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Utilizing Multi-Class Support Vector Machine to Detect Plant Leaf Diseases

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Abstract: Plant disease has a large influence on agricultural output and food security. For successful illness management, early detection and correct diagnosis of these disorders are critical. Digital image processing techniques have emerged as a viable tool for automated plant leaf disease identification in recent years. The goal of this study is to use image processing to create a more efficient and accurate system for detecting leaf illness.
K-means clustering, Gray-Level Co-Occurrence Matrix (GLCM), and Support Vector Machine are used to create the model. K-means clustering is employed for image segmentation, GLCM, and multiclass SVM for feature extraction and illness classification respectively. The maximum accuracy is 98.4%.
Keywords: Digital Image Processing, K-means, GLCM, multiclass Support Vector Machine, Pre-processing, Segmentation, Extraction.

I. INTRODUCTION

The agricultural sector is the pillar of many economies throughout the world, providing food, fiber, and other essential resources to the population. Plant diseases, on the other hand, represent a major risk to the agricultural business, resulting in large crop losses and output reduction. Plant leaf diseases are caused by pathogens like fungi, bacteria, and viruses, as well as environmental factors such as temperature, humidity, and soil conditions.
It is essential to recognize and diagnose illnesses of plant leaves in order to stop the spread of infection and lessen the financial burden on farmers. Visual inspection by experienced professionals is a time-consuming and frequently inaccurate component of traditional techniques of diagnosis.
The development of more effective and precise methods for plant leaf disease identification, however, is a result of technological advancements, particularly in the areas of image processing and machine learning.
By increasing crop yields and decreasing the use of environmentally hazardous pesticides and other chemicals, this technology has the possibility of completely change the agricultural sector.
The need for precise and prompt identification of plant diseases has never been more pressing due to the rising global need for agricultural products and the difficulties created by climate change.
Several methods, including image processing, machine learning, and deep learning algorithms, are used to identify plant leaf disease.
These methods make it possible to diagnose plant illnesses automatically and effectively, which can help with early disease identification and control, averting major crop loss. The agriculture sector could undergo a revolution because to this technology by allowing farmers to quickly identify and cure plant diseases, increasing agricultural yields and enhancing food security.

II. LITERATURE REVIEW

Plant leaf disease detection is an ongoing research area that has gotten a lot of interest in recent years because of the growing demand for efficient and reliable disease detection systems in agriculture.
R. Meena Prakash et al. employ digital image processing to identify illness in citrus leaves. They employed the K-means clustering approach for picture segmentation, the GLCM method for feature extraction, and the SVM method for classification. This suggested technique extracts four features: contrast, energy, homogeneity, and correlation. The dataset is made up of 60 photos of leaves, 35 of which are sick and 25 of which are healthy [1].
Raut and Fulsunge proposed an algorithm to detect plant leaf and fruit disease detection [2]. Image acquisition, pre-processing i.e., image resizing, filtering of noise, contrast enhancement, and morphological operations are done. Using k-means segmentation is done and the input image is partitioned into three clusters.

Different statistical texture features i.e., energy entropy, correlation, contrast, and covariance are extracted using GLCM. Multilevel SVM is used as a classifier.

A total of 73 leaf images and 21 fruit images are used for disease detection. And they found the k-means and SVM algorithm provides maximum accuracy and consumes very less time.

In paper [3] Khirade and Patil consider color, texture, and morphological features for the detection of diseases. In their paper, they have discussed a technique for pre-processing, noise removal, and various methods for image segmentation like Boundary and spot detection, k-means, and the Otsu Threshold algorithm.

Features extraction using color co-occurrence method and H&B components and classified using both ANN and backpropagation. Using this model various plant diseases can be identified.

Singh and Misra proposed an automatic method for plant disease detection using a genetic algorithm [4]. They have worked on little leaf disease in pine trees and classified it into five classes after features extraction using genetic algorithm and minimum distance criterion and then classification.

