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Vegetable Plants Disease Detection Using Digital Image Processing on SVM Algorithm

Dr. S.S.Thakare , Pranav Thakare, Chanchal Sulkiya, Pranav Choratkar
Department of Electronics and Telecommunications Engineering,
Government College of Engineering, Amravati, Maharashtra, India.

***Abstract**:* The cultivation of plants and crops has seen rapid growth due to the increasing demands of humans and animals worldwide. Agricultural science has developed various techniques to improve production rates in the agricultural sector. However, farmers often face challenges in protecting their crops from diseases and insects during plant growth, resulting in lower harvests and economic losses. For decades, agricultural scientists have been striving to develop quick and efficient systems for detecting plant diseases and providing timely treatment. However, traditional manual detection techniques are time-consuming. To overcome this, new technologies, including machine learning, especially deep learning, have been introduced into the cultivation system for faster and more efficient plant disease detection. In this study, we propose a model that uses image processing and a Support Vector Machine (SVM) for training the dataset to detect leaf diseases. Our system achieves a high accuracy rate of 94.38 percent. Our research work can assist farmers in increasing crop and fruit production rates while mitigating plant diseases and insect attacks, thereby reducing losses and providing immediate remedies.

I. INTRODUCTION

India is an agricultural country, and approximately 70 percent of its population depends on agriculture. Farmers have a wide range of crop varieties to choose from and finding suitable fertilizers for plant growth. Therefore, any loss to crops can have a significant impact on productivity and the economy. Leaves, being a crucial part of plants, often show disease symptoms at an early stage. Monitoring crops for diseases from the initial stage of their life cycle until harvest is essential. In the past, the method used for disease monitoring was naked-eye observation, which is time-consuming and requires expert manual oversight of crop fields. In recent years, automatic and semi-automatic plant disease detection systems have been developed using various techniques, making it easier and cheaper to detect diseases based on symptoms observed on plant leaves. These systems have proven to be fast, cost-effective, and more accurate compared to manual observation by farmers. In many cases, disease symptoms are visible on leaves, stems, and fruits. This project focuses on using plant leaves for disease detection, as they often exhibit disease symptoms. This system can be effectively used by farmers to increase their yield without relying solely on expert advice. The main objective is to detect diseases using image-processing technologies, providing farmers with valuable information about crop health and disease management.

II. LITERATURE REVIEW

Dhiman Mondal [1] proposes classification and identification techniques for plant leaf disease detection. The preprocessing step involves converting RGB images into grayscale to extract vein images from the leaves. Morphological operations are then applied, followed by binary image conversion. Disease detection is performed using Pearson correlation, dominating feature set, and Naive Bayesian classifier.

Pranjali B. [2] outlines four steps for plant disease detection. This includes image acquisition from various regions for training and testing, noise removal using Gaussian filter, thresholding to obtain green color components, and segmentation using K-means clustering after converting RGB images into HSV for feature extraction.

In the paper [3], the authors propose a technique for jute plant disease detection using image processing. The image is resized and enhanced in quality while removing noise. Hue-based segmentation with customized thresholding is applied after converting the image into HSV from RGB to extract the region of interest. This method is particularly effective for detecting stem-oriented diseases in jute plants.

Tejoindhi M.R. [4] presents a technique for paddy plant disease detection by comparing it with healthy and non-healthy samples. However, due to the non-linearly separable training data, the detection is not sufficient.

In the paper [5], the detection of unhealthy plant leaves involves RGB image acquisition, conversion to HSI format, masking and removal of green pixels, component segmentation using Otsu's method, texture feature computation using color-co-occurrence methodology, and disease classification using Genetic Algorithm.

Tanvimehera [6] focuses on tomato disease detection using computer vision. A grayscale image is thresholded using the threshold algorithm 8 for image segmentation. However, this method has limitations in distinguishing ripe and unripe tomatoes, hence K-means clustering is used to overcome these drawbacks. YCbCr color space conversion is also used for feature enhancement and calculation of the infection percentage.

