Ilkogretim Online - Elementary Education Online, 2022; Vol 21 (Issue 3): pp. 23-40
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2022.03.03

Detection And Classification Of Plant Leaf Disease Using Image Processing

Laxmi M. Tech Scholar, Department of Computer Science and Engineering, Sharnbasva University, Kalaburagi, Karnataka. laxmibg31@gmail.com

Savita Patil Assistant Professor, Department of Computer Science and Engineering, Sharnbasva University, Kalaburagi, Karnataka. savitha019@gmail.com

Abstract:
India is a developing nation where people are employed in the agriculture industry. Many people labour in the Siddha, Ayurveda, and herbal industries that produce food, medicine, and cosmetics. They must be able to locate and recognise various agricultural plants and herbs. The role of medicinal leaves in human life is one of the most significant. In biology and agriculture, recognising leaves is highly difficult because it helps discover new plants. This project uses MATLAB to identify leaf recognition. A digital camera with a resolution of 16.0 Megapixels is used to gather, photograph, and then store the various medicinal leaves in JPEG format. Using MATLAB's image processing technique, the medicinal leaves are analysed.

Introduction:
Several personnel carried out the detection of leaf spot disease utilising the following techniques: image acquisition, image pre-processing, disease spot segmentation, feature extraction, and disease classification. [3]-[4]. [5] Methodologies like K-mean clustering, texture analysis, and color analysis are suggested for Malus domestica plant disease diagnosis. the numerous illnesses and symptoms that affect banana leaves. For the purpose of detecting disease, algorithms were utilised. They also discussed the significance of pattern classification for identifying diseases. [6] analysed the severity of the leaf disease using image processing methods. They employed feature extraction techniques including triangular and threshold thresholds. Using image processing techniques, [7] was able to identify rice brown spot and infected blast leaves. For disease detection, they employed the zooming method and SOM neural network. employing KMeans clustering, the back propagation method, and CCM, the [8] inquiry was conducted on the plant diseases Early scorch, Ashen mould, Late scorch, Cottony mould, and Ting whiteness. [9] used morphological processing, color clustering, and LABVIEW IMAQ Vision to analyse cold disorders utilising image processing techniques. [10] carried performed leaf disease detection on orchid leaves, including Sun scorch and Black leaf spot. They employed border

segmentation and classification of pattern techniques to identify damaged leaves. They employed border segmentation and classification of pattern techniques to find ill leaves. The current work uses image processing techniques to automate the diagnosis of leaf diseases on Phaseolus vulgaris (beans) and Camellia assamica (tea) plants. Phaseolus vulgaris (beans) and Camellia assamica (tea) plant leaf disease identification has been automated utilising image processing techniques in the current work.

Millions of people around the world rely on Phaseolus vulgaris L. as a staple food and source of key nutrients [11]. Numerous illnesses impact it, but anthracnose is one of the most significant. Fungus Colletotrichum lindemuthianum is the culprit behind anthracnose illness. The underside of the leaves as well as the veins and petioles of the leaves exhibit depressed, elongated, and round lesions as symptoms [12]. One of the world's most well-liked non-alcoholic beverage crops is Camellia assamica (J. W. Mast.) Wight [13]. Alternaria alternata, a fungus, has a detrimental effect on the leaf. Young leaves' tips and margins will initially develop brownish-gray spots as disease symptoms. As the lesions progress near the midrib, the leaves curl, die, and defoliate [14].

The goal of this study is to identify the many varieties of leaves' form characteristics. the use of SPSS software for the analysis of various leaf data. because the trained output can be easily analysed, and the neural network can then be automatically formed. It is proven that the suggested strategy is successful and efficient at recognising and classifying the various leaves.

Image Definition:

The term "image" refers to a group of pixels or dots that are kept in a rectangular array. Each individual pixel has a unique type of color. By counting the number of pixels in a certain image, we may determine the size of that image. There are various types of photographs, including grayscale and black and white photos. Each type is distinct from the other. Since every pixel in a black-and-white image is either black or white, only one bit is required for each pixel. As opposed to grayscale photos, which employ 8 bits per pixel. Things become a little more challenging for photos in color. The number of bits at each dot in a color image is referred to as the image's height. The bit plane is another name for it. 2x color is achievable for bit planes made up of the symbol x. The color information of an image can be stored using a variety of techniques. The RGB image, commonly known as a true color image, is one of the methods. Red, green, and blue pixels are each represented by a three-dimensional array. Recognizing Patterns Different pattern recognition approaches are utilised in MATLAB to find the same type of pattern. These methods help us identify the same type of pattern in the situation. Similar patterns can be used to generate outputs or solve problems more quickly when they are found. We must train the machine in order for it to detect the pattern.

