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Classification and Identification of Leaf Diseases using Deep Learning

Keerthana M[1], Raksha K R[2], Thanuja V[3], Sridhar R[4]

[1,2,3]*Students, Department of Information Science & Engineering, Global Academy of Technology, Bengaluru, Karnataka, India*
[4]*Asst. Professor, Department of Information Science & Engineering, Global Academy of Technology, Bengaluru, Karnataka, India*

Abstract - *Agriculture plays a major role in India, where 70% of the population depends on the economic growth of agriculture. Image processing is an area where research and advancement are taking a progress in agriculture field. Mechanisms like Deep Learning and Image processing tools are used to detect the diseases of the leaf. In the Image processing, there are basic steps performed such as acquisition, segmentation, augmentation and feature extraction. The most common used techniques are SVM, CNN and ANN. We use CNN algorithm for classification, which provides better accuracy for large datasets comparatively. The accuracy obtained by using CNN model is 96%.*

Key Words: Python Programming, Image Processing, Deep Learning, CNN.

1. INTRODUCTION

India is a fast developing country and agriculture is the backbone for the countries development in the early stages. On top of that the awareness and necessity of the cultivation need to be instilled in the minds of younger generation. Nowadays technology plays vital role in all the fields, but till today they are using the old methodologies in agriculture. Identifying the condition of plant plays an important role for successful cultivation. Some diseases are visible to eyes and can be easily detected and procured. Some are so sophisticated and needs powerful microscopes and specific electromagnetic spectrum. In plants, there are variety of disease like Bacterial Blight, Yellow Spot, early and fungal diseases etc. Image processing is the technique which can be used to analyze the plant images in order to detect the disease by determining affected area. The various steps involved in plant disease detection are Image Pre-processing, Image Segmentation, Feature Extraction and Classification. Image pre-processing is the task of importing image data that suppress unwanted noise and enhance the quality of the image. Image segmentation is the method where relevant portion of the image is extracted from the complete image. This segmentation process is based on various features like color, boundary etc. Feature Extraction is a process where numbers of features are reduced to set of features which can still describe the original image accurately. Classification is a technique of classifying similar data together into one class. Some of the classification algorithm used to detect and classify plant diseases is CNN, ANN, RNN etc.

A Neural network is a set of algorithms to recognize relationships in a set of data through a process that mimics the way the human brain operates. Neural networks can be adapted to changing input so the network generates the best possible result without needing to redesign the output criteria. The training performs batch-splitting by dividing a given batch. Testing represents a class of software that learns from a given set of data and then makes prediction on the new datasets based on its learning. In Deep Learning, we basically create a model to predict on the test data. So, we use the training data to fit model and testing data to test it. The models generated is to predict the results unknown which is named as the test set.

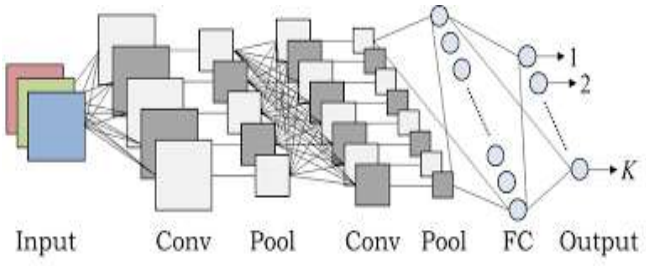


Fig. 1. CNN Flow

2. OBJECTIVES

To detect unhealthy region of plant leaves. Classification of plant leaf diseases using various features .Coding is used to analyze the leaf infection. The main aim is to obtain an automate detection of the plant diseases. On one hand visual analysis is least expensive and simple method, it is not as efficient and reliable as others .So, we detect the plant diseases using image processing and deep learning with greater efficiency.