Ms. Poojapawer [7] proposes a methodology that includes image acquisition, image preprocessing, and feature extraction using Gray-Level Co-occurrence Matrix (GLCM), followed by unsupervised and supervised classification for paddy plant disease detection.

In the paper [8], RGB images are converted into grayscale and enhanced using histogram equalization and contrast adjustment. Various classification features such as SVM, ANN, and FUZZY classification are used, and different types of feature values, including texture, structure, and geometric features, are extracted for paddy plant disease identification.

Mukesh Kumar Tripathi [9] discusses the utilization of machine learning, image processing, and identification-based approaches for agricultural product disease detection.

In the paper [10], image processing techniques are used for citrus leaf disease detection, including image preprocessing, leaf segmentation using K-means clustering, feature extraction using Gray-Level Co-occurrence Matrix (GLCM), and disease classification using a support vector machine (SVM).

III. METHODOLOGY

The proposed work focuses more on the detection of disease on the leaf using MATLAB. In our proposed model image processing method is used for the construction of a system through which leaf disorder is identified if any distorted picture is supplied within a very short time. As a result, a farmer without full sense disease detection knowledge, modern techniques, and software can be effortlessly applied to this system. The dataset which is used as input is mixed of healthy and distorted images and after completing the action of the input dataset the system output provides the affected and healthy leaves.

In proposed system GLCM method is used to extract features from images. After successful feature extraction K-means clustering algorithm is used for forming of clusters where value of k=3 is considered for forming of 3 clusters. After that using SVM(Support Vector Machine) model is trained and using the same algorithm classification of diseases is done based on the trained model.

System Architecture:

System architecture can be understood from the Fig.1 below which explains the work flow of proposed system.

Complete process from loading the image to output are shown in Fig.1 for better understanding of the working process.

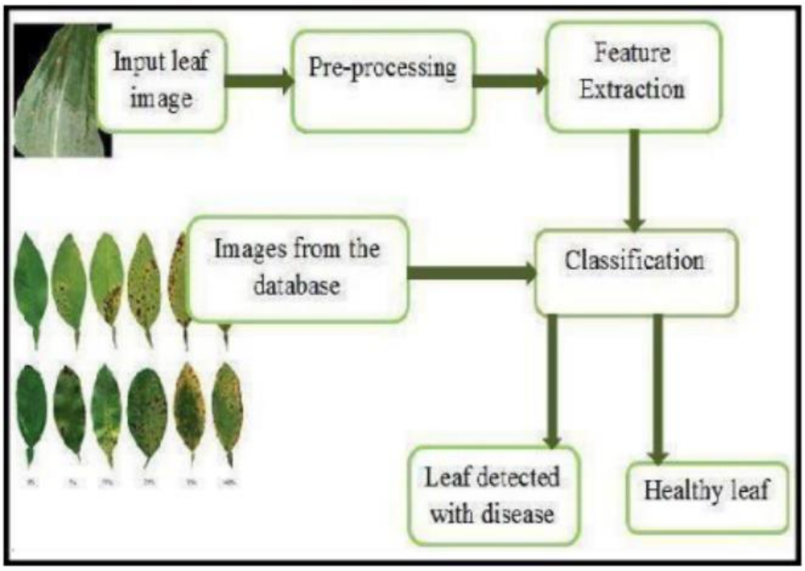

Fig.1: System Architecture for proposed system.

Courtesy: https://www.frontiersin.org/articles/10.3389/fpls.2016.01419/full

Plant disease detection using Deep Image Processing (DIP) architecture involves leveraging advanced machine learning techniques to identify and diagnose diseases in plants based on images of their leaves. DIP architecture uses deep learning algorithms, such as convolutional neural networks (CNNs), to automatically learn and extract relevant features from plant leaf images. These features are then used to classify the images as healthy or diseased, enabling early and accurate detection of plant diseases.DIP-based plant disease detection systems offer several advantages, including faster and more accurate detection compared to manual observation methods. Farmers can quickly capture images of plant leaves using smartphones or other digital devices, and the DIP architecture can analyze the images in real-time, providing instant feedback on the health status of the plants. This enables timely intervention and treatment, reducing crop losses and improving overall agricultural productivity.By using DIP architecture for plant disease detection, farmers can make informed decisions about disease management strategies, such as applying targeted treatments or taking preventive measures. DIP-based systems can also be integrated with other technologies, such as Internet of Things (IoT) devices and remote sensing, for continuous monitoring and management of plant health in large-scale agricultural settings. Overall, plant disease detection using DIP architecture has the potential to revolutionize agriculture by enabling early and accurate disease detection, leading to improved crop yields and sustainable farming practices.