To start, we must first classify the data. The essential features are used to categorise the data. Various learning modules, including supervised learning and unsupervised learning modules, are available for categorising the data.

We use both of these modules to look for patterns. In the supervised learning module, we train the computer by pointing out patterns in the data set, and then the generated findings are applied to the test data set.The training dataset is used to train the machine, while the testing dataset is used to test it. Since there are no obvious patterns in the dataset for the unsupervised learning module, we use some method to try to find the patterns.

There are algorithms for clustering and classification, like the Markov Model (MM). We use a variety of techniques, including feature extraction, preprocessing, and classification, to recognise the patterns we find.

Preprocessing aims to smooth out the data by standardising it in a more structured manner. There are filters, such as noise filters. Typically, feature extraction is carried out with the use of software that extracts information from the data. This phase also involves the usage of sensors, and the classification comes last.

PROBLEM DEFINITION AND ANALYSIS

Finding the sick portion of the plant is the major goal. Convolutional neural networks are developed in MATLAB in order to categorise the diseased part.

1. The goal is to discover the best method at the lowest possible cost to identify the sick portion. We have taken into account the basic five types of plant leaf disease in this problem: Alternaria Alternata, Anthracnose, Bacterial Blight, Cercospora Leaf Spot, and Healthy Leaves.
2. All of these illnesses fall under the categories of bacterial, viral, or fungal infections. Determine the percentage of the area that is afflicted and the disease in our suggested solution. Compared to other existing methodologies, our method yields results in the shortest amount of time with the highest degree of precision and accuracy.

OBJECTIVES

1. To use and put into practise the new algorithm to track the development of the crop and find the unhealthy parts of the plant.
2. To apply the global optimization technique to improve the ideal outcome.
3. The most effective strategy to fix this issue is to change the current solution.

LITERATURE REVIEW

The 1st paper objective is to identify rice illness using pattern recognition. the 11th International Conference on Computer & Information Technology.

The purpose of this paper is to present product model framework for identification of disease in rice plants using various images of rice plants. Computerized cameras are used to capture pictures of the contaminated section of the rice plant. Different processes, such as picture division, picture developing, and so on, are used to identify the abandoned portion of the plant. The damaged leaf fragment is organised using the neural system. On the infected plant, precise processing operations and picture preparation are combined.

Procedures embraced in work:

• Creating examination strategies for photographs and preparing them Binary cutoff techniques.

• Self-organizing map; computation of the border layout using the eight-availability technique (SOM).

The self-organizing map is used in this assessment work to locate the sick portion of the rice plant leaf. Four different cropped photos are used for testing. Neural network pattern recognition algorithms are used to retrieve the infected zone. The framework will be able to accomplish the appropriate field issue finding by using efficient example acknowledgment methods, and the proposal will let the ranchers take the necessary action to improve the quality of the harvest. It won't just lower future improvement costs; it will also help the environment.

Finding plant leaf diseases using picture segmentation & soft computing methods is the goal of the second paper. published in Agriculture Information Processing.

The main idea of the paper is to use picture segmentation algorithms to track crop growth. The image is subsequently categorised to find the sick area after noise reduction and feature extraction.

Methods/Strategies used in the work:

Dispersion technique, Support Vector Machine (SVM), Artificial Neural Network (ANN), and Self-sorting out component.

Using photo segmentation techniques and machine learning algorithms, the information for crop ripening stages and contaminated section recognition is generated.

The extraction of hazy shading pixels from the image's base ran into a few problems.

• The grape leaf disease pixels cannot be divided more effectively using neural networks.

• The framework will exhibit incredibly strong programmed determination abilities. successful execution for the framework improvement of the agrarian item investigation/review.

The third paper's goal is to use image processing to find plant illnesses in remote areas. IOSR Journal of Electronics & Communication Engineering publication.

Gist of the Paper: Utilizing a classification technique, the infected section of the plant can be identified using color and other altering features.

Workplace strategy/methodology:

• Segmentation\s• RGB

• Image capture • Classification • Color transformation

Different pixel information are retrieved, and green leaves & diseased leaves are compared by calculating the ratio of the healthy leaf's pixels to its infected leaf's pixels. After the acquisition of the photographs, the background is removed & distinct regions of the images prepared.