3. RELATED WORK

Plant Disease Detecting system aims to determine whether plant is infected by disease or not and determine the disease with the help of modern technology. The author helps farmers to detect disease and to respond by taking necessary steps. The farmers are using naked eye observation and their knowledge on plant for the detection of plant disease which

is time consuming, difficult and accuracy is not good. Automatic detection of the disease by observing the symptoms on the plant leaves through devices is easier and cheaper. In plants, there are variety of diseases like Bacterial Blight, yellow spot, early and late scorch, Aphids etc. Image processing is the technique which can be used to analyze plant images in order to detect the diseases by determining the affected area .The various steps involved in plant disease detection are: Image Preprocessing, Image Segmentation, Feature Extraction and Classification in [1]. Identification of plant disease is difficult in agriculture field. So image processing can be used for identification of leaf disease in MATLAB. Identification of disease follows the steps like loading the image, contrast enhancement, converting RGB to HSI, extracting of features and SVM in [2]. Digital image processing has three basic steps. Image processing contains segmentation, color extraction, diseases specific data extraction and filtration of images. Image analysis deals with the classification of leaf diseases. Plant leaf can be classified based on their features with the help of various classification techniques such as SVM, PCA and neural network. These classifications can be defined various plant properties of the plant such as color, intensity, dimensions in [3]. The main steps for disease detection are Image Acquisition, Image Preprocessing, Image Segmentation, Feature Extraction and Statistical Analysis. This proposed work is in first image filtering using median filter and convert the RGB image to CIELAB color component. In second step image segmented using the k-medoid technique, in third step masking green-pixels & Remove of masked green pixels. In fourth step calculate the Texture features statistics, in last this features are passed to the neural network. The Neural Network classification performs well and successful detection and classification of the disease in [4]. Image processing is a diverging area where researches and advancements are taking a geometrical progress in the agricultural field. Identification of plant diseases can not only maximize the yield production but can also be supportive for varied agricultural practices in [5]. Agricultural productivity is economy dependent. Which is the one of the reasons that disease detection in plants plays an important role in agriculture field, diseases in plants are quite natural. If care is not taken properly in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected in [6]. Data mining techniques have been adopted in the prediction of plant diseases. Rice is one of the major crops cultivated in India. Nowadays, technology plays a very important role in prediction of plant disease. The management of perennial leaf requires close monitoring system especially for the diseases that affects production and post- harvest life in [7]. The studies of plant disease refers to visual observation of patterns in particular with plants. Nowadays crops face many diseases. ssssInsecticides do not provide efficient results because insecticides may be toxic to some kind of birds. It also damages food chains. A common practice for plant scientists is to estimate the damage of plant either in leaf or stem because of disease by an eye on percentage of affected area. It results in low throughput. This paper provides various methods used to study plant diseases using image processing in [8]. Images are captured by digital camera mobile and processed using image growing, then the part of the leaf spot has been used for the classification purpose of the train and test. The technique evolved into the system in both image processing techniques and advance computing techniques in [9]. Convolutional neural networks (CNNs) has achieved great success in the classification of plant diseases. A number of studies have improved the process of inference, leaving it as an untouchable black box. Extraction of the learned feature through CNN as an interpretable form and also ensures the reliability, validation of the model authenticity and the training dataset by human intervention. In this paper, a variety of neuron and layer-wise visualization methods were applied using a CNN, trained with available plant disease image dataset. A neural network can capture the colors and textures of specific to respective diseases upon diagnosis, which resembles human decision-making. Several visual methods were used, others had to be optimized to target a specific layer that fully captures the features to generate consequential outputs. The results provide an effectiveness for the CNN black box users in the field of biological plants to better understand the diagnosis process and lead to further efficient use of deep learning for plant disease diagnosis in [10].

