ISSN- 2394-5125 VOL 10, ISSUE 02, 2023

AUTOMATIC DETECTION AND CLASSIFICATION OF PLANT LEAF DISEASES USING IMAGE ANALYTICS

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Abstract:
Country like India is considered as agricultural country. It is very natural that economy of country also depends majorly on agriculture. One of the reasons for identifying plant diseases are that they are widespread in the fields. Without proper care in this particular area, serious plant effects can be observed and the quality, quantity, or productivity of a particular product can be compromised. CNN algorithms for image analysis are used to detect the effects of disease on the leaves. Automated disease symptom detection helps upgrade agricultural products. Reduce the cost of pesticides, pesticides and other commodities and improve agricultural productivity.

Keywords: K- mean clustering, RGB, HIS, YCbCr, convolutional neural network (CNN), artificial neural network (ANN).

1. INTRODUCTION:

India is a horticultural country where nearly 70% of population depending on agribusiness. Farmers has decent varieties to select the right diverse crops and to find the suitable crop pesticides. Plant disease leadsto a significant decline in both the quality and quantity of rural produce. Plant welfare as well as disease control has an important role in increasing the yield of cultivation. It requires a huge amount of work and, in addition, lots of processing time.
Image Processing strategies can be used to identify plant diseases. Signs of contamination are common on leaves, stems and natural products. Disease identification crop sheets are known to show signs of illness.

2.LITERATURE REVIEW:

The nearest neighbor method gives the impression that a given test model is as algorithmically rational as the simplest of all class expectations. Determining the ideal parameters in an SVM is difficult when thepreparation of information is not directlydistinguishable, which is generally one of its drawbacks (Ghaiwat, 2016).
Sanjay B (2016) clarifies that there are basically four stages in a marked treatment plan. At this stage, the RGB image input to HIS value is created first. For example, HSI is used to prove

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recognizable tones. Subsequent runs hide the green pixel and replace it with an estimate of the limit. Second, green pixel separation and masking is achieved using the pre-registered cut off level of the available fragment that is first ejected at this stage while the article is being split. In addition, the split ends at the last or fourth significant step forward.

Mrunalini (2011) states that a preparation-based machine-compiled recognition framework proves to be of great value in the Indian economy because it saves energy, efforts, time and money.
To extract a list of features, use the methods described there, called the shading co-event technique. The neural network is used to consistently distinguish leaf infections. The proposed arrangement can incredibly enhance accurate leaf detection evidence, and due to steam and root infections, it generally becomes an entrancing strategy to put less energy into the calculation.

There are several phases in which four of them are significantly important in the detection process. **(Arivazhagan, 2013).** Disease Detection Strategy: Initially, a shading change structure is used for the Info- RGB image, at which point a special edge estimation is used. Green pixels are obfuscated and removed, combined by a splitting process to give a glimpse of the surface of the information RGB object useful segment.
Finally, use a classifier to identify the disease using extracted features. The proposed computational power has been demonstrated by tests that generate a datastore of about 500 plant leaves.
Kulkarni (2012) presents an early and accurate plant disease detection strategy using the artificial neural network (ANN) and various image preparation strategies. ANN-dependent classifier ranks different plant infections and uses a combination of surfaces, shades, and properties to categorize between these diseases.
To demonstrate disease detection in plant leaf, researchers have adopted different sets of strategies such as K- mean clustering, surface area, and shading analysis (**Sabha,2012**). It mainly uses the surface and shading attributes that appear in traditionally affected zones to recognize and distinguish explicit cultivation.

Bayes Classifiers and key component classifiers are used for K-mean clustering (Sabha, 2012). According to the histogram, adjustments are applied to detect plant illnesses. Plant infection appears on the leaves, so adjustment histograms are created based on how the edges are located and the qualityof the shading (**Smitha, 2013**).

