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Python Based Image Processing and Machine Learning for Plant Disease Detection

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Abstract— Although plant diseases pose a major threat to food security, the lack of necessary infrastructure makes it still difficult to quickly identify plant diseases in many parts of the world. The combination of increasing global technology penetration and recent advances in machine vision made possible by machine learning has paved the way for diagnosing illnesses using python. Machine learning technique to identify 14 crop species and 26 diseases (or their absence) using a public dataset of 54,306 diseased and healthy plant leaf images collected under controlled conditions Train the network. The trained model achieved 99.35% accuracy in a sustained test set, demonstrating the feasibility of this approach. Overall, the approach of training machine learning models with increasingly large and publicly accessible image datasets represents a clear path to the diagnosis of global plant diseases.

***Keywords*—** Digital image processing, Agri-farm plant disease, Machine learning, Plant disease detection.

I. INTRODUCTION

The main purpose of "plant disease detection" is to maintain and track crop disease records and detect farm disease records. This application for Agriculture farms to maintain farm data such as disease details detection, plant disease details, disease details detection, laboratory details, etc. The project title is "Plant Disease detection" and it was developed using PYTHON as the front end. Plant disease detection can be entered with a username and password. It is accessible to managers who detect diseases, plant diseases, and farmers. Only they can add data to the database. The data is easy to get. The data is easy to get. Plant Disease Detection automates farm management, making it more efficient and error-free. It aims to standardize data, consolidate data, ensure data integrity, and reduce inconsistencies. The "Plant Disease Detection" project is designed to replace existing systems that help plant diseases test disease detection online and keep a record of plant disease details. Disease details are detected and disease details are saved in the database. The administrator manages the entire system. The title of the project is "Detection of plant diseases”. This is a web-based application. This system is a computer software system used to manage farm operations and events. This system aims to provide an all-in-one solution for farm and healthcare services.

Traditionally, this was done manually. The main function of this system is to register and store plant diseases, detect disease details, get those details as needed, and manipulate those details in a meaningful way. These services are intended to be delivered in an efficient and cost-effective manner with the aim of reducing the time and resources currently required for such tasks. Plant disease detection can be entered with username and password. It is accessible to managers who detect diseases, plant diseases, and farmers. Only they can add data to the database. The data is easy to get. The data is easy to get. Plant Disease Detection automates farm management, making it more efficient and error-free. It aims to standardize data, consolidate data, ensure data integrity, and reduce inconsistencies. Plant disease detection can streamline and digitize all processes within the facility. This streamlines customer service improvements, process cost reductions, disease record retrieval, plant disease detection, disease detection and more therefore and there is a database for each module implemented. Current systems require multiple records of crop diseases and manual detection of disease details.

A. Improved process

One of the main advantages here is automation. Helps optimize the user experience. Disease experts, crop diseases, and agricultural authorities can interact online, perform analysis, and share information.

B. Digital disease records

The farm database contains all the necessary data about plant diseases. The medical history, test results, and treatments listed can be obtained through disease detection without delay to make an accurate diagnosis and monitor the health of the plant disease. You can reduce the risk of error.

C. Cause of disease interaction
Engaging all employees is important for improving coordination and teamwork. You don't have to make a special request or wait a long time for a reply. Each specialist is responsible for a specific process phase and can share the results with colleagues with a single click.

D. Facility management
Agricultural authorities can manage available resources, analyze the causes of illness, reduce equipment downtime, and optimize supply chains. Another fact to mention is that the root cause of farm illness is dealing with digital data rather than endless paperwork.

E. Less time consuming
Everything is planned more accurately as services and interactions improve in every way. Saves time for all system users and provides up-to-date information.

II. BACKGROUND STUDY

Rossi, V., Onesti, G., Legler, S.E [1] The system is designed to help farmers diagnose infected crops and resolve problems immediately. Farmers need to have an application that works as a professional human labor in the process of diagnosing certain plant diseases. Plant diagnostic applications apply knowledge-based systems in the form of rule-based models acquired through data mining techniques. This paper presents a rule-based model using leaf image datasets. The experimental results show the accuracy of the rule-based model of 129 leaf images collected from the Mango Field area under the supervision of product quality and standardization at the University of Maejo and three class label answers (anthrax, seaweed spots, normal). It was shown to be 89.92%. From the experimental results, it is clear that the rule-based model can be applied to crop diagnostic applications.

