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Smart Leaf Disease Detection Using Computer Vision And Machine Learning Techniques

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Abstract

The Research suggests and experimentally test a software programme for the automated identification and categorization of plant leaf ailments. Furthermore, even though they've never been good at biology, they still want to learn more about that plant. Simply put, it indicates that he or she is curious to learn more about this certain subject. Its name or unique characteristics can pique his curiosity. If a plant is uncommon or on the brink of becoming extinct, he or she could sometimes be interested in looking it up. Even today, a very small number of highly skilled individuals still do manual identification and categorization of unidentified plant species. Here, we provide a fresh method for categorizing various plant species that is based on the fusion of leaf features and random forest (RF) classification algorithms. The four steps of the suggested technique are preprocessing, segmentation, feature extraction, and classification. since the majority of plant species have distinctive leaves. The form, color, texture, and veining of each leaf makes it unique from the others. The characteristics of a leaf include its color, veins, GLCM, shape, and Gabor traits, among others. By conceptually concatenating two vectors, all of these properties are combined. Therefore, this research's categorization strategy is based on plant leaves. According to experimental findings, this approach's accuracy and other metrics may be tested by fusing all of these features or by using alternative combinations of them. An intelligent system that can recognize different tree species from images of their leaves can do it quickly and accurately. Here, we're creating Web apps built on the Asp.net and C# frameworks to assist small farmers in rapidly and simply evaluating the damage to their plants.

Keywords— Histogram Equalization, Gaussian Filter,Morphological Operation, Vein, Erosion, Haralick, Random Forest.

Introduction

Reliable, accurate assessments from the claimant force level are unlikely for Numerous people do research on plant pathology, including evaluations of social Additionally, disease forecasting, dispersion gradients, recognizing relationships between symptoms and the environment, and testing germplasm for pathogen resistance are all other topics. Despite the need to ensure that phototachymetric evaluations are both accurate and precise, these evaluations require assistance often inferred beginning with ocular evaluations at various degrees of determination (plots, plants, or tissues). Gauging a disease's severity, which is described here similarly to those, is a common method of assessing a disease's amount of force. amount (for example, area) from claiming sick plant tissue in relation to the total amount of vulnerable tissue available. Additionally, severity may have a chance to be expressed as the number of lesions for each testing unit for rusts and other diseases. illness occurrence, as shown by as an instance, the degree of sickness in a population's examining organs and plants may also indicate the severity of the disease. Frequency Additionally, various check information must be compared for visual estimations of infection severity since raters are inherently susceptible to bias and observational mistakes. This business benefits farmers and other customers who care about plants. However, there are several situations in which substantial chunks occur. Before, plants suffered greatly from alleged diseases caused by viruses and other tiny creatures. Additionally, by watching and organizingall the instrumentation's stock in this manner, growths and other things may be improved. And there are several ways to combat this disease; our one responsibility is to support the farmers and the other customers in helping the plants recover their health.

Related Works

In their proposal for a method for a semi-automatic leaf disease detection and classification system for a soybean cluster, Shrilekha Pandey and Shivani Goel explain the research model, theory, strategy for gathering data, and technique for evaluating the Sukhvir Kaur. Grayscale pictures are easier to analyze and execute for a variety of applications due to their superior clarity and suitability for analysis compared to RGB images, according to the report. The application of histogram equalization improves the contrast of the photographs and gives the human eye a clear picture. In many biological and medical applications, such as digital X-rays, plant disease, etc., histogram equalization is utilized to provide better-quality grayscale images. Therefore, these kinds of pictures will be utilized to analyze and diagnose plant leaf illnesses and ascertain the severity of such diseases [1].

Plant disease detection, quantification, and classification methods for digital image processing are proposed by Jayne Garcia and Arnal Barbed. This essay attempted to provide a thorough analysis of the subject. The explanations are brief and provide a fast overview of the theories underpinning the solutions because of the many references. It is crucial to emphasize that this effort is not the only one done on the issue. Due to length restrictions, not all relevant articles could be included; instead, the ones that could were chosen to cover the widest range of potential issues. As a result, the reader may consult the bibliographies of the relevant publications to get a more thorough grasp of a particular application or topic [2].

The K-means Clustering Method is a method proposed by Anand R, Veni S, and Aravinth J for the use of image processing to the identification of Brinjal leaves. Implementation of a system for the identification and categorization of leaf disease. The segregation of the ill is put into practice. K-Means segmentation is used to divide apart the sick portion. Following that, SVM is used to extract and classify the GLCM texture features. Testing of the technique is done on citrus leaf disease detection. Future research will be done to classify diseases in many plant species and to increase classification precision [3].