A. Devaraj et al. designed their system to determine the illness of leaves, which is more time efficient [5]. Image acquisition, pre-processing i.e., filtering, RGB to HIS conversion, morphological operations, l*a*b conversion, and classification using Random Forest classifier are the main steps involved in their system.

Authors deployed a model [6, 14] which involves image pre-processing, segmentation using Lloyd’s or k-means algorithm, features extraction using GLCM, and classifying using multiclass SVM. Throughout their project, they convert RGB to greyscale, remove noise, and compute the centroid, and Kernal functions.

P. Kulkarni et al. developed a machine-learning model for plant disease detection. The model is consisting of a Gaussian filter, Otsu’s thresholding algorithm, morphological transform, bitwise AND operation, HSV color space conversion, and Random Forest classifier. Their system is able to detect 20 different diseases with 93% accuracy [7].

Nishant Shelar et al. demonstrated the application of CNN to detect plant diseases. The PlantVillage dataset is used. Pre-processing and augmentation are done using the image-data generator API by Keras.

The convolutional Neural Network (VGG19) consisted of a convolutional layer, a pooling layer, and a fully connected layer. Their model accuracy was 95.6% [8].

Menukaewjinda et al. [9] suggested a BPNN technique for effective grape leaf color extraction. They evaluated MSOFM and genetic algorithms and discovered that these systems provide automated parameter modification for grape leaf disease color extraction. Support vector machine has also been proven to be highly promising for efficiently classifying leaf diseases.

N. Chourasia and colleagues investigate the use of convolutional neural networks for illness identification. The architectures AlexNet and GoogLeNet, as well as the Transfer Learning and Training from Scratch training mechanisms, are used throughout the project [10].

Sahu and Pandey in their research offer a novel HRF-MCSVM model for detecting plant foliar diseases using automated diagnosis from leaf pictures.

By adjusting MSVM hyperparameters, the TDO optimizer improves true positive rates. HRF-MCSVM outperforms previous approaches in terms of accuracy (97.9%), specificity, sensitivity, and recall. Future aims include broadening the method to identify other illnesses in a sustainable manner [11].

In [12], a review has been suggested which is useful for researchers looking for effective ML and DL-based classifiers for leaf disease identification, as measured by metrics such as F1 score, precision, and accuracy. Javidan et al. propose a new technique using SVM with a linear kernel. Using PCA the outperformed deep learning methods have accuracies of 86.82% and 94.05%, respectively, demonstrating efficient and accurate detection of grape leaf diseases [13].

Gavhale and Gawande suggested a technique using BPNN, SVM, K-nearest neighbor, and SGDM, which are applied to analyze healthy and diseased plant leaves [15].

III. PROPOSED ALGORITHM

Plant diseases are conditions that harm the growth, health, and productivity of plants. In this project, digital image processing is used to detect five types of sick plant leaves, including Anthracnose, Alternaria alternata, Cercospora Leaf Spot, bird eye spot, Bacterial Blight, and healthy leaves. Using this designed algorithm detection of plant illness becomes very easy and effective for various types of plants.

Some basic types of plant diseases are:

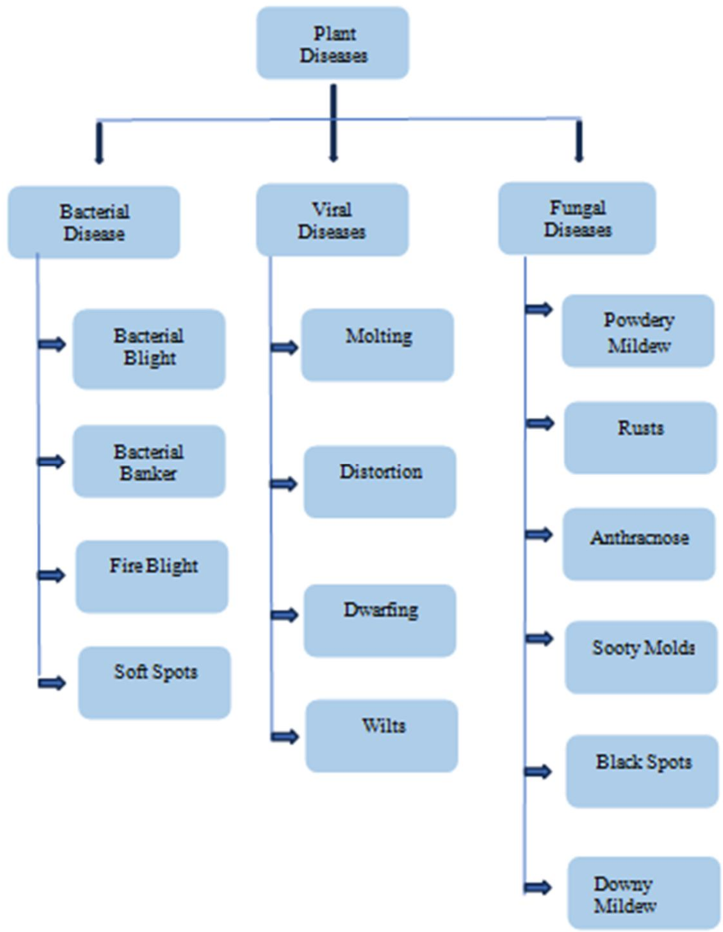

Figure 1- Various types of plant diseases

The suggested algorithm block diagram's step-by-step procedure is depicted below.

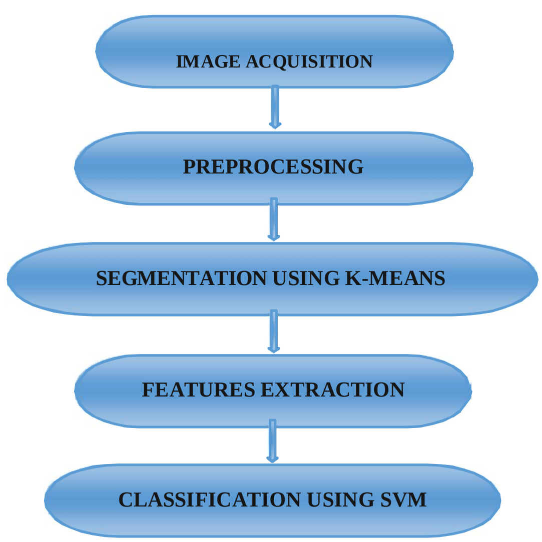

Figure 2- Block Diagram of Proposed algorithm

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A. Image Acquisition

First, collect the dataset or capture images using a digital camera and ready them to feed the proposed system. Resized all the images to 256x256 and the dataset is given as the input to the acquisition process. Again, images are resized to 300x400 for showing the output.

B. Image Pre-Processing

Pre-processing refers to the set of techniques and operations applied to raw images to improve their quality, enhance relevant information, and make them suitable for further analysis. Pre-processing aims to remove noise, contrast enhancement, color correction, and RGB to greyscale conversion morphological operations to ensure accurate and effective image analysis using various MATLAB codes.

Figure 3: Pre-processed leaf image

C. Segmentation

Image segmentation is a fundamental concept in digital image processing that involves dividing an image into meaningful and semantically coherent segments. It helps to isolate and identify the regions of interest (ROI) within the leaf image, allowing for more accurate and targeted analysis. Segmentation is done using various methods However, k-means clustering is a popular tool for detecting plant diseases. K-means clustering is an unsupervised learning approach that divides data into K clusters based on similarities. Each pixel's color information is considered a data point, and the algorithm partitions the pixels into K clusters, aiming to minimize the within-cluster variance. Using l*a*b color space conversion image can be regenerated.