• The optimum method for extracting the image feature is image segmentation. But more importantly, it's crucial to consider how reliable the outcomes are.

• The forecast framework showed an intriguing improvement in the results. In contrast to current expectation models, it may be a promising option.

• These methods can also be scaled and adjusted to meet different needs.

METERIALS AND METHODS

Software requirements

To solve the disease detection challenge, MATLAB is employed. This offers powerful backing for the use of sophisticated algorithms. The implementation of classifiers and machine learning algorithms is fairly simple.

Additionally, users of MATLAB can test and train their data. Users can choose different cutoff values for each characteristic, train the data on a specific dataset, and then check the data using testing tools. We evaluate a number of metrics in our challenge, including mean, correlation, contrast, variance, and smoothness. [2] The MATLAB already has algorithms for calculating all of these parameters.

We can quickly identify a leaf's specific disease kind by implementing the SVM classifier in MATLAB & passing the aforementioned parameters. Users of MATLAB can plot color, saturation, and intensity measurements for both healthy and diseased leaf types. In MATLAB, it is relatively simple to complete all prerequisites for putting the aforementioned techniques into practise. Here are several justifications for using MATLAB for this project.

- Simple algorithmic implementation.
- Previous events.
- Accuracy and exactness.
- Use of cutting-edge algorithms.
- Simple GUI execution.

MATLAB is ideal for processing digital images because it is a general-purpose programming language. Because it ensures that all user-implemented image processing stages are correctly documented, MATLAB enables users to replicate their work.

Additionally, using the guide command in MATLAB, a user can quickly design an interface. There is no need to write any code for the GUI because MATLAB generates the coding modularities for the GUIs automatically.

Testing is simple and all source codes are available. In MATLAB, the picture enhancement and segmentation processes are relatively simple. The Wiener function adaptively applies a Wiener filter (a form of linear filter) to an image, adjusting to the regional image variance. Wiener doesn't do much smoothing if the variance is high. Wiener smoothes more if it is smaller. In many cases, this method outperforms linear filtering in terms of results. Edges and other high-frequency portions of an image are preserved by the adaptive filter because it is more selective than a comparable linear filter. The wiener2 function does all preparatory calculations & implements the filter for input image, thus there are no design duties either. However, wiener2 takes more time to process data than linear filtering.

A) Methods/ Methodology for plant leaf disease detection & classification using image processing

The following are the steps for plant leaf disease detection and classification using image processing:

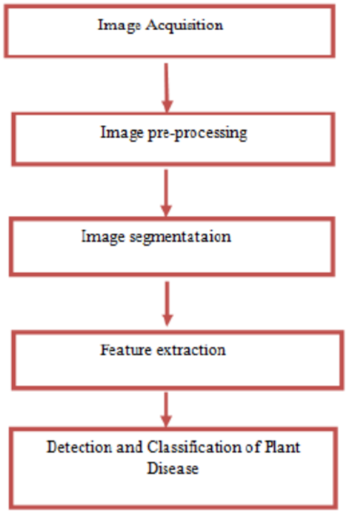


Fig.1. Block diagram of basic steps for plant disease detection & identification.

Image acquisition

Using a digital camera to capture images is known as image acquisition. Phaseolus vulgaris and Camellia sinensis leaf sick photos were preserved on digital media for future MATLAB procedures, and these images were the focus of our investigation..

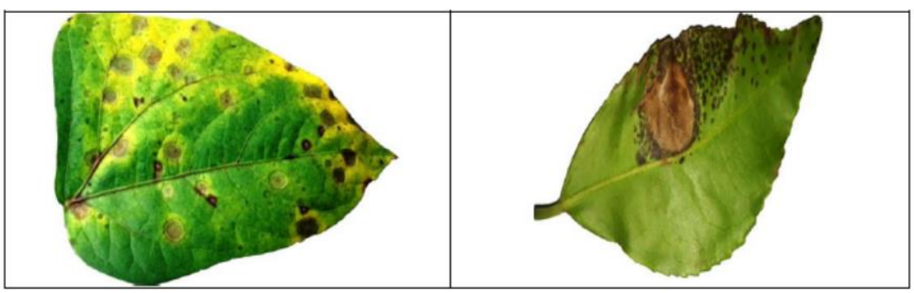


Fig.2 Original images of the diseased/infected leafs.

Image Pre- processing:

To enhance quality of the image & eliminate undesirable noise, image pre-processing is done, then the image is clipped and smoothed. Increasing contrast is the fundamental goal of the image enhancement. The following formula uses color conversion to create greyscale versions of the RGB images:

$$F(x) = 0.2989*R + 0.5870*B + 0.114*B \text{.....................} (1)$$

The intensity of the image is then equalised using a histogram, and the cumulative distribution function are used to spread the intensity [15].

