual problem and should be prepared accordingly. Choose the Deep Learning Algorithm appropriately. Algorithm should be used while training the dataset. Final testing should be done on the dataset.

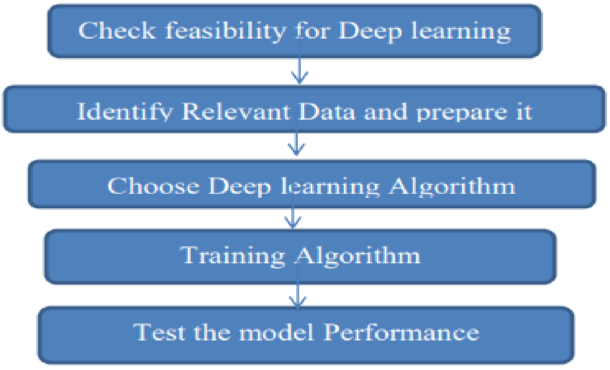

Figure 2: Workflow Model

DATASET PREPARATION:This dataset consists of about 87K RGB images of healthy and diseased crop leaves which is categorized into 38 different classes. The total dataset is divided into 80/20 ratio of training and validation set preserving the directory structure. A new directory containing 33 test images is created later for prediction purpose and the dataset link from kaggle which is available in below url. (**https://www.kaggle.com/vipoooool/new-plant-diseases-dataset**) Initial step for any image processing based project is acquiring proper dataset which is valid. Most of the time the standard dataset is preferred but in certain circumstances we do not get proper dataset .So in such conditions we can collect the images and can form our own dataset. Data available here is not labeled.

OBJECTIVES: Traditionally, identification of plant diseases has relied on human annotation by visual inspection and the agricultural production cost can be significantly increased if plant diseases are not detected and cured in their early stages using CNN model. So, to train a model by given image dataset with classify the disease type of leaves.

SCOPE OF THE PROJECT: Plant leaf diseases cause a major production and economic losses in the agricultural industry it includes detection of diseased leaf to measure the affected area by disease, to determine the affected leaf.

II. LITERATURE SURVEY

Title: (Differential) Co-Expression Analysis of Gene Expression: A Survey of Best Practices.**Author**: Hussain A. Chowdhury, Dhruba K. Bhattacharyya, Jugal K. Kalita

Year: 2019 It presented an overview of best practices in the analysis of (differential) co-expression, coexpression networks, differential networking, and differential connectivity that can be discovered in microarrays and RNA seq data, and shed some light on the analysis of scRNA-seq data as well. It has discussed co-expression analysis for RNA-seq along with a comparison of analysis of co-expression networks in microarrays vs. RNAseq. We discussed differential co-expression and differential networking along with a comparison of differential expression, differential networking and differential connectivity. It included many tools used for analyzing microarry, RNA-seq, and scRNA-seq data. Reverse engineering to reconstruct transcriptional network is also discussed. Preprocessing and co-expression analysis of scRNA-seq data along with useful tools and applications are also included. It discussed biological interpretation and functional analysis to extract biological information from a set of given genes that are identified through analysis. It presented some recommendations and guidelines for the analyst. Analysis of gene expression data is widely used in transcriptomic studies to understand functions of molecules inside a cell and interactions among molecules. Differential co-expression analysis studies diseases and phenotypic variations by finding modules of genes whose co-expression patterns vary across conditions. It review the best practices in gene expression data analysis in terms of analysis of (differential) co-expression, coexpression network, differential networking, and differential connectivity considering both microarray and RNA-seq data along with comparisons. It highlights hurdles in RNA-seq data analysis using methods developed for microarrays. It includes discussion of necessary tools for gene expression analysis. In addition, it shed light on scRNA-seq data analysis by including preprocessing and scRNA-seq in co-expression analysis along with useful tools specific to scRNA-seq. To get insights, biological interpretation and functional profiling is included. Finally, it provides guidelines for the analyst, along with research issues and challenges which should be addressed.

Title: A Smart Phone Image Processing Application for Plant Disease Diagnosis network with shuffle frog leap algorithm

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Author: Nikos Petrellis
Year: 2017
A smart phone application for plant disease recognition was presented. It is based on image processing that analyzes the color features of the spots in plant parts. It was evaluated on grape diseases with an accuracy that exceeds 90% using a small training set. Although professional agriculture engineers are responsible for the recognition of plant diseases, intelligent systems can be used for their diagnosis in early stages. The expert systems that have been proposed in the literature for this purpose are often based on facts described by the user or image processing of plant photos in visible, infrared, light etc. The recognition of a disease can often be based on symptoms like lesions or spots in various parts of a plant. The color, area and the number of these spots can determine to a great extent the disease that has mortified a plant. Higher cost molecular analyses and tests can follow if necessary. A Windows Phone application is described here capable of recognizing vineyard diseases through photos of the leaves with accuracy higher than 90%. This application can easily be extended for different plant diseases and different smart phone platforms.