Using digital image processing, R. Meena Prakash, G.P. Saraswathy, G. Ramalakshmi, K.H. Mangal Eshwari, and T. Kavitha present a method for detecting and classifying leaf disease. The primary focus of this research is the automated leaf surface-based detection of tomato pests and diseases. The transfer learning technique used to train the detection models to categorize the tomato illness and pasts obtains an average classification accuracy of 89 percent. Future study will concentrate on the complex algorithms to identify tomato pests and disease based on relative low-quality leaf photos [4]. However, the overall good performance relies on relatively high-quality test photographs (i.e., simple backdrop, object-centered, positive close-up photography).

Plants Disease Identification and Classification Through Leaf Images: A Survey by Sukhvir Kaur, Shrilekha Pandey, and Shivani Goel proposes a method. The identification of diseases is a little easier in this study than their precise categorization. Sometimes it becomes difficult for a specialist to confidently categorize a certain illness. Focus may also be placed on the creation of systems that can accurately classify diverse bacterial, viral, and fungal illnesses. Deficits in minerals or nutrients are regarded in literature as a different kind of plant disease. Another intriguing area for study may be the creation of systems that can successfully distinguish between an illness and a deficit. This might be seen as a highly challenging aim since, according to experts [5, it is difficult to distinguish between an infected leaf and a deficient leaf.

A. Wan Mohd Fedzil Using border segmentation techniques, W.M.N., Shah Rizam M.S.B., R. Jailani, and Nooritawati M.T. offer a method for detecting orchid leaf disease. A suggested image processing technique aims to identify and diagnose diseases. In order to identify leaf disease, the leaves of the pepper plant are used as a set of leaves. Healthy and diseased plants may be distinguished using this method, which also yields superior results. By examining the visual symptoms present on the plants' leaves, this image analysis technology makes it possible to remove disease-free pepper plants from a farm, increasing output [6].

Different Methods

A. Image Equalization

Over the last several decades, many approaches for digital image processing have been created. Digital cameras automatically focus, expose for the optimum amount of light, and record the image in low luminance, but often also catch the details of the bright region. When this occurs in a backlit image, the dark illuminated area saturates the whole picture when the pixel intensity in the bright area gets close to the camera's maximum sensitivity.

B. Image Pre-processing

A Gaussian filter is a filter whose impulse response is a Gaussian function in electronics and signal processing (or an approximation to it). A step function input is not overshot with a gaussian filter, and the rise and fall times are kept to a minimum. This behaviour is closely related to the Gaussian filter with the smallest group delay achievable. These characteristics are crucial in fields like digital communications systems and oscilloscopes.

It is a precise illustration of how the distribution of numerical data is distributed. Karl Pearson was the first to present it as an estimate of the probability distribution of a continuous variable (quantitative variable). A histogram only connects one variable, in contrast to a bar graph's two-variable relationship. The first stage in creating a histogram is to "bin" (or "bucket") the range of values, or split it into a series of intervals, and then count the number of values that fall into each interval. The bins are often defined as a series of discrete intervals that don't overlap. The bins (intervals) must be next to one another and are often (but not always) of comparable size.

C. Image Segmentation

Vector quantization technique k-means clustering, originated from signal processing, is useful for data mining cluster analysis. k-means clustering divides n observations into k clusters using the closest mean as the prototype. This partitions data into Voronoi cells. Since the total variance is constant, this maximises the sum of squared deviations across points in different clusters (between-cluster sum of squares, BCSS), which comes from the law of total variance.

Multiple flaws may occur in binary pictures. Noise and texture warp basic thresholding binary areas. Morphological image processing accounts for picture shape and structure to remove these flaws. Greyscale photographs may use these methods. Morphological image processing involves non-linear actions on image characteristics' form or morphology.

Morphological procedures are ideal for binary image processing since they solely depend on pixel values' relative ordering. Using morphological techniques on greyscale photographs might make their light transfer functions unknown and their absolute pixel values unimportant. Morphological methods use structure elements to examine images.

Each pixel of a structuring element in a binary picture is connected with its neighbourhood pixel. The structural element fits the picture if its pixels set to 1 match the image pixels. A structural element hits or intersects an image if at least one of its pixels set to 1 matches an image pixel set to 1. Ignored zero-valued pixels of the structural element indicate picture values that are irrelevant.

D. Feature Extraction:

Skin lesions are represented by form, colour, and texture in feature extraction. Lesion region is dominated by colour and texture.

Skin lesion pictures have area, perimeter, and eccentricity. Area is the number of skin lesion pixels. Perimeter: Region border distance. It is the number of edge pixels in segmented skin lesion picture. Eccentricity: Major-Minor axis ratio.

Color features measure lesion picture colours.

We calculated Mean, Standard deviation, Skewness, and Kurtosis of the segmented area of skin lesion photographs in HSV and YCbCr colour spaces. This statistic better identifies color-changing skin lesions.