4. DEVELOPED METHODOLOGY

A. Image Processing

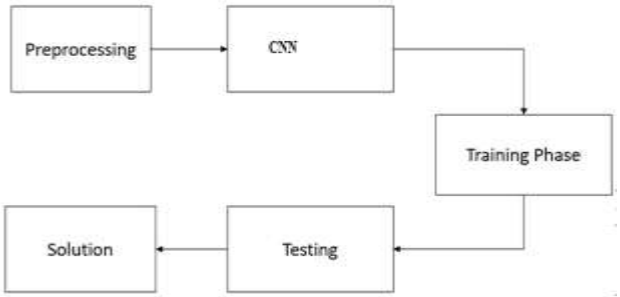
Image processing is a process of performing some operations on an image, in order to get an enhanced image or to extract some useful information from it. Acquisition, Segmentation, Augmentation, Feature Extraction. Image acquisition is the first main step of digital image processing. Image acquisition is simple process when given an image that is already in digital form. Generally, the image acquisition stage includes preprocessing, such as scaling etc. Image Segmentation procedures partition an image into its constituent parts or objects. Generally, autonomous segmentation is the most difficult tasks in digital image processing. A rugged segmentation process that brings a long way toward successful solution of imaging problems that require objects to be identified individually. Image Augmentation is a technique that is used to artificially expand the dataset, parameters that are generally used to increase the data sample count are zoom, shear, rotation, pre-processing function and so on. Image feature extraction is one of the most important segments in this project. Feature selection works by selecting the best features based on unilabiate statistical tests. The features are carefully selected based on their unique differences between the different types of leaves.

B. CNN Model

CNN is a widely-used image recognition model that has been shown to attain greater than 78.1% accuracy on the ImageNet dataset. The model is the conclusion of many ideas developed by many researchers over the years. An 256x256x3 input representing a visual field of 256 pixels and 3 color (RGB) channels. Five convolution layers, with a few interspersed max-pooling operations. Successive stacks of "CNN Models". A softmax output layer at the end at an intermediate output layer just after the mixed layer. Steps involved in CNN are Convolution layer in CNN is performed on an input image using a filter. Relu (Rectified Linear Unit) which simply converts all of the negative values to 0 and keeps the positive values the same. Pooling layer is used to reduce the spatial size of the Convolved Feature. They are of two types such as Max Pooling and Average Pooling. Fully Connected layers in a neural networks is a layer where all the inputs from one layer are connected to every activation unit of the next layer. These networks are commonly trained under a log loss (or cross-entropy) system, giving a non-linear variant of multinomial logistic regression.

C. Classification and Identification

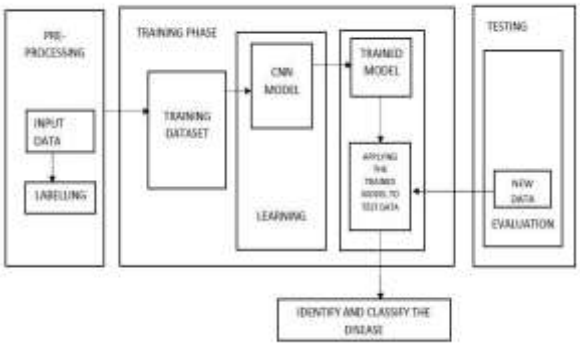
Once the model is trained with the available dataset, it is then tested. Input the Image (filename.jpg) for the prediction. Predict function is called on the loaded pickle module to classify the image as healthy or not.



D. System Architecture

The phases of the proposed work are:

- Collection of raw data.
- Training data using CNN model.
- Testing data.
- Determine accuracy.



E. Low Level Design

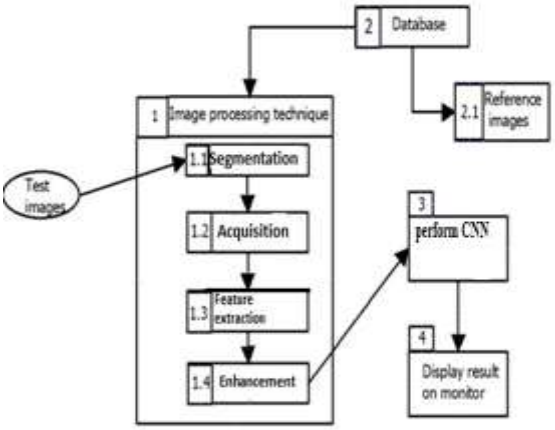


Fig .2. Data Flow

Steps carried out:

1. Image Pre-processing
2. Loading Images.
3. Building CNN model.
4. Training the model.
5. Classification of the image.

F.Tools, Libraries and Datasets

The application is built upon various libraries using various tools and datasets. All of them have a crucial part to play in building the complete application with the optional interfaces.