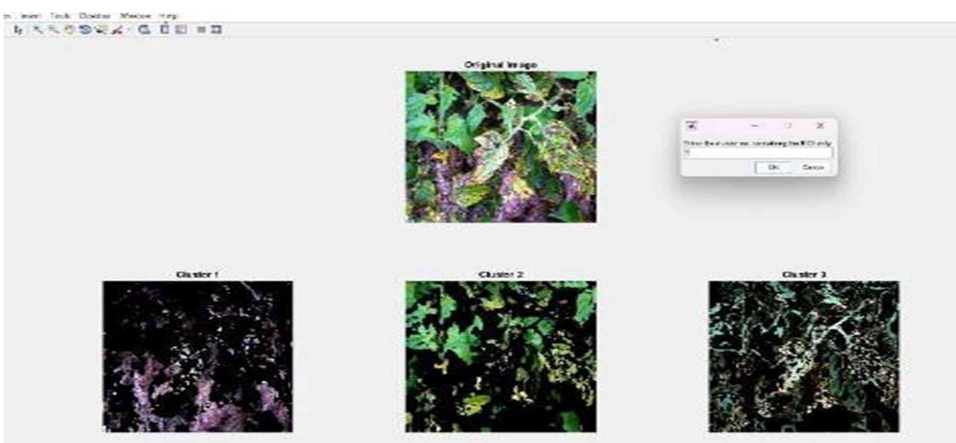

Figure 4: Three different clusters with ROI

D. Features Extraction

The process of obtaining relevant and distinguishing information from images in order to portray them in a more condensed and comprehensible manner is known as feature extraction in the context of image processing. Color, texture, and morphological characteristics are taken into account to identify plant illness. It is common practice to characterize the texture patterns in an image using feature extraction utilizing GLCM. The frequency of pixel intensity value pairs at a particular distance and orientation inside the image is calculated by GLCM.

Calculate the GLCM for each pixel in the picture using the specified neighborhood window and offset. To determine the GLCM, follow these steps:

1) Select a pixel (p1) in the input image.
2) Identify the pixel (p2) that is at the specified offset from p1.
3) Record the pair of intensity values (grey levels) at P1 and p2.
4) Move on to the next pixel and repeat the process until all pixels in the image have been considered.
5) Accumulate the frequency of each intensity value pair in a matrix, which is the GLCM.

Once the GLCM is normalized, you can compute various statistics as features from the GLCM. Common statistics include Contrast, Correlation, Energy, Homogeneity, Mean, Standard Deviation, Entropy, RMS, Variance, Smoothness, Kurtosis, and Skewness.

E. Classification

SVM classification is a supervised learning technique used for binary and multi-class classification tasks. The pre-processed data is used as input into the SVM model for training. The SVM method will determine the hyperplane that optimally separates the samples of distinct classes while maximizing the difference between the two classes.

Multiclass SVM has some hyperparameters that need to be set before training, such as the kernel type, regularization parameter, and kernel-specific parameters. Once the model is trained and tested, it can be applied to predicting classes.

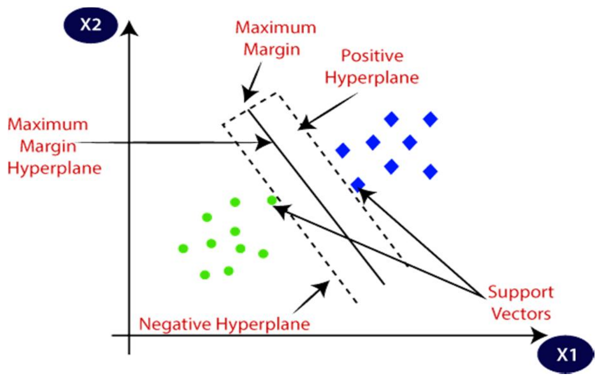

Figure 5: Classification using Multiclass SVM

IV. RESULTS

A GUI has been created to display the output result. The results of plant leaf disease detection using Multi-Class SVM depend on the quality of the dataset, feature selection, hyperparameter tuning, and the complexity of the classification issue. Plant disease detection uses GLCM and k-means in particular. When the dataset is balanced and the characteristics are indicative of the disease traits, SVM may accurately diagnose plant leaf diseases. However, the overall quality of features that were extracted and the chosen hyperparameters has a significant impact on performance.