Comparison with existing system:

PARAMETER	EXISTING SYSTEM	PROPOSED SYSTEM
COSTING	HIGHER	LESSER
OPERATIVE	HARD	EASY
ALOGITHAM USED	LSTM	SVM
ACCURACY	83%	98.38 %

After implementing proposed methodology the result of this, the SVM calculated the data and got an Accuracy of 98.38 % ,the Affected Region of the Leaf & and Disease found.

Features Values extracted from different Images:

	Image A	Image B	Image C	Image D	Image E	Image F	Image G	Image H	Image I	Image J	Image K	Image L	Image M
Mean	36.9812	41.2492	72.6554	35.9273	39.9816	38.3033	34.558	28.3381	24.3841	28.917	14.8441	128.906	76.6184
S.D.	72.7193	71.5093	94.7109	64.0483	71.2748	63.5418	61.3358	52.1931	47.9203	61.917	47.8127	118.697	97.9822
Entropy	3.7913	3.2719	3.91729	3.24062	2.75092	3.24343	2.79095	3.81644	2.81951	2.65594	1.70988	3.6237	3.84391
RMS	9.51572	8.19696	9.91402	8.36129	8.02521	8.7595	7.89475	9.19921	7.94115	7.51572	5.57478	12.5744	9.36415
Variance	3643.88	4609.22	7902.33	3443.43	4942.6	3851.7	3343.11	2421.75	2036.09	3570.52	2150.79	10666.3	6332.3
Smoothne	1	1	1	1	1	1	1	1	1	1	1	1	1
Kurtosis	2.53889	3.83129	1.62666	3.70728	3.36593	3.65038	3.58334	8.95192	6.48632	6.64873	15.5978	1.09883	1.51714
Skewness	1.41678	1.50194	0.669583	1.50846	1.40729	1.40336	1.44684	2.41677	2.03526	2.15409	3.63202	0.015921	0.599022
IDM	255	255	255	255	255	255	255	255	255	255	255	255	255
Contrast	0.45324	0.666483	2.36616	0.757261	1.8428	1.819	0.738618	0.498667	0.418137	1.3815	0.078876	0.41152	0.413971
Correlatio	0.237323	0.916991	0.846789	0.898844	0.762655	0.748459	0.873214	0.876104	0.857885	0.770558	0.978321	0.981417	0.970585
Energy	0.534468	0.480133	0.343312	0.442433	0.497969	0.404986	0.508186	0.459063	0.565303	0.561588	0.762589	0.350451	0.410582
Homogen	0.983233	0.911685	0.891532	0.928486	0.885482	0.858737	0.893914	0.927747	0.938959	0.896044	0.974878	0.94482	0.972992
Accuracy													

Fig.2: Features Values Data.
Above feature values show extraction of them from different images.

The below Graph shows The Accuracy Of 13 Images of the dataset which we analyze. The graph shows how accuracy varies according to Images depending on the features extracted from different using proposed system. Also different extensions of images are used for finding best extension format for the proposed system. Images named as A,B,C,D,E,F,G,H,I,J,K,L are different images from testing dataset.