Image Segmentation:

Digital images are converted using this technique into a variety of segments that are somewhat similar. The process of segmenting an image makes it easier to spot objects and image borders. In this study, objects are classified into K number of classes using K-mean clustering, which is based on a collection of features. In order to classify data, the sum of squares of the distance between data objects and the associated cluster are minimised [1].

Finding Features:

The feature extraction method for identifying plant diseases uses features such as color, texture, morphology, and structure. The color co-occurrence technique takes into account the image's texture and color. The RGB image of leaves is first translated into a representation in HIS color space as part of the color co-occurrence techniques. Each pixel map is used to create a color co-occurrence matrix, producing three different color co-occurrence matrices, one for each of the colors H, S & I [1].

$$X = 0.5\ \{(R\text{-}G) + (R\text{-}G)\}$$

$$Y = \sqrt{}\ (R\text{-}G)^2 + (R\text{-}B)\ (G\text{-}B)$$

$$\theta = \text{acos}\left(\frac{x}{y}\right)$$

$$H = \begin{cases} \theta & \text{if } B<G \\ 360-\theta & B>G \end{cases}$$

$$S = 1 - \frac{3}{(R+G+B)} * [\min(R,G,B)]$$

$$I = \frac{1}{3}(R+G+B)$$

Classification:

In order to analyse the diseased zone that has been taken from a picture and identify the type of leaves disease infection classification is used. Back propagation neural networks (BPNNs), which create associations between known patterns of input and certain outputs, are utilised in our investigation. While the output layer determines disease outcome of affected region, the input layer evaluates the diseased region. Between the input and output layers, there is a hidden layer that acts as a connecting link for the i/p & o/p pictures. It is used to get the lowest possible inaccuracy in the disease classification of the affected area [2].

B) Methods/ Methodology for medical leaves image recognition processing.

Step 1: Leaf preparation: Using a 16.0 Megapixel digital camera, the necessary medicinal leaves are collected [1].

Step 2: The input images that were obtained are saved in MATLAB as JPEG files.

Step 3: In the MATLAB, a programme is created and loaded. the transformation of the input photos.
Step 4: The program's photos were obtained after execution.
Step 5: In SPS software, the image data was copied and pasted.

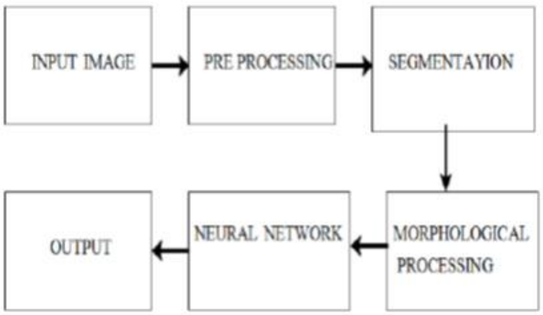


Fig.3. Image recognition process of medical laves.

Preprocessing

The image is captured with a digital camera and stored and loaded in the current directory as JPEG files. Fig.1. Any form of color or monochrome source's photos can be used with MATH. It supports raw format as well as file types including TIF (TIFF), JPG (JPEG), and BMP (bitmap).

EXPERIMENT AND RESULTS

A) Methods/ Methodology for plant leaf disease detection & classification using image processing

The results of the leaf disease detection are as follows:

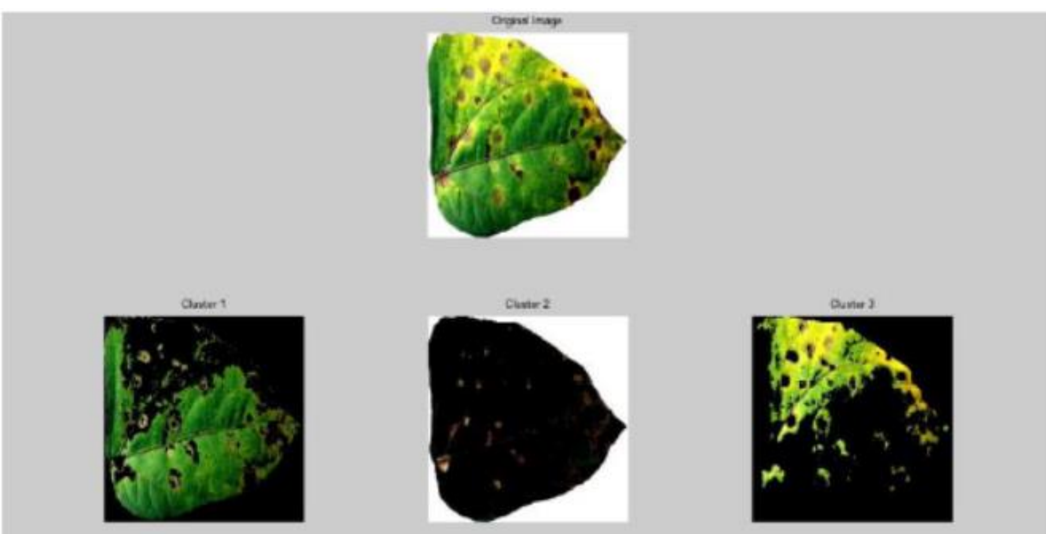


Fig. 4: Leaf disease detection using image processing technique.

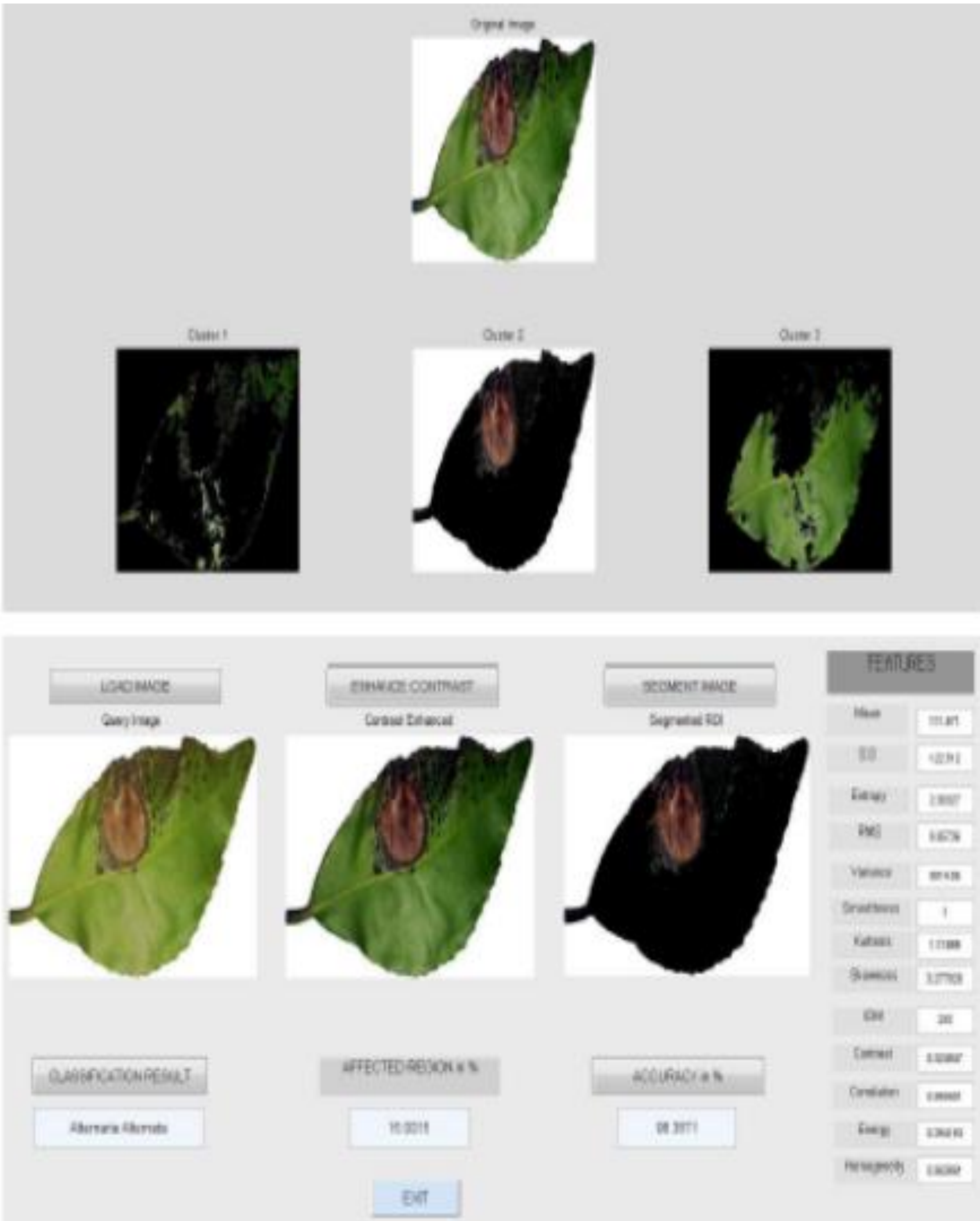


Fig. 5: Leaf disease detection using image processing techniques.