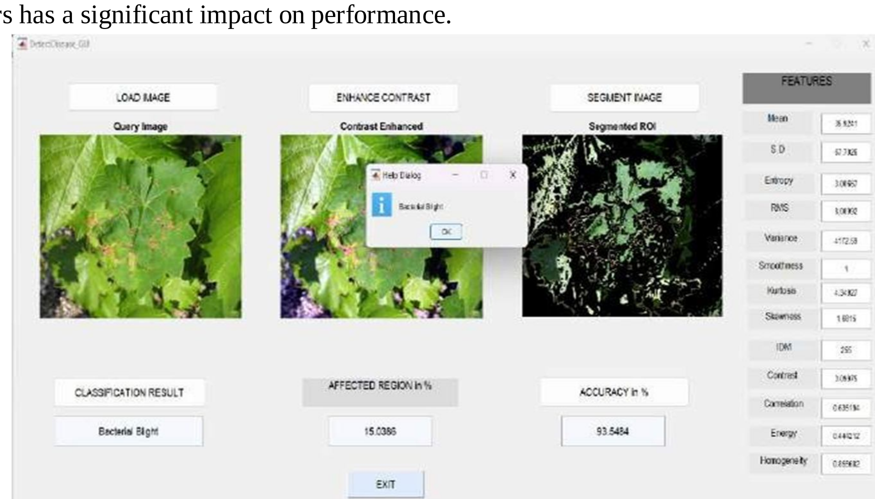

Figure 6: Detection of Bacterial Blight

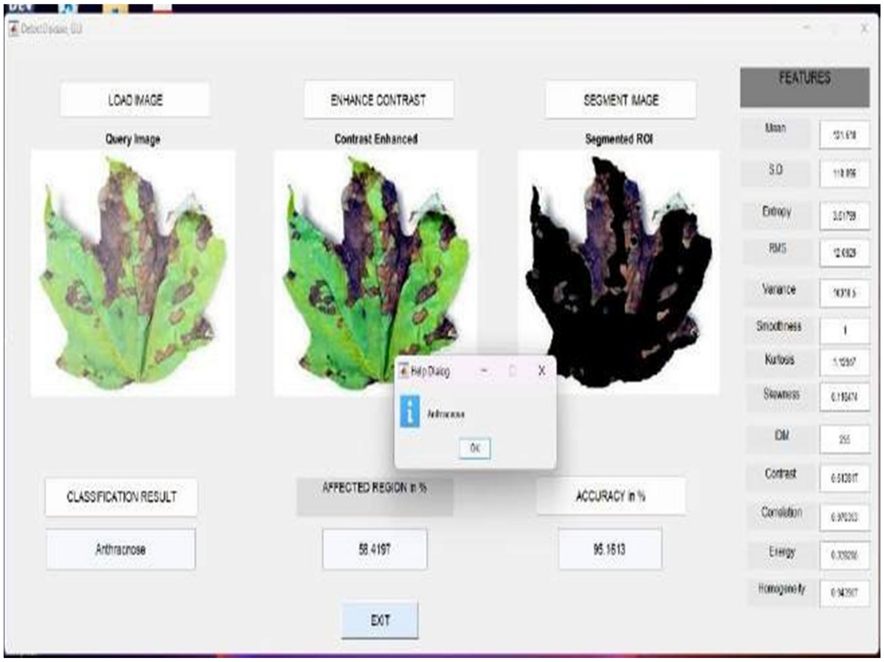

Figure 7: Detection of Anthracnose

V. CONCLUSION AND FUTURE WORK

Image-based diagnosis of plant leaf disease using k-means clustering, Gray-Level Co-occurrence Matrix, and Support Vector Machine is an excellent method for distinguishing healthy and sick plant leaves. Segmenting the leaf picture to identify regions of interest, extracting important features to define the sick areas, and lastly training a multiclass SVM classifier to appropriately categorize the leaves. The suggested method has maximum accuracy of 98.4%. The effectiveness of the algorithm is highly influenced by the image quality. preprocessing, feature extraction, and the selection of SVM hyperparameters. Proper hyperparameter tuning and feature selection can have a considerable influence on the model's accuracy and resilience. After detection data has been loaded into AccuracyD.mat and TrainingD.mat folder in MATLAB software. Identification of viral diseases of leaves has been kept as future work.