R.Pydipati,T.F.Burks,W.S.Lee [2] The central idea is to build a seven-layer network structure whose main purpose is to extract the rich properties of citrus fruits. These features are superior to traditional features in identifying different disease categories and can improve detection accuracy. We propose a new network consisting of an input layer, three convolution layers, two fully connected layers, and an output layer. The convolution layer contains convolution and pooling operations. The proposed method gives good results in identifying citrus diseases. We perform three sets of experiments to show that our results are more accurate than the results of the other two common machine learning algorithms. Finally, experiments have shown that the proposed method is effective in identifying citrus diseases and provides effective technical support for accurate detection and prevention of citrus diseases.

Shanwen Zhang, Xiaowei Wu, Zhuhong You, Liqing Zhang [3] This article describes a support vector machine (SVM) for detecting cucumber leaf disease. Given the small sample size, a new experimental program was proposed to sample all leaf spots instead of sampling all leaves. Radial basis functions (RBFs), polynomials and sigmoid kernel functions were also used in the experiments to perform comparative tests. As a result, it was found that the SVM method, which takes each spot as a sample based on the RBF kernel function, is optimal for classifying cucumber leaf diseases. J.L. Hernández-Hernández, G. García-Mateos, J.M. González-Esquiva, D. Escarabajal-Henarejos, A. Ruiz-Canales, J.M. Molina-Martínez [4] Applying texture analysis using the Grayscale Co-occurrence Matrix (GLCM) to segment oil palm regions based on WorldView2 images. Various parameters of GLCM consisting of 5 distances and 3 directions are calculated and 8 texture features are extracted. Oil palm and non-oil palm features are trained and categorized using support vector machines (SVMs) based on the land use categories determined in the WorldView2 image. Segmentation based on 10x10, 20x20, 40x40, and 80x80 windows is determined using the output of the SVM classification results. Next, the normalized difference vegetation index (NDVI) of the segmentation area is calculated. It determines the accuracy of the segmentation of the oil palm area. The resulting segmentation of the oil palm area shows promising results that can be used for the purpose of developing an automated oil palm census.

Hrishikesh P. Kanjalkar, S.S.Lokhande [5] Farmers around the world can save the world from a potential economic crisis by taking immediate action to prevent serious damage to their crops. Manual disease detection may not be the ideal solution, so robotic methods of leaf disease detection may help agriculture while increasing crop yields. The purpose of this study is to improve classification results by combining ensemble classification with hybrid low masks, Gabor, SIFT, GLSM, and LBP. The proposed method demonstrates the use of ensemble classification. Gabor and SIFT are used for comparison. The features used are also important for best results, as the ensemble classification has been shown to be more accurate. In the experiment, we used images of diseased leaves of three plant species in the botanical village.

III. PROPOSED METHODOLOGY

A. Image database
The images used for the analysis are from the Plant Village Grape Plant Dataset (Black Rot). Since the database contains images of the leaves of a vine, which is usually a single leaf, and the background is monochrome, it was easier to segment the leaf area without a complex background. A total of 400 images were used. The resolution of each image in the dataset was 256x256. Healthy leaves are clean and have a perfect texture. Diseased leaves, on the other hand, are affected by brown spots and lesions.