Calculating statistical Haralic characteristics quantifies skin lesion texture. Haralick Features: Texture characteristics computed from grayscale photographs by Robert Haralic are 13. This characteristics are computed via angles. Classifier accuracy is improved by these.

Leaf veins provide vein characteristics. Vein characteristics have four types: V1=A1/A, V2=A2/A, V3=A3/A, V4=A4/A Where A1, A2, A3, and A4 are vein pixels and A is leaf area. The leaf vein is formed by opening. This operation subtracts the margin from the Gray scale picture with flat, disk-shaped structuring element of radius 1, 2, 3, 4. A vein-like structure develops.

E. Classification

Random forests are tree-based algorithms that use random data and variable selection to build decision trees. Combine output from each tree and allow most popular output from all ensembles of trees to increase classification accuracy. Random forest finds crucial training set traits. Random decision forests remedy decision trees' overfitting to training sets. The strength of each forest tree and correlation among decision trees determine the generalisation error. Most tree predictions are accurate for most data. Random inputs and feature computed from dataset for optimum classification results. Missing data may be worked.

Proposed Approach

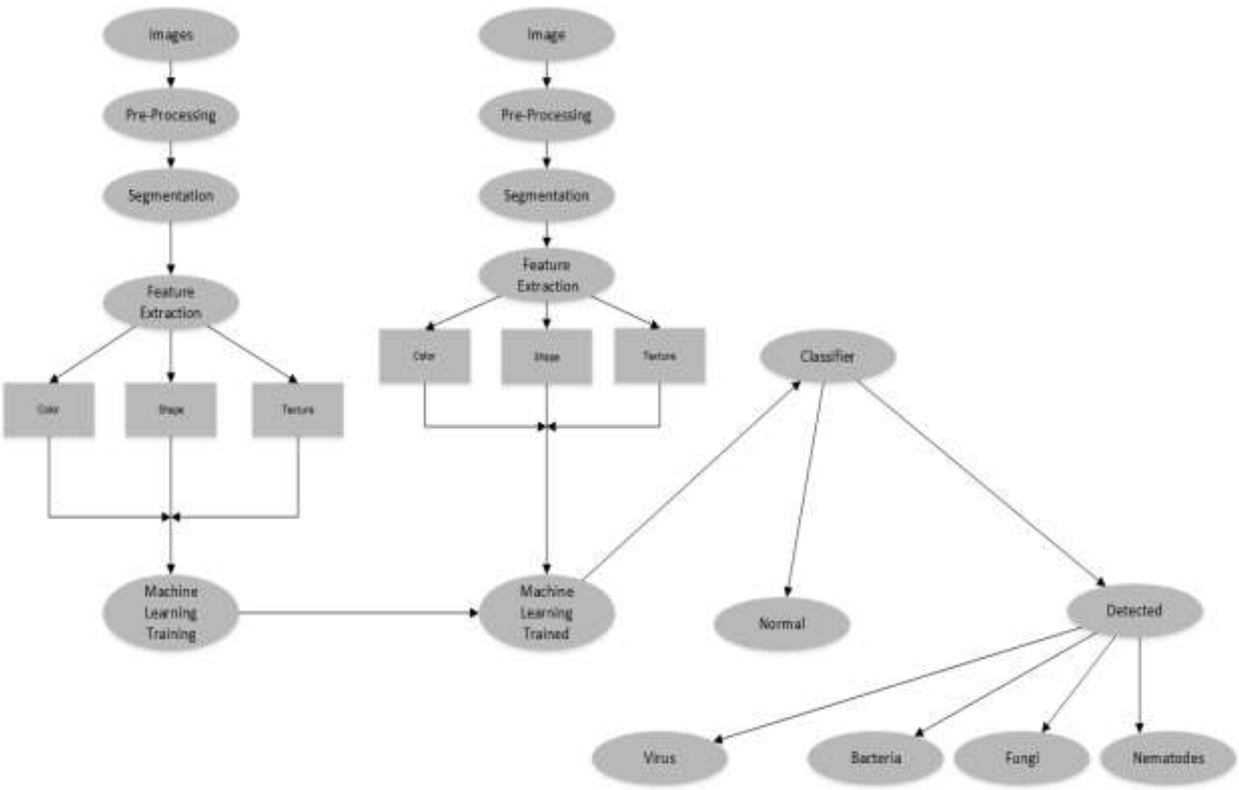

Fig.1. Proposed System

[1] Training

Step 1: Select or upload images and its Label.

Step 2: Apply Pre-Processing using Histogram Equalization and Denoising on whole image datasets.

Step 3: Apply Color and Cluster Based Combine Segmentation approach.

Step 4: Extract Shape, Color and Texture Features for all images.

Step 5: Apply machine Learning Approach RF and make database.

[2] Testing

Step 1: Select or upload image.

Step 2: Apply Pre-Processing using Histogram Equalization and Denoising.