REFERENCES

[1] M. Prakash, G. Saraswathy, G. Ramalakshmi, K. Mangaleswari, and T. Kaviya, “Detection of Leaf Diseases and Classification using Digital Image Processing” 2017 International Conference on Innovations in Information, Embedded and Communication Systems. IEEE2017.

[2] S. Raut and A. Fulsunge, “Plant Disease Detection in Image Processing Using MATLAB” International Journal of Innovative Research in Science, Engineering and Technology Volume 6, Issue 6, June 2017.

[3] S. D. Khirade and A. B. Patil, “Plant Disease Detection Using Image Processing” 2015 Internation Conference on Computing Communication Control and Automation. IEEE 2015.

[4] V. Singh and A. K. Misra, “Detection of plant diseases using image segmentation and soft computing techniques” Information Processing in Agriculture 4 (2017) 41-49. Elsevier B.V. 2017.

[5] A. Devaraj, K. Rathan, S. Jaahnavi, and K. Indira, “Identification od Plant Disease using Image Processing Technique” International Conference on Communication and Signal Processing. IEEE 2019.

[6] A. Santhosh, K. Saravanakumar, P. Saravanakumar, S.Vimalraj, and R. Saranya, “DETECTION OF LEAF DISEASES AND CLASSIFYING THEM USING MULTICLASS SVM” International Research Journal of Engineering and Technology (IRJET) Volume 6, Issue 3, March 2019.

[7] P. Kulkarni, A. Karwande, T. Kolhe, S. Kamble, A. Joshi, and M. Wyawahare, “Plant Disease Detection Using Image Processing and Machine Learning” IEEE 2021.

[8] N. Shelar, S. Shinde, S. Sawant, S. Dhumal, and K. Fakir, “Plant Disease Detection Using CNN” ITM Web of Conferences 44, ICACC2022.

[9] A. Meunkaewjinda, P. Kumsawat, K. Attakitmongcol, and A. Srikaew, "Grape leaf disease detection from color imagery using hybrid intelligent system." 5th international conference on electrical engineering/electronics, computer, telecommunications and information technology, vol. 1, IEEE, 2008.

[10] N. Chourasia, S. Lanjewar, S. Daduriya, M. Mahalle, and U. Giri, “LEAF DISEASE DETECTION USING IMAGE PROCESSING” International Journal of Creative Research Thoughts, Volume 6, Issue 1, March 2018.

[11] S. K. Sahu, M. Pandey, “An optimal hybrid multiclass SVM for plant leaf disease detection using spatial Fuzzy C-Means model” Expert Systems with Applications 214, 2023.