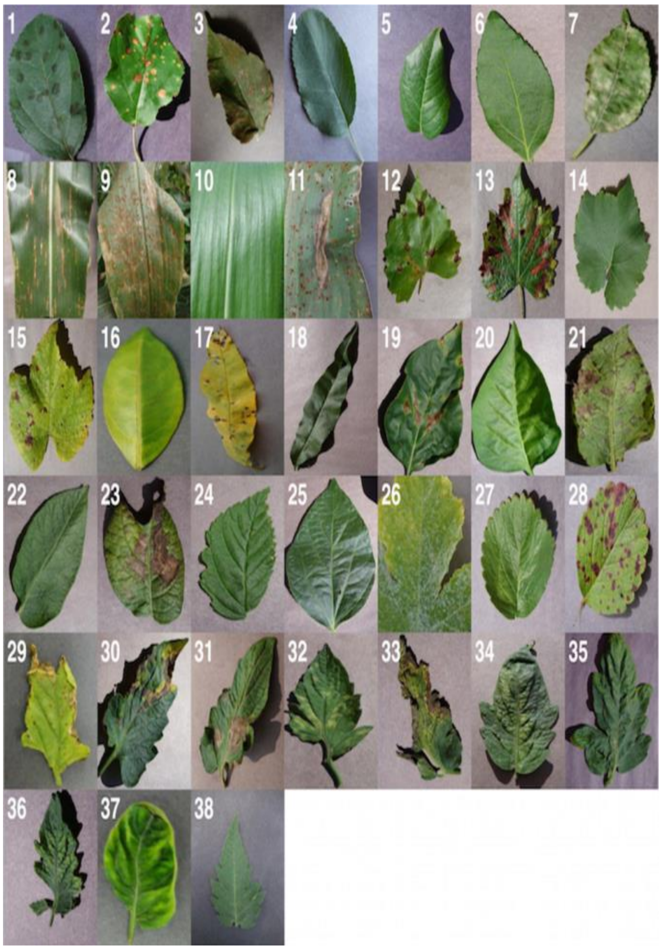


Fig. 1. Sample images in the dataset

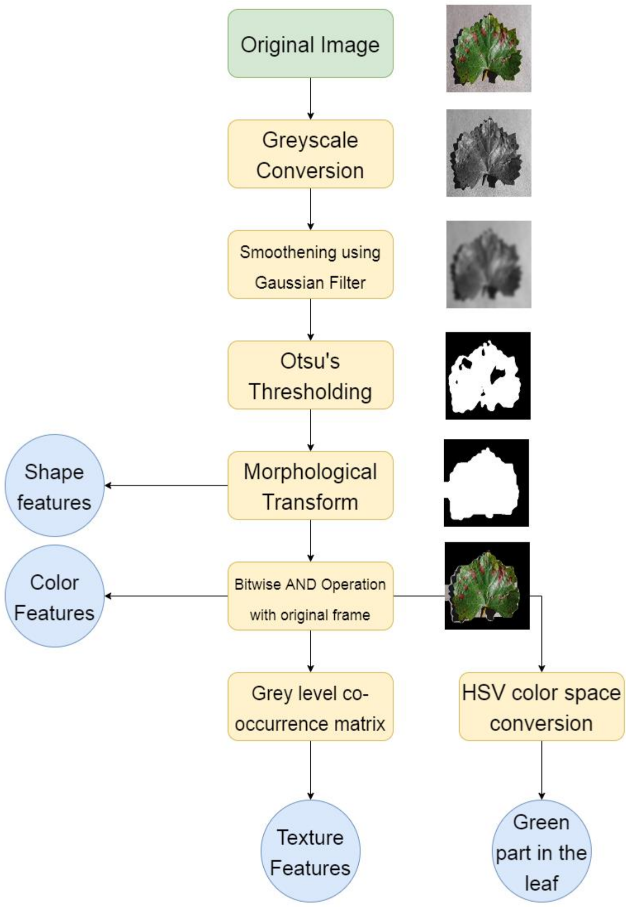


Fig. 2. Steps for data pre-processing and feature extraction.

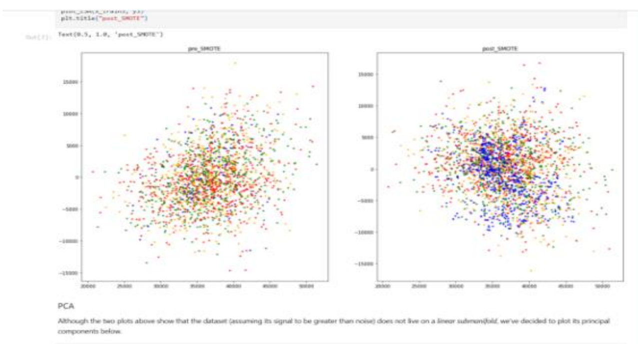
B. Data preprocessing and feature extraction

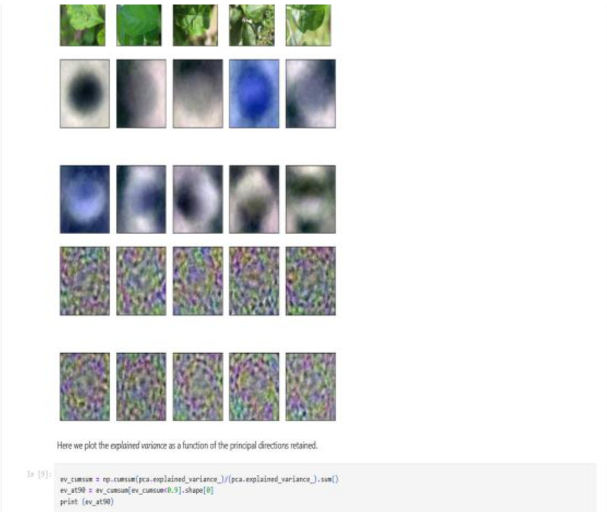
Data pre-processing is an important task in computer vision-based systems. Figure 2 shows the pre-processing procedure for each image. To get accurate results, some background noise should be removed before extracting the features. Therefore, the RGB image is first converted to grayscale and then the Gaussian filter is used to smooth the image. Next, Otsu's threshold processing algorithm is implemented to binarize the image. The morphological transformation is then applied to the binarized image to close the small holes in the foreground. Here, after foreground detection, a bitwise AND operation is performed on the binarized image and the original color image, and the RGB image of the segmented leaves is acquired. After image segmentation, shape, texture, and color features are now extracted from the image. Use contour lines to calculate the area of the leaf and the perimeter of the leaf. An outline is a line connecting all points along the edges of an object of the same color or intensity. The mean and standard deviation of each channel in the RGB image is also estimated. To get the amount of green in the image, the image is first converted to HSV color space, with a pixel intensity (H) of 30-70 in the hue channel and the calculated number of pixels in the channel. The non-green part of the image is calculated by subtracting the green part from 1.