Title: Plant Diseases Recognition for Smart Farming Using bModel-based Statistical Features. **Author**: Chit Su Hlaing, SaiMaungMaungZaw**Year**: 2017
It has shown the advantages of GP distribution model for SIFT descriptor and successfully applied in plant disease classification. Furthermore, it proposed feature achieves a good tradeoff between performance and classification accuracy. Although it proposed feature can successfully model the SIFT feature and applied in plant diseases recognition, it need to try to improve our proposed feature by considering and cooperation with other image processing methods. It research is to detect and classify the plant disease in agricultural domain, by implementing image processing techniques. It aims to propose an innovative set of statistical texture features for classification of plant diseases images of leaves. The input images are taken by various mobile cameras. The Scale-invariant feature transform (SIFT) features used as texture feature and it is invariant to scaling, rotation, noise and illumination. But the exact mathematical model of SIFT texture descriptor is too complex and take high computing time in training and classification. The model-based statistical features are calculated from SIFT descriptor to represent the features of an image in a small number of dimensions. It derive texture information probability density function called Generalized Pareto Distributions from SIFT texture feature. It proposed 18 feature is to reduce computational cost of mobile devices. In our experiment, 10-Fold cross validation with SVM classifiers are applied to show that our experiment has no data bias and exclude theoretically derived values.

III. SYSTEM ANALYSIS

A.EXISTING SYSTEM

Plants are considered to be important as they are the source of energy supply to mankind. Plant diseases can affect the leaf any time between sowing and harvesting which leads to huge loss on the production of crop and economical value of market. Therefore, leaf disease detection plays a vital role in agricultural field. However, it requires huge manpower, more processing time and extensive knowledge about plant diseases. Hence, machine learning is applied to detect diseases in plant leaves as it analyzes the data from different aspects, and classifies it into one of the predefined set of classes. The morphological features and properties like color, intensity and dimensions of the plant leaves are taken into consideration for classification Data collection (Splitting Training set & Test) set) Building classification Model Pre Processing (Sequential) Prediction (plant Leaf Disease Prediction) and the various types of plant diseases and different classification techniques in machine learning that are used for identifying diseases in different plant leaves.

Drawback:
It described machine learning algorithm. So, compare to deep learning not better accurate results came and it has not focused on identifying the mulberry plant leaf diseases with CNN as classifier.
It has not focused on increasing the recognition rate and classification accuracy of severity of leaf diseases.

B.PROPOSED SYSTEM

We planned to design deep learning technique so that a person with lesser expertise in software should also be able to use it easily. It proposed system to predicting leaf diseases. It explains about the experimental analysis of our methodology. Samples of 38 images are collected that comprised of different plant diseases like Apple, Tomato, Grape and Healthy Leaves. Different number of images is collected for each disease that was classified into database images and input images. The primary attributes of the image are relied upon the shape and texture oriented features. The sample screenshots displays the plant leaf disease detection using color based segmentation model.

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Advantages:
Increasing throughput & reducing subjectiveness arising from human experts in detecting the plant diseases.
It is essential to detect a particular disease. In our country many farmers are not so educated to get correct information about all diseases.

IV. ARCHITECTURE

Modules
A.Import the given image from dataset (module-1).
B.To train the module by given image dataset (module-2).
C.Working process of Layers in CNN model (module-3).
D.Plant leaf disease identification process (module-4).

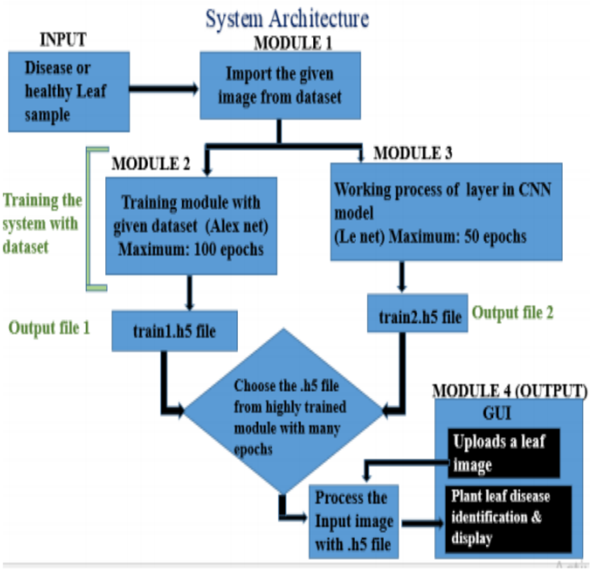

Figure 3: Plant leaf disease leaf detection using deep learning approach architecture.