The layer separation strategy is used for planning these examples of finding layers for RGB objects in red, green, and blue layers, and for preparatory steps that include edge localization methods to distinguish the edges of layers. Spatial gray dependent matrices are used to build matching structures for the surface investigations.
Sanjay B. (2011) shows the boundaries of an image and the basic edge detection strategy. Such an approach is used separately for diseases identification in the leaves. In the final stage, the

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order of infection is carried out by determining the remaining leaf area and the damaged zone. After the study is completed, this method is quick and accurate for measuring the degree of affected leaf area in plant is estimated using border separation. The author uses the imaging method to distinguish the calculation of disease region divisions in the yield sheet (**Piyush, 2012**).

This publication implements a technique for identifying lesions by distinguishing the effects of shading spaces HSI, YCbCr and CIELAB. In the final step, you can estimate the edges and identify disease by applying Otsu's strategy for image segmentation. As a result of the test, the camera strip and veins show excitement from scratch. The CIELAB shading model is used for eliminating this commotion (**Arti N., 2013**). Existing techniques aim to increase throughput and reduce subjectivity by simply eye perception to detect and identify plant diseases.

Outline of a study of plant leaf diseases using image processing techniques investigated various plant species used to detect plant diseases and high density. Introduced the computerized image processing technology.

The main methods for detecting plant infections are: feedforward forward BPNN, Wheat Disease Diagnostic System reliant on Android Phones by **Y.Q. Xia, Y. Li, C.Li (2015).**

In **2015, Li, Xia and Li**, had recommended an application model for Purified Wheat Infection analysis.

Customers use the app gadget in this procedure to capture an image of a wheat infection and send the image to the system's test database. After processing the diseased image, the server does object splitting by transforming the image from the RGB to the HSI values. Disease shading and surface attributes are controlled using a shading window and dim plain co-event grid. Recommended highlights are contributions to the confirmation vectors support engine, after that the notable proof has been provided to the customer (**Kiran, 2014**).

A similar study by **Padmavathi and Thangadurai (2016)** showed the relative after effects of RGB and grayscale images in leaf disease detection in rice field. Shading is an important factor in quantifying the severity of disease when determining infected leaves. We used grayscale and RGB images, emphasized the image using a medium channel, and cropped the segments used to confirm the severity of the disease. Models for the discriminating detection of plant diseases regarding the placement of leaf objects were created using a deep convolution system. Thirteen types of diseases are known from healthy leaves helpful to recognize infected leaves from the field.

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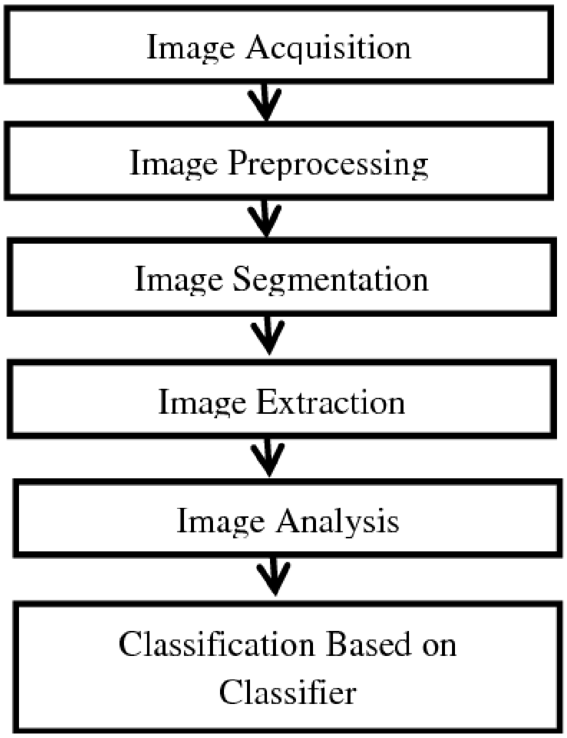

Fig. 1: PROPOSED METHODOLOGY

3. METHODOLOGY:

Using the K-means clustering algorithm, leaf disease can be predicted. This paper shows various means of image acquisition, pre-processing methods, feature extraction, and segmentation. The steps involved are as follows:

Image Acquisition:

The camera records pictures of the plant leaves. Image acquisition is nothing but capturing and collecting images through camera. The captured image is a RGB (red, green, blue) image initially. The captured image needs to be converted gray scale to reduce the number color band information.