Some of the libraries, tools and datasets with its uses are:

1) Anaconda: Anaconda is a user interface (UI) that launch variety of applications that can easily manage

anaconda packages, and channels without using commands.

2) Jupyter Notebook is an open-source application that create and share documents that contain live code, equations, visualizations and narrative text.

3) TensorFlow is an end-to-end open source platform for machine learning.

4) Keras: An open-source neural-network library which allows users to productize deep models. It is used to predict the emotion of patients in the application.

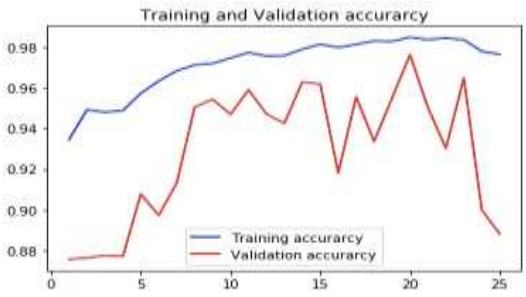
5) OpenCV: It is a library of Python bindings designed to solve problems related to Computer Vision. In the application, this library is used for video and image analysis like facial detection

6) NumPy: It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

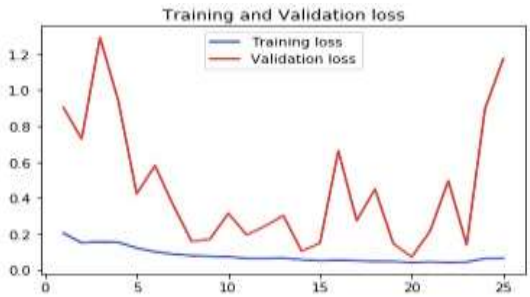
7) Python: It is an interpreter, high-level, general-purpose programming language. It is dynamically typed and garbage-collected. It supports multiple programming paradigms, including structured object-oriented, and functional programming. It has a comprehensive standard library. The application is built using this programming language.

5. EXPERIMENTAL RESULTS

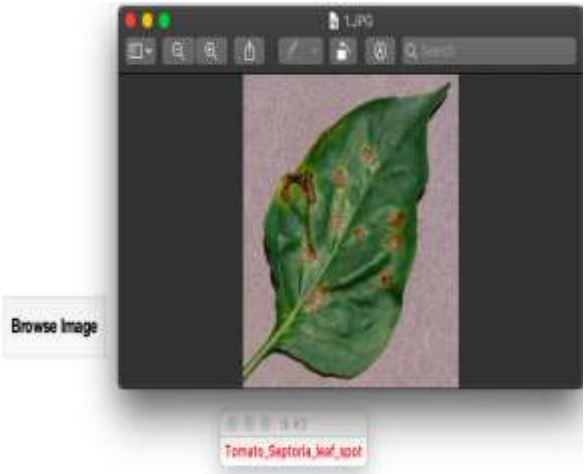
1. Graph showing training and validation accuracy



2. Graph showing training and validation loss



Tkinter is the standard GUI library for Python. Combination of Python and Tkinter provides a fast and easy way to create GUI applications. Tkinter will provide a powerful object-oriented interface to the Tk GUI toolkit.



6. TESTING

Good quality with effective accuracy can be achieved by testing the product using various techniques at different phases of the project development. The use of testing is to discover errors. Testing is the process of trying to discover every fault or weakness in a product. It provides a way to identify and check the functionality of components assemblies and/or a finished product. It is the technique of exercising the software with the ensuring intention for the system which meets its user's requirements and expectations and does not fail in an unacceptable manner.

