Image Prescription and Machine Learning for Classification of Plant Leaf Diseases Detection

Naganaboyina Sandhya[1], Vasudha Kandula[2], Vasudharini Chintada[3], Ashritha Sri Manjeera Gollapudi[4], Dr. M. Madhusudhana Subramanyan[5], Dr. G. Raja Govindan[6]

[1,2,3,4]*Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A.P, India*

[5]*Associate Professor, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A.P, India*

[6]*Associate Professor, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A.P, India*

Abstract: **As the source of human energy, plants are seen as being significant. Plant diseases can harm leaves at any point between planting and harvesting, greatly reducing crop production and market value. Thus, the early diagnosis of leaf disease is crucial in agricultural fields. Unfortunately, it necessitates a significant amount of labour, prolonged processing, and in-depth understanding of plant diseases. Because machine learning classifies data into a predefined set of categories after analysing it from many angles, it can be used to detect diseases in plant leaves. For classification, physical characteristics and traits including the colour, The quantity and size of plant leaves are considered. This research gives an overview of several plant disease kinds and various machine learning classification approaches that are employed for detecting illnesses in diverse plant leaves.**

Index Terms: **Support Vector Machine, Machine Learning, Artificial Neural Network, Classification, Disease Detection.**

I. INTRODUCTION

Agriculture is the foundation of INDIA's early development because it is a rapidly emerging nation. Yet, there are many challenges in the agriculture sector, including significant losses in crop output. one of the most prevalent types of major causes of output loss, and in the world of agriculture, identifying plant leaf diseases is also highly challenging. The traditional way of diagnosing diseases, known as the "naked eye method," is imprecise, labor-intensive, and unsuitable for settings with a larger population. Also, it costs a lot because professionals must keep an eye on it constantly. As a result, machine learning, a trustworthy prediction approach, is utilised to identify numerous illnesses of plant leaves brought on by bacteria, viruses, and fungi. Yet, as the accuracy varies depending on the input data, disease prediction using classification algorithms seems to be a challenging endeavour. Finding plant diseases is a positive step towards sustainable farming and clean crops. Early disease diagnosis in plants, also known as disease control and management, improves crop quality and lowers output losses. This article proposes a method for illness identification that combines image processing and machine learning using photos of potato leaves. This work reviews and compares a number of academic contributions on the identification of various plant leaf diseases using various classification techniques. Part IV discusses the classification of numerous plant diseases, the conclusion, the methods of classification in Parts II and III. Deep learning techniques and cutting-edge technology are being used to highlight current trends and challenges in the diagnosis of plant leaf diseases.

II. LITERATURE REVIEW

Plant disease is addressed in the article employing image classification by Saradhambal.G, Dhivya.R, Latha.S, and R. Rajesh. They collect 75 images of diverse diseased plant leaves, including those with bacterial blight and other diseases, for their methodology. There were five classes altogether. including 1 class for healthy, normal leaves and 4 classes for diseases. After minor image preprocessing to remove noise, a lab colour model conversion was carried out. They used clustering and Otsu's technique to segment the image. Following that, a feature extraction process is carried out in order to determine the class. The dataset was tiny, and they haven't talked about the accuracy they were able to accomplish [1].

It is made clear in another work titled "Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm" that they employed the CNN model for the classification of leaf diseases. 500 shots total, 400 of which are training images, while the remaining 100 are test images, was employed in their methodology. There were five classes total for classification, including one class for healthy people. The 512*512 image size that was chosen was a good size. Three R, G, and B channel matrices were employed as the the output of the CNN model was fed into the LVQ neural network as input (Learning Vector Quantization). an around 88 percent accuracy on average is attained. Only tomato-related diseases were included in their suggested model [2].

SVM is used for classification in the paper "Plant Disease Classification Using Image Segmentation and SVM Methods" by K. Elangovan and S. Nalini. Their solution involved converting the image to a different colour space. Following cropping, the image underwent smoothing, noise removal, and greyscale conversion using image preprocessing techniques. Moreover, segmentation was done before Features were taken out. Shape, colour, and texture were considered to be features and applied to classification. Moreover, they make no mention of the model's suggested accuracy [3].

Hrishikesh P. and others created a program to check for leaf diseases in ten different plants. For this plant's leaves with fewer information, the algorithm was devised and evaluated. compute-intensive effort An picture was transformed into HIS space, and the most green pixels were found and removed. The colour co-occurrence method, based on SGDM, was then used to segment the image. Features from the photos were taken out and compared to the features that are kept in feature collections. For classification, an SVM classifier was employed. As compared to the previous procedure, accuracy was increased.[4]

A technique for detecting cotton leaf disease was created by Vivek Chaudhari et al. The implementation of DWT for feature extraction and a clustering technique for segmentation. The PCA approach was used to decrease the extracted features, and a neural network was employed for classification. Comparing the method against an earlier one for disease identification and categorization yielded accurate findings. By using different neural learning rates, the suggested technique had a 98% accuracy rate.[5]

The Deep Residual Learning for CNN is described as superior to all other models by Kaiming He et al. The Residual network has a lower error rate than other models, according to this paper's definition of error rates for all models. Residual networks are simpler and easier to install.[6]

III. METHODOLOGY

We have developed a four-phase model that can identify and categorise plant leaves that are sick.
- Dataset Gathering.
- Image Preprocessing
- Segmentation
- Classifier Selection.