Image Pre-processing:

The images were captured from fields directly, it may contain impurities like noise, blurriness, unwanted areas from background etc., The point of information pre- processing is to avoid image turbulence and change pixel values. This will expand the exhibition of picture.

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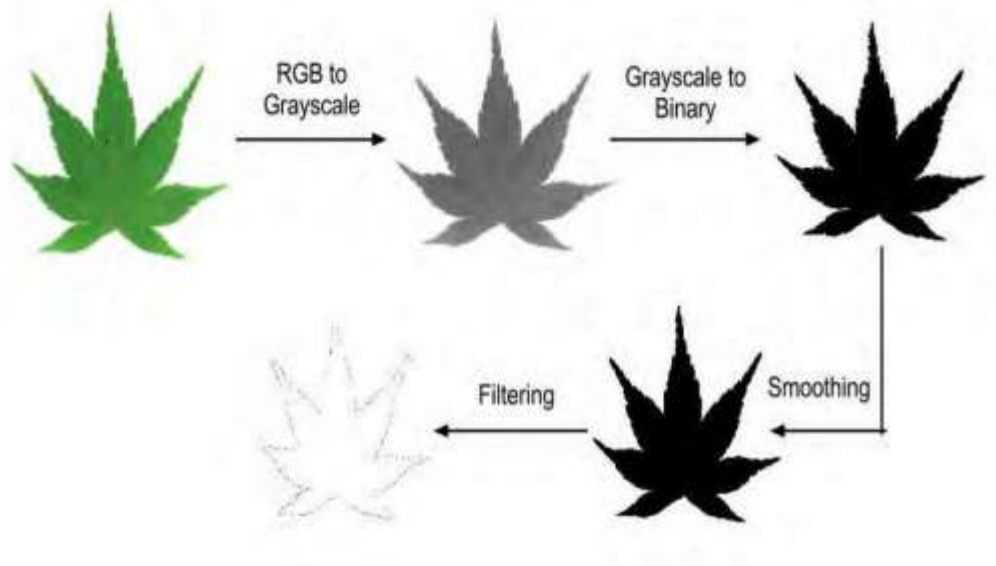

Fig. 2: Image processing step

Image segmentation:

At the third step in the proposed method, Image segmentation is carried out. The subdivided elements were grouped into individual category using the Otsu classifier and K-mean algorithm can be used for image segmentation. Based on a collected feature, pixels are divided into classes. Classification is carried out by reducing the sum of squares of distances between the items and the clusters.

Feature Extraction:

A particular method of dimensionality reduction known as "feature extraction" depicts an intriguing portion of an object as a small feature vector. This technique is useful when the dimensions of the image are large and you need to reduce the representation of features to easily perform tasks such as collating and retrieving objects. The gray- level co-occurrence matrix (GLCM) is used for this step.

Convolutional Neural Network:

CNNs and RNNs are applied for totally different objectives, and the neural network designs themselves differ to suit those various situations.

RNNs are predictive and use activation functions from past data values with in series to generate the next output in a series, whereas CNNs use filters within convolutional layers to convert data.