PNG-A,B,C,D

JPG -E,F,G,H

BMP-I,J,K,L

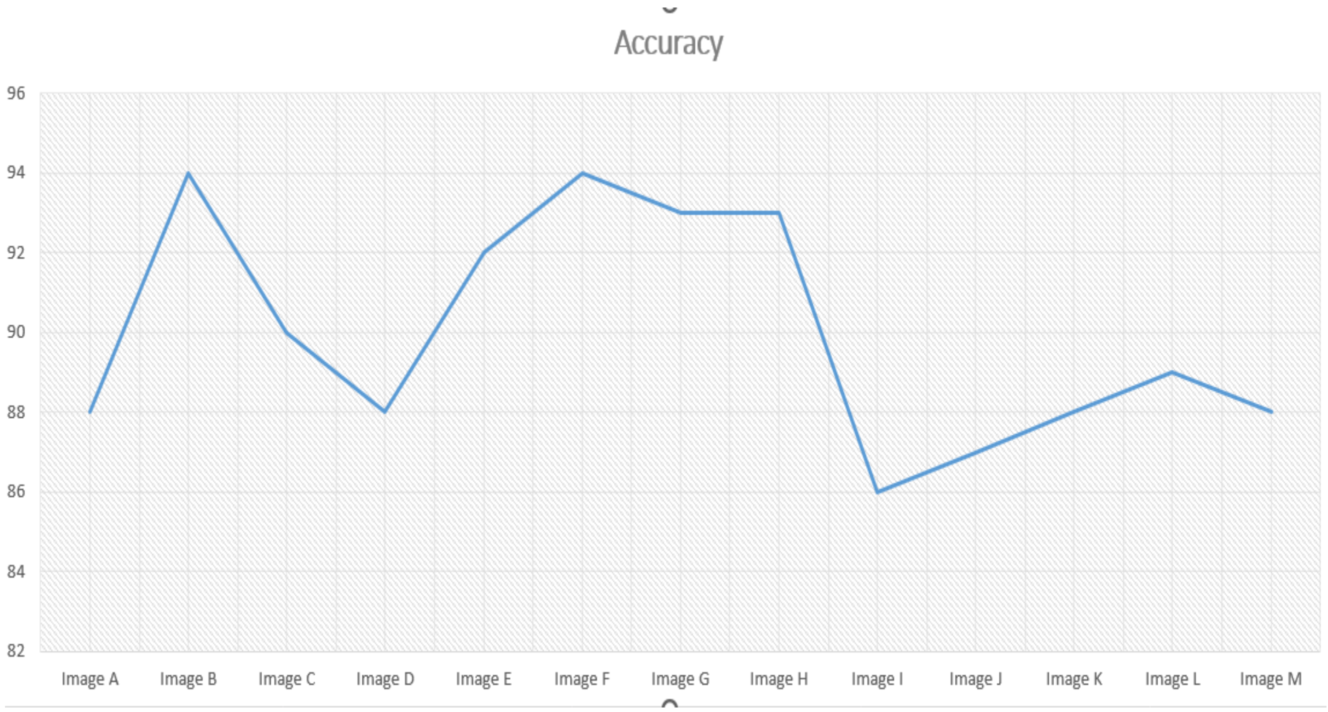

Fig.3: Accuracy from different Images

As observed from above it seems .jpg images are more prone to give accurate results as compared to other formats. Also observed from Fig.2 it is observed that .jpg images are prone to more accurate feature extraction which gives it more accuracy while classification of different diseases.

Diseases Considered while training SVM model:

1] Alternaria Alternata

Alternaria alternata causes dark spot in vegetables around the world. It is a fungus that occurs during the cold storage of vegetables, becoming visible during the marketing period thereby causing big loss. In order to control Alternaria alternata , it is mandatory to improve the current methods to detect this species.

2] Bacterial Blight:

Bacterial blight is occured by the bacterium Pseudomonas syringae. syringae (Pss), which lives in diseased stem tissue (cankers), plant debris, and soil. It can be spread by insects and on fyling tools, but is more widely spread by wind and rain. Often It is found on the surface of plants and does not cause disease.

3] Cercospora Leaf Spot:

Cercospora leaf spot is an infectious disease that affects smooth, panicle, oakleaf and bigleaf types of hydrangea in both landscapes and nurseries. This disease is caused by the fungus Cercospora hydrangea and is perhaps the most common disease seen on this ornamental during the months of July through October. The disease rarely kills the plant, but if it is severe, it can reduce overall plant vigor by repeated defoliation.