A. Module 1-Manual CNN

- We have to import our data set using keras preprocessing image data generator function also we create size, rescale, range, zoom range, horizontal flip.
- Then we import our image dataset from folder through the data generator function. Here we set train, test, and validation also we set target size, batchsize and class-mode from this function we have to train.
- The train dataset is used to train the model (CNN) so that it can identify the test image and the disease it has CNN has different layers that are Dense, Dropout, Activation, Flatten, Convolution2D, and MaxPooling2D**.**

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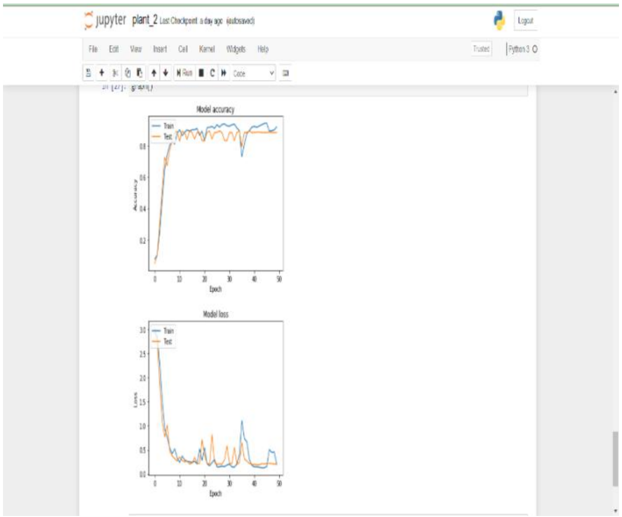
Apple:(Module1)

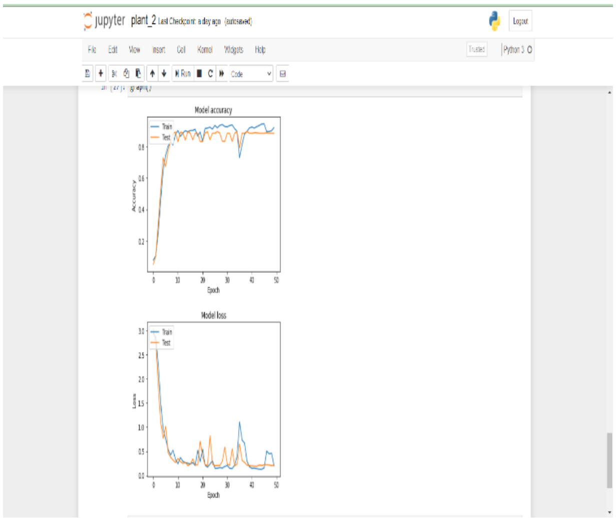
```
Trainned data for Apple___healthy:

 ====== Images in:  dataset/train/Apple___healthy
images_count:   22
min_width:      256
max_width:      256
min_height:     256
max_height:     256
```

B.Module 1-Output Screenshot



- To train our dataset using classifier and fit generator function also we make training steps per epoch's then total number of epochs, validation data and validation steps using this data we can train our dataset.
- Gray information within a leaf can also be treating as important features.Leaf features such as shape, vein and damaged part of leaf appear generally darker than its surrounding leaf regions.
- The input images are first enhanced by contrast-stretching and gray-scale morphological routines to improve the quality of local dark patches and thereby make detection easier. The extraction of dark patches is achieved by low-level gray-scale threshold.

Module 2-Output Screenshot



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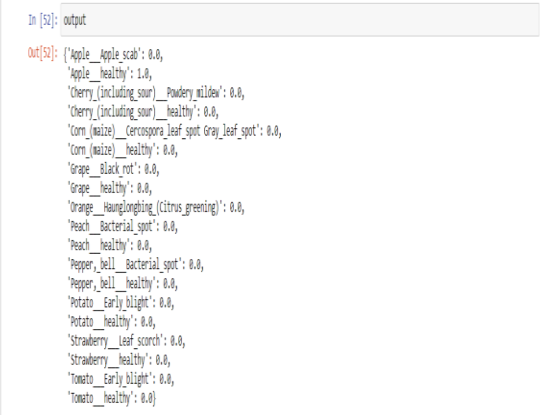
C.Module 3-Le Net

- A Convolutional Neural Network is a Deep Learning algorithm which can take in an input image, assign importance to various objects in the image and be able to differentiate one from the other.
- Their network consists of four layers with 1,024 input units, 256 units in the first hidden layer, eight units in the second hidden layer, and two output units.
- The layers which are present in the CNN module are: Input Layer, Convo Layer, Pooling Layer, Fully Connected Layer, Softmax / LogisticLayer and Output Layer.