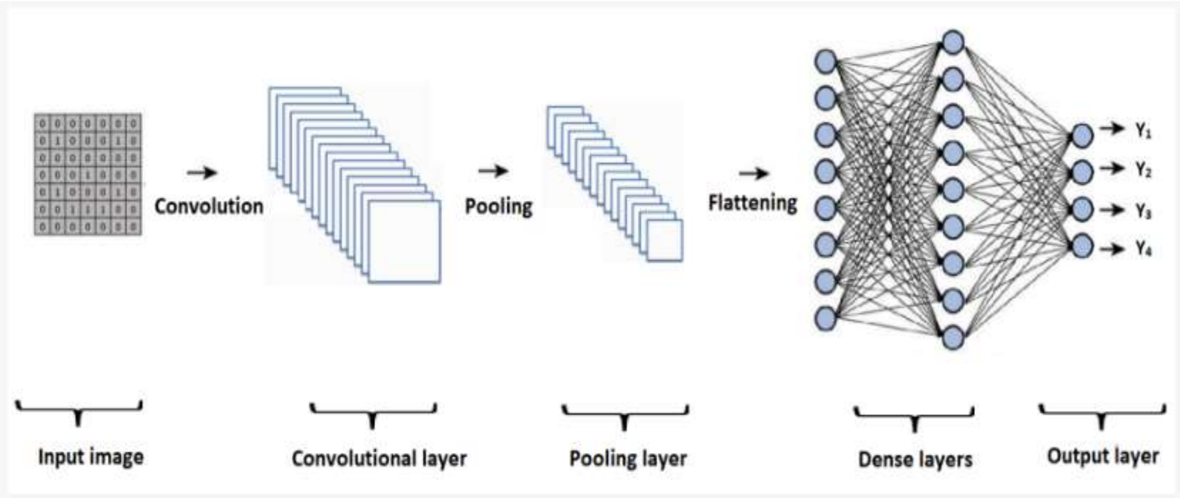

Fig. 3: CNN Architecture Representation

As we can see in figure CNN has three layers: convolution, Pooling and Flattening.

Convolutional Layer-

Using a kernel or filter image features are extracted at convolution layer. Kernel height & width are different the image on which convolution has to be done. A convolution matrix or convolution mask are other names for it.

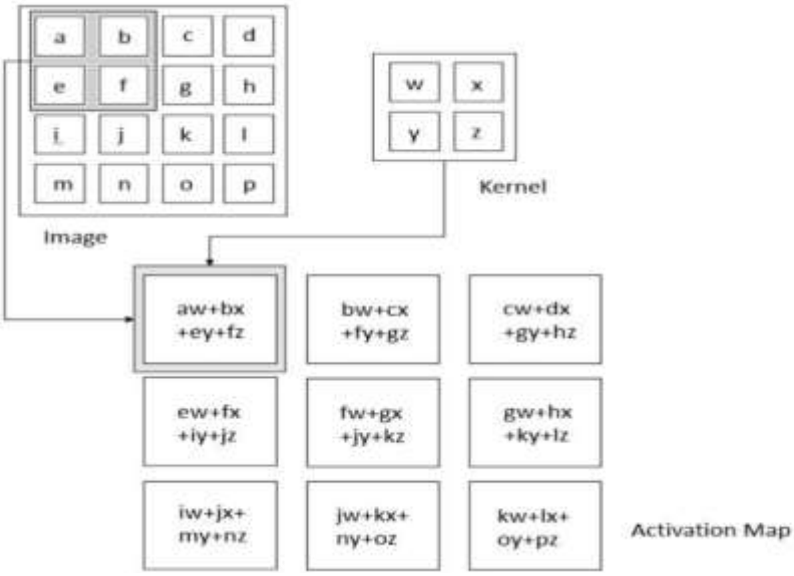

Fig. 4: Convolution Layer

The convolution operation is performed by sliding a filter (kernel) over the input feature map, computing the dot product of the filter with each local region of the input, and adding a bias term. The output feature map is generated by applying an activation function to the sum of

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these values. The following formula represents this operation:

output (i, j, k) = activation_function(sum_{a=0}^{f-1} sum_{b=0}^{f-1} sum_{c=0}^{C-1} input(i+a,j+b,c) * kernel(a,b,c,k) + bias(k))

Here, **i** and **j** are the spatial coordinates of the output feature map, **k** is the index of the output channel, **f** is the size of the filter,
c is the number of input channels, **input(i+a,j+b,c)** is the value of the input feature map at position **(i+a,j+b,c), kernel(a,b,c,k)** is the value of the filter at position **(a,b,c,k), bias(k)** is the bias term for the output channel **k**, and **activation_function** is a nonlinear activation function such as ReLU or sigmoid.