Fig:1

Dataset Gathering: First off, the leaf photos were gathered from internet sources including GitHub, Kaggle, and other image datasets that have 20,000 photographs split into 19 different categories. The collection includes both healthy and diseased leaves, and It provides details on ailments that affect several crops, including apple, potato, tomato, grape, strawberry, and maize, including black rot, rust, bacterial spot, early blight, late blight, leaf scorch, target spot, and mosaic virus.

Image Processing: In order to speed up computations, photos are downsized to smaller pixel sizes in this stage. Some noise can be found in the captured photos. With filtering techniques like Gaussian Blur, this noise is eliminated. The photographs that follow are RGB format, which is unsuitable for further research because format RGB cannot distinguish between image intensity. As a result, it is converted to HSV, a different colour space that distinguishes between colour and intensity. RGB colour space is also noisier than HSV.

Fig:2

Segmentation: Images are segmented in this step in order to distinguish the leaves from the backdrop. K-means clustering is used for segmentation, with a backdrop cluster centre and a foreground cluster centre. K-means clustering is an unsupervised learning technique that groups or arranges the datapoints into a specified number (k) of clusters or groups based on how similar they are to one another.

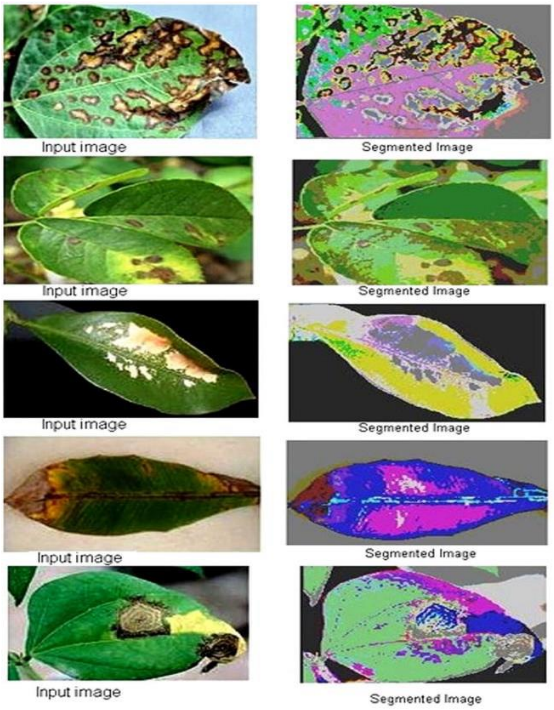
Fig:3

First Author, Year	Classification Algorithms	Reported Accuracy	Advantages	Disadvantages	Future study
Sandika Biswa, 2014	Neural Networks and FCM Clustering	93%	Robust	Difficult in segmentation	To identify the disease severity with accuracy
A. A. Joshi, 2016	KNN Classifier	87.02%	Straightforward Implementation, Quickly Picks Up Complex Models	Complexity of computation is high	To combat different rice illnesses
John William Orillo, 2013	ANN Classifier	93.44%	It is possible to accurately obtain leaf characteristics based on colour.	high cost of calculation	To increase accuracy
Pooja Pawar, 2016	ANN	79.44%	Single crop of various types	Further study is difficult	Integration of Gabor filter
Harshal Waghmare, 2016	Multi class support vector machine	95.55%	Classification performs accurate	Only when the testing to training ratio rises does accuracy improve.	in order to combat certain diseases
Santanu Phadikar, 2008	Organizing Map on its Own	93%	Straightforward and effective in terms of computation	Better classification is not provided by image alteration in the frequency domain.	To get more accuracy
K. Renugambal, 2015	Linear and non-linear SVM	95%	Further feature analysis and segmentation methods are used.	Precision is relatively poor.	To focus on optimization algorithm
D. Luna, 2017	ANN	97.61%	Greater Precision, Easier Implementation	time-consuming computation.	to take into account the herbal medicine's location for accurate characterisation
Mukherjee, 2017	Multi-Layer Perceptron Neural Network	83%	physical characteristics are used to categorise medicinal plant	The work is made harder by dithering at the edges.	to collaborate with various other types of therapeutic plants

Table: Advantages and Dis-advantages of various models

IV. RESULTS AND OUTPUT

The data base is initially built using pictures of healthy plant leaves and sick or diseased plant leaves. In this stage, the K-Means method is used to transform RGB colour pictures to HSV separated in colour space. The system outputs whether a leaf is healthy or sick, and if a leaf is contaminated, the categorization will show what kind of disease it has. As input data, samples of plant leaves affected with various diseases were employed, including bacterially infected rose leaves, fungally infected beans leaves, bacterially infected lemon leaves, burnt banana leaves, and bacterially infected rose leaves. The original image and the output segmented images are shown in this figure.



V. CONCLUSION

In this work, numerous methods for identifying and classifying bacterial, fungal, and viral plant leaf diseases are reviewed and summarised. The use of classification techniques facilitates the automated detection of plant leaf diseases and their morphological-based categorization. The primary goal of this paper's ongoing research is to employ CNN as a classifier to detect leaf diseases in mulberry plants. By utilising hybrid algorithms, Also, it is intended to focus on improving the rate of recognition and categorization accuracy of the seriousness of leaf ailments.

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