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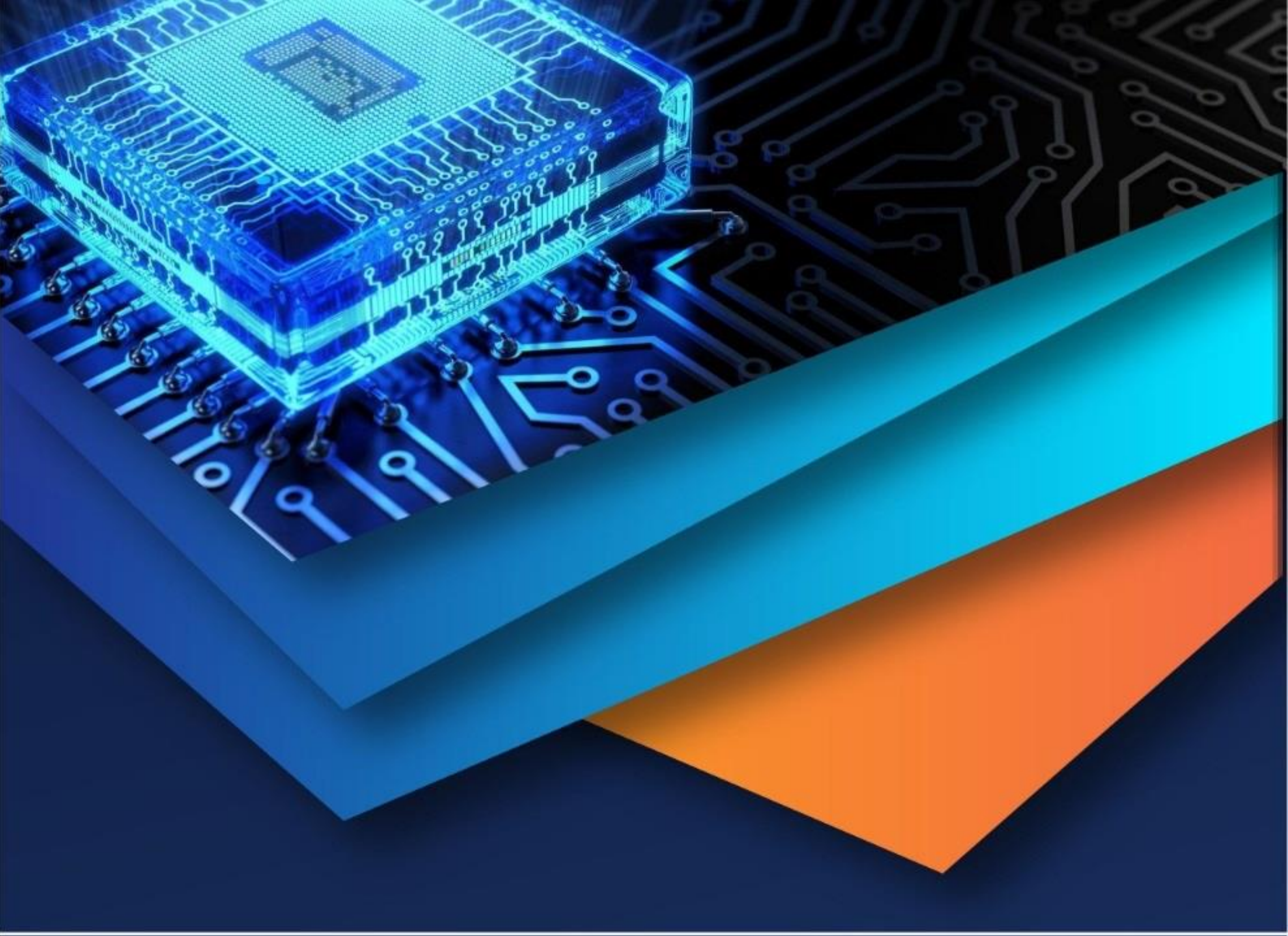
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

[12] C. Sarkar, D. Gupta, U. Gupta, and B. B. Hazarika, "Leaf disease detection using machine learning and deep learning: Review and challenges." Applied Soft Computing, 2023.
[13] S. M. Javidan, A. Banakar, K. A. Vakilian, and Y. Ampatzidis, "Diagnosis of grape leaf diseases using automatic K-means clustering and machine learning." Smart Agricultural Technology 3: 100081, 2023.
[14] S. U. Rahman, F. Alam, N. Ahmad, and S. Arshad, "Image processing based system for the detection, identification and treatment of tomato leaf diseases." Multimedia Tools and Applications 82, no. 6, 2023.
[15] Kiran R. Gavhale and U. Gawande, "An overview of the research on plant leaves disease detection using image processing techniques." Iosr journal of computer engineering 16, no. 1, 2014.



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