Pooling Layer-

This layer helps to reduce the total data generated at convolution layer which helps in storing the data efficiently.

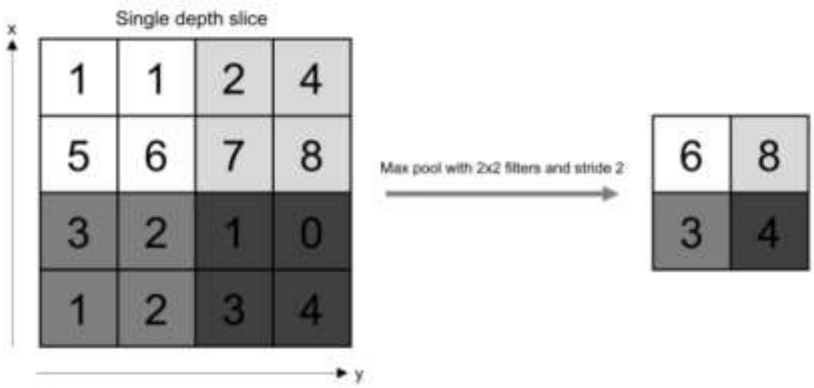

Fig. 5: Pooling Layer

Flattening Layer-
This layer converts all the 2D arrays of pooled features into one linear vector. And the flattened array is fed to fully connected layer as an input to classify the image.

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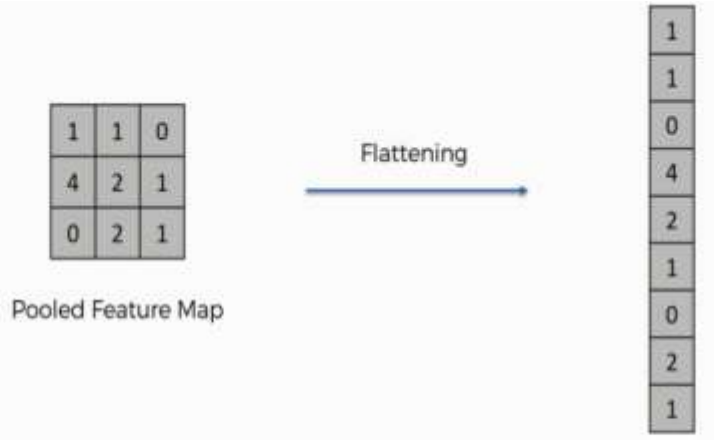

Fig. 6: Flattening Layer

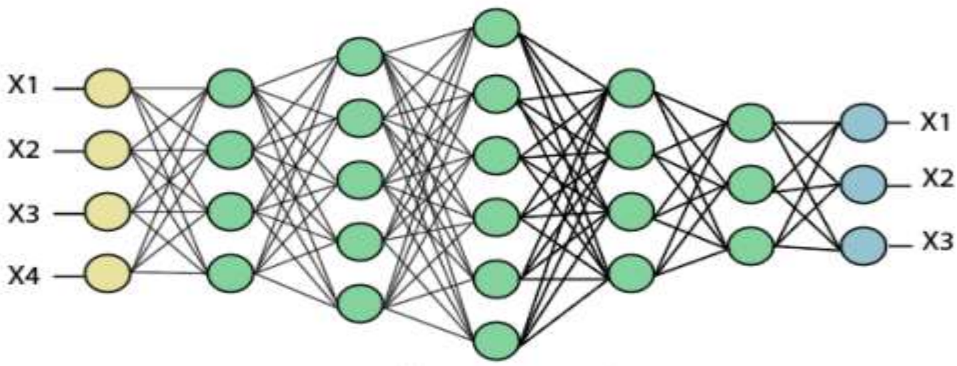

Fig. 7: Fully Connected Layer

The fully connected layer takes the flattened output of the last pooling layer and performs a matrix multiplication with a weight matrix, followed by an optional bias term and an activation function. The output of the final fully connected layer represents the predicted class or label of the input image.