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4] Anthracose:
Generally found in the eastern part of the India, anthracnose is caused by fungi in the genus Colletotrichum, a common group of plant pathogens that are responsible for diseases on many plant species. Infected plants develop dark, water soaked lesions on stems, leaves or fruit.

Working Output of System:

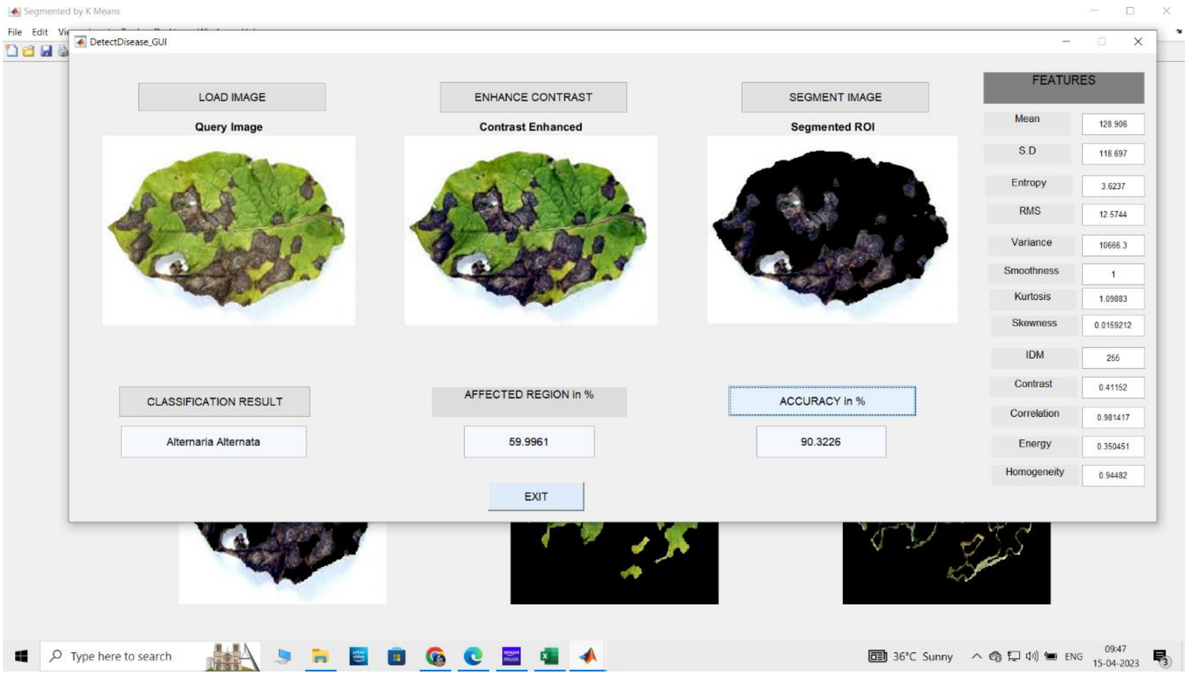

Fig.4: Graphical User Interface created for proposed system.

A simple GUI is created for person to operate this at naïve level in which pre-technical knowledge is not required to operate this system. Load, Contrast, Segment push buttons are available for simple implementation to avoid confusion among peers who will be using this system for disease detection.

IV. CONCLUSION

This study presents an original approach for detecting leaf diseases in crops, providing farmers with a remedy to enhance productivity in the agricultural industry. The SVM model demonstrates superior performance with an accuracy of 94.38%. Agricultural experts have acknowledged the quick disease detection process through image processing, marking a significant milestone in this technology. The SVM model efficiently segments and analyzes the affected portion of the leaf, yielding instant results. This saves farmers time and minimizes the possibility of incorrect disease detection. Our future goal is to develop an open multimedia system and software that can automatically detect plant diseases and provide solutions.

From the observations from Fig.2, Fig.3, Fig.4 that the .jpg format of image is more desirable while using proposed system as it is more accurate while extracting features from images hence providing better accuracy while working with proposed system. Hence, it can concluded that proposed system will be better while implementing with .jpg extension format images.

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