Step 3: Apply Color and Cluster Based Combine Segmentation approach.

Step 4: Extract Shape, Color and Texture Features.

Step 5: Apply machine Learning classification Approach RF using database.

Step 6: Classify Disease type.

Results

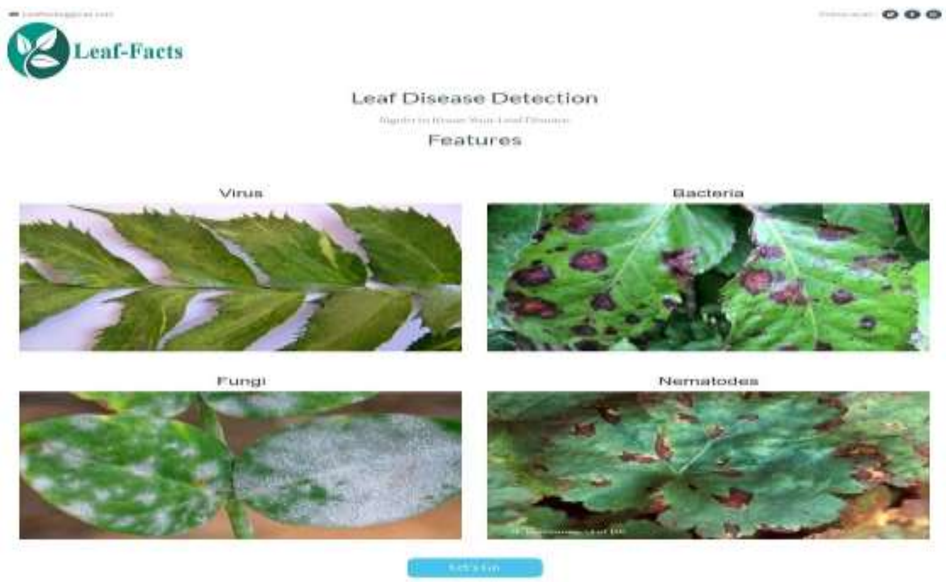

Fig.2. Home Page

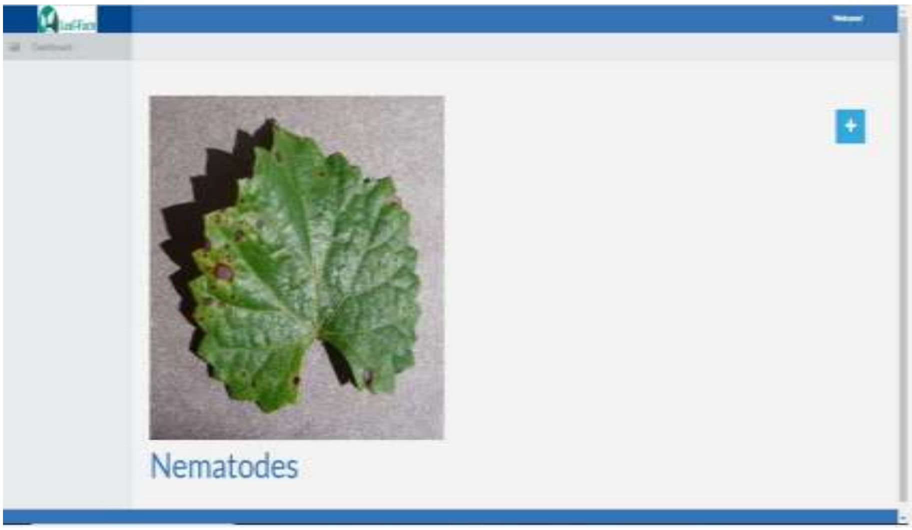

Fig.3. Check Defect Type

Table 1: Results Analysis

Actual	1	2	3	4	5	Precison	Recall	Acurracy
1	2	0	0	0	0	100%	100%	
2	0	2	0	0	0	100%	100%	
3	0	0	2	0	0	66.67%	100%	90%
4	0	0	0	1	1	100%	50%	
5	0	0	0	0	2	100%	100%	

Conclusion

Four processes make up the standard procedure for a computer-aided plant defect diagnosis system: building the leaf database, angel augmentation, analysis (extraction of leaves), feature extraction, and classification. This analytical assignment's main goal is to suggest methods that improve the anniversary operating of leaf feature-based bulb defect diagnosis. A system for classifying leaves has been created. The technique employs RF as a classifier and combines form and vein, colour, and texture data. We get to the conclusion that using vein for feature descriptors is a reasonable substitute for categorising structurally complicated photos. GLCM provide improved performance over previous moment-based methods and offer remarkable invariance properties. More accurately than any other classifier is the Random Forest Classifier. To identify plant defects with more than 90% accuracy, we have combined characteristics. Although the system's performance is adequate, we think it still has room for improvement. As a result, future study will focus on additional characteristics.

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