The following formula represents this operation:

output = activation_function(input * weights + bias)

Here, input is a flattened vector of the output feature map, weights is a weight matrix, bias is a bias vector, and activation_function is a nonlinear activation function such as ReLU or softmax.

4. Technology used:

Python programming language is easy to learn and understand. Python is a language that supports both modules and clusters. There are standard libraries also available in Python

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programming which are very suitable for the digital image classification work. These standard libraries save computation time and provides lot of ease in computation.

5. RESULT:

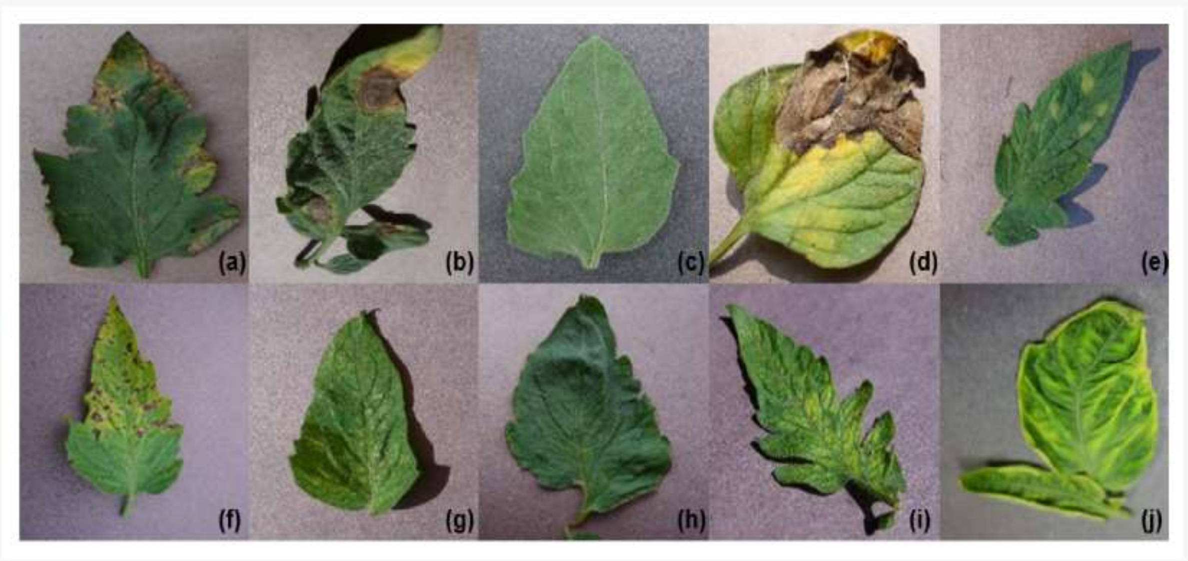

Fig. 8: Sample images

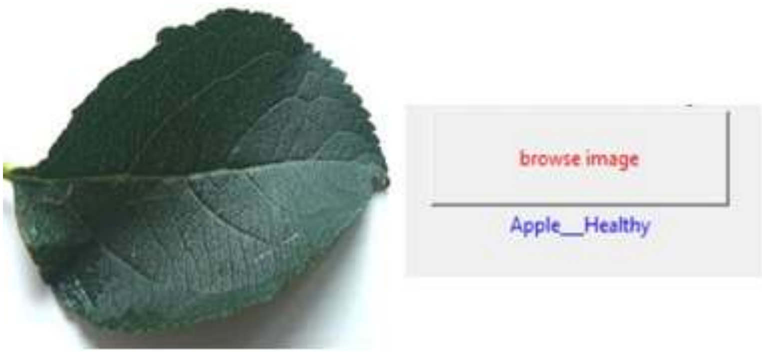

Fig 9: Input image of Apple leaf, output shows healthy leaf

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Fig. 10: Input image of Cercospora leaf, output shows affected leaf