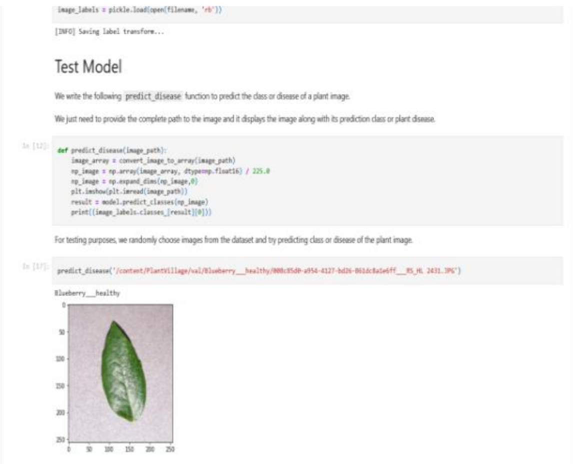
IV. METHODOLOGY

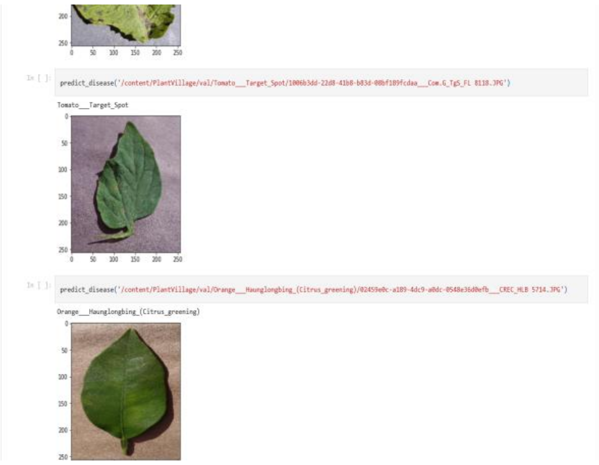
This is an image to be converted to HSV format. The leaves are segmented from the image. The L * a * b * model is then used in combination with Kmeans adaptive clustering to extract the affected area. Gray Scaling is applied to the extracted healthy and diseased images, and binarization is performed using Otsu's method of binarization. In both cases (both healthy and sick), the pixel count is calculated based on white pixels. Classification is applied using a supervised machine learning algorithm, a support vector machine and its different kernel.

V. RESULTS AND DISCUSSION









The images used for the analysis are from the Plant Village Grape Plant Dataset (Black Rot). Since the database contains images of the leaves of a vine, which is usually a single leaf, and the background is monochrome, it was easier to segment the leaf area without a complex background. A total of 400 images were used. The resolution of each image in the dataset was 256x256. Healthy leaves are unstained and have a perfect texture, while diseased leaves are affected by brown spots and lesions.

VI. Conclusion and Future Scope

This machine learning application was successfully created using this application and stored in a database all plant diseases, disease detection, laboratory details, plant disease detection disease details, and management details. The application has been very well tested and the bugs have been fixed appropriately. Testing has also shown that the performance of the system is sufficient. All the required output is produced. Therefore, this system provides an easy way to automate all the functions of consumption. This is useful if this application is implemented in different ways. Further improve your project to make it more attractive and convenient than your current website. You can see that the application is functioning normally and meets the requirements. The application has been very well tested and the bugs have been properly debugged. It also acts as a file share between valuable resources. Systems that have been in use for several years will gradually deteriorate and become less effective due to changes in the environment that must be adapted. For some time, it is possible to overcome the problem of additions and minor changes to acknowledge the need for fundamental changes.

The following conclusions can be deduced from the development of the project.

Increase efficiency by automating the entire system.

Provides a user-friendly graphical user interface that has proven to be superior to existing systems.

Grant authorized users' appropriate access based on privileges.

Effectively overcome communication delays.

It will be very easy to update the information.

Feature system security, data security, and reliability.

The system has ample room for future changes as needed.

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