Module 3-Output Screenshot



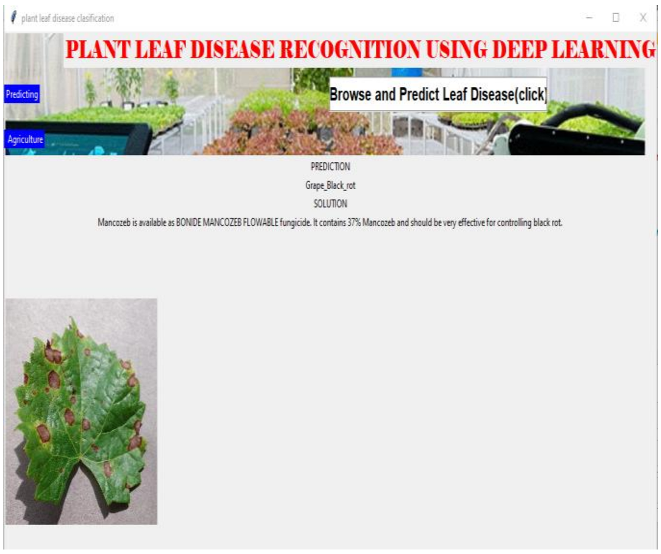
```
In [52]: output

Out[52]: {'Apple__Apple_scab': 0.0,
 'Apple__healthy': 1.0,
 'Cherry_(including_sour)__Powdery_mildew': 0.0,
 'Cherry_(including_sour)__healthy': 0.0,
 'Corn_(maize)__Cercospora_leaf_spot Gray_leaf_spot': 0.0,
 'Corn_(maize)__healthy': 0.0,
 'Grape__Black_rot': 0.0,
 'Grape__healthy': 0.0,
 'Orange__Haunglongbing_(Citrus_greening)': 0.0,
 'Peach__Bacterial_spot': 0.0,
 'Peach__healthy': 0.0,
 'Pepper,_bell__Bacterial_spot': 0.0,
 'Pepper,_bell__healthy': 0.0,
 'Potato__Early_blight': 0.0,
 'Potato__healthy': 0.0,
 'Strawberry__Leaf_scorch': 0.0,
 'Strawberry__healthy': 0.0,
 'Tomato__Early_blight': 0.0,
 'Tomato__healthy': 0.0}
```

D. Module 4 (GUI)

- We give input image using keras preprocessing package. That input image is converted into array value using pillow and image to array function package.
- We have already classified disease of leaf in our dataset. It classifies what are the plant disease leaves. Then we have to predict our leaf diseases using predict function.
- The disease leaf parts are cropped and extracted and then used as the input into the inception layer of the CNN. The Training phase involves the feature extraction and classification using convolution neural network.

Module 4 -Output Screenshot 1



Module 4 -Output Screenshot 2

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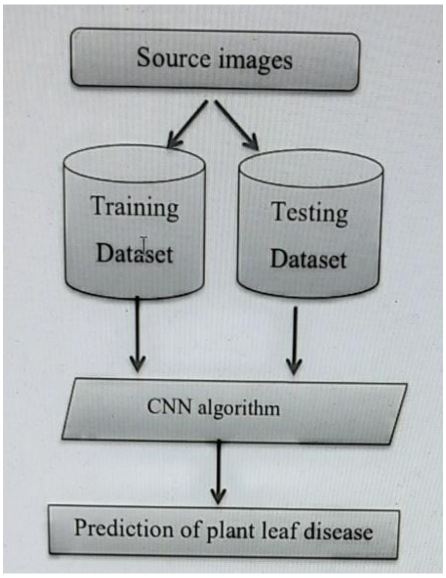
V. IMPLEMENTATION TECHNIQUES

The initial step is to gather the dataset. Followed by which is Splitting of dataset.The data is split into training data and test data. The training set contains a known output and the model learns on this data in order to be generalized to other data later on. It has the test dataset (or subset) in order to test our models and it will do this using Tensor flow library in Python using the Keras method.Deep learning needs data gathering have lot of past image data's. Training and testing this model working and predicting correctly.In order to construct a detection model the flow happens through data gathering and selecting a CNN algorithm then training & testing a model and finally prediction of sample is done.Image details are given to a preprocessing algorithm is used to train and test dataset and using CNN algorithm prediction is carried out.



VI. CONCLUSION

It focused how image from given dataset (trained dataset) in field and past data set used predict the pattern of plant diseases using CNN model. This brings some of the following insights about plant leaf disease prediction. As maximum types of plant leaves will be covered under this system, farmer may get to know about the leaf which may never have been cultivated and lists out all possible plant leaves, it helps the farmer in decision making of which crop to cultivate. Also, this system takes into consideration the past production of data which will help the farmer get insight into the demand and the cost of various plants in market.

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VII. FUTURE SCOPE

Agricultural department wants to automate the detecting the yield crops from eligibility process (real time). To automate this process by showing the prediction result in web application or desktop application. To optimize the work to implement in Artificial Intelligence environment.

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