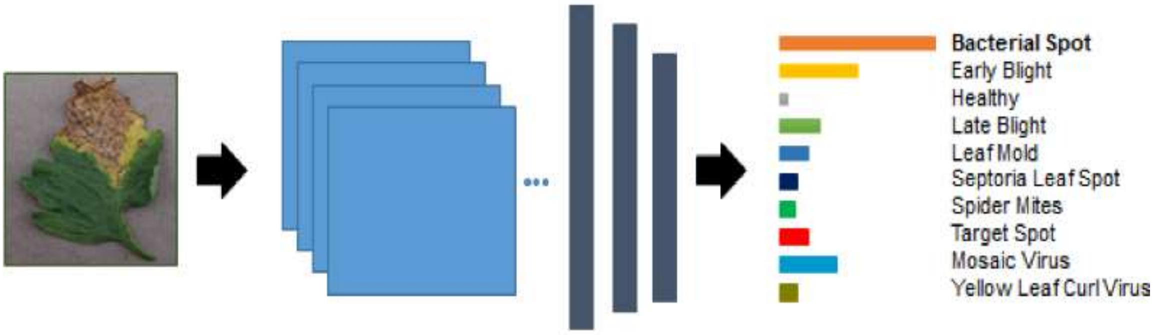

Fig. 11: Learning and Classification phase

6.Result Analysis & Conclusion:

Accurate identification and classification of plant diseases is very important for effective crop production, which can be achieved by image-processing. The paper focused of various strategies for segmenting the diseased plant part and strategies for extracting the characteristics of infected leaves and classifying diseases.

A convolutional neural network (CNN) consisting of the various layers used for prediction of output. It outlines the complete procedure, from the dataset used for training and testing, to image pre-processing, to deep CNN training methods and optimizations. The image processing methods used allow us to correctly identify and categorize between various plant diseases. Epoch value 26 is used in this work.

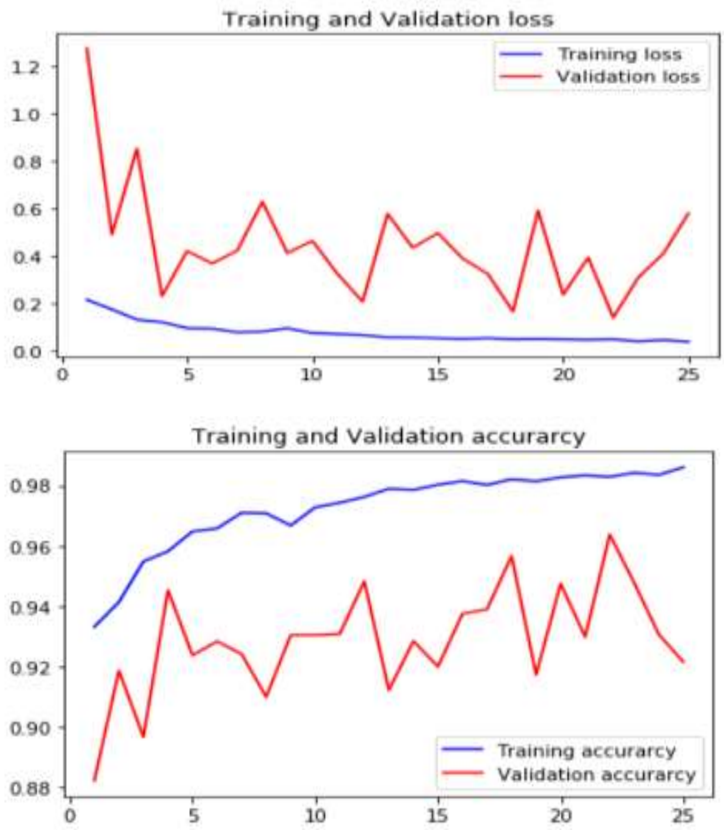

Fig. 12: Training and Validation accuracy result (Performance)

7. Future work:

Overall, this task was carried out from scratch and has a decent level of accuracy. In order to improve accuracy, further work will involve increasing the number of images in the defined database and modifying the architecture as per the dataset. Also work can be done for real time disease detection. Also, research can be done in this field by employing large datasets with different plant leaf disease which can show variation in result in CNN approaches.

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