Steps	Test Data	Expected Results	Observed Results	Remarks
Step 1	Tomato leaf	Tomato bacterial_spot	Tomato bacterial_spot	Pass
Step 2	Potato leaf	Potato_healthy	Potato healthy	Pass
Step 3	Bell pepper leaf	Bell pepper healthy	Bell pepper_healthy	Pass
Step 4	Tomato leaf	Early Blight	Early blight	Pass
Step 5	Background	Background	Background	Pass

7. CONCLUSION

An automated system has been developed for Identifying and classifying. The accurate identification and classification of the plant disease is very important for the successful cultivation of crop. This project uses certain classification techniques to extract the features of the infected leaf and then it will identify the plant diseases with better accuracy. It will be helpful for the farmers to get more profit. The image processing could be used in the field of agriculture for several application. It includes detection of diseased leaf, to measure the affected area by diseases, to determine the colour of the affected area. This solution will be highly useful in place where an expertise in identifying diseases is not available like new comers in agriculture and people growing plants and crops at their homes. It is expected that the number of infected crops will reduce after this solution starts to work in full flow. In recent years, there has been a significant increase in scientific literature focusing on detecting stress in plants using image analysis.

Disease detection is a important activity in the managing of crop plants in agriculture. Detecting early onset of stress and diseases would be beneficial to farmers as it would enable earlier interventions to help mitigate against crop loss and reduces the crop quality. Imaging is a process where the plants are scanned to collect high-resolution data. The technology has become more popular since the falling costs of camera production have enabled researchers and developers greater access to this technology.

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REFERENCES

[1]. Abhishek K M ,Dhruva K,Harshitha M, Sheryas K "A REVIEW ON PLANT DISEASE DETECTION USING IMAGE PROCESSING" published in 2019.

[2]. Sujatha R,Y Sravan Kumar and Garine Uma Akhil "LEAF DISEASE DETECTION USING IMAGE PROCESSING " published in 2017.

[3] Surender Kumar and Rupinder Kaur".PLANT DISEASE DETECTION USING IMAGE PROCESSING" published in 2015.

[4]. Arti N Rathod, Bhavesh A Tanwala,Vatsal H "LEAF DISEASE DETECTION USING IMAGE PROCESSING AND NEURAL NETWORK "published in 2014.

[5] Pooja V, Rahul Das, Kanchana V".IDENTIFICATION OF PLANT LEAF DISEASES USING IMAGE PROCESSING TECHNIQUES" published by 2017.

[6]. : Vijai Singh, A K Misra "DETECTION OF PLANT LEAF DISEASES USING IMAGE SEGMENTATION AND SOFT COMPUTING TECHNIQUES "published in 2016.

[7] Saradhambal G, Divya R, Latha S, R Rajesh".PLANT DISEASE DETECTION AND ITS SOLUTION USING IMAGE CLASSIFICATION " published in 2018.

[8]. Jayamala K Patil, Raj Kumar "ADVANCES IN IMAGE PROCESSING FOR DETECTION OF PLANT DISEASES" published in 2013.

[9]. Arti N Rathod, Bhavesh A Tanwala,Vatsal H. "IMAGE PROCESSING TECHNIQUES FOR DETECTION OF PLANT LEAF DISEASE" published in 2013.

[10]. AnandhaKrishnan MG, Annete Joy, Jerin Francis "PLANT LEAF DISEASE DETECTION USING DEEP LEARNING AND CONVOLUTIONAL NEURAL NETWORK" published in 2017.

BIOGRAPHIES

Keerthana M is currently pursuing Bachelor of Engineering in Information Science at Global Academy of Technology which is affiliated to Visvesvaraya Technological University of Belagavi, India.

Raksha K R is currently pursuing Bachelor of Engineering in Information Science at Global Academy of Technology which is affiliated to Visvesvaraya Technological University of Belagavi, India.

Thanuja V is currently pursuing Bachelor of Engineering in Information Science at Global Academy of Technology which is affiliated to Visvesvaraya Technological University of Belagavi, India.

Sridhar R pursed BE in CSE and M.Tech in CSE from Visvesvaraya Technological University, Belagavi, India. He is currently working as Assistant Professor in Department of Information Science & Engineering, Global Academy of Technology. His main research work focuses on wireless sensor networks. He has 18 years of teaching experience.