B) Methods/ Methodology for medical leaves image recognition processing.

RGB Convert to Grayscale image

One of the formats for color images is RGB. Our input photos are in Fig. 6. The color of the image, which is primarily green, has been impacted by numerous changes in the climate, water, and nutrients. Thus, the reliability of that color feature is poor. The color information for the image may be deleted.

Castor

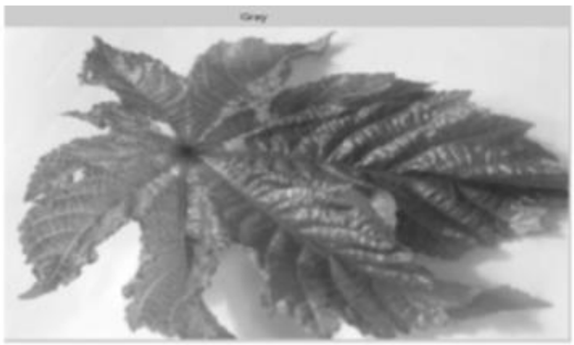
Betel

Fig.6. RGB Images

Grayscale image Convert to Binary

Grayscale images Fig.7 is different from one-bit bi-tonal black-and-white images, which are images with only black and white as colours when speaking of computer imaging (also called bi-level or binary images). There are many different hues of grey in grayscale photographs. Images that are simply one (mono) color are referred to as monochromatic or grayscale (chrome).

Grayscale images are often produced by calculating the amount of light present at each pixel in a single band of the electromagnetic spectrum when only a single frequency is captured (such as infrared, visible light, ultraviolet, etc.). The photographs are monochrome as is appropriate in these situations. They can, however, also be produced artificially by transforming full-color photos to grayscale.



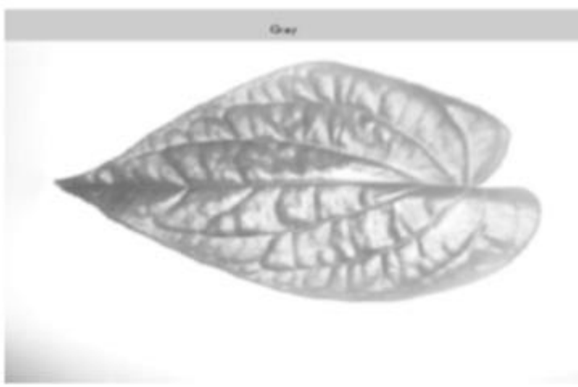


Fig.7. Gray scale Image

Grayscale image Convert to Binary image

A digital image known as a binary image only has two possible values for each pixel. Fig.8 Although two colors can be employed, binary images are most frequently created in black and white. The foreground colour in the image is utilised for the object, while the background colour is used for the remaining portions of the image. This is frequently referred to as bi-tonal in the document scanning industry. Bi-level and two-level are other names for binary images. As a result, a single bit represents each pixel (0 or 1).

The names "black-and-white," "monochrome," or "monochromatic" are widely used to express this concept; however, they can also be used to refer to any images with only one sample per pixel, such as grayscale images. A binary image is one that is set to Photoshop's "Bitmap" mode.

Binary images are routinely created during digital image processing, either as masks or as the final product of techniques like segmentation, thresholding, and dithering. Laser printers, fax machines, and bi-level computer displays are a few examples of input/output devices that can only handle bi-level images.

Fig.8. Binary Images.

Filtering

Smoothing helps to improve the image's visual quality by lowering noise. Filtering is a common term used to describe smoothness. In image processing, there are various forms of filtering.

Fig.9. Filter Images.

Fig.10. Edge Detection

Segmentation

The purpose of picture segmentation is to separate an image into pieces that are relevant for a particular application. The segmentation might be based on depth, motion, texture, colour, or grey level and is based on measurements taken from the image. For my project, edge-based segmentation is the most suitable segmentation method.

To prevent a bias in the size of the segmented object without utilising a complicated thresholding strategy, an edge-based segmentation approach can be applied. The idea behind edge-based segmentation is that an edge's position can be determined by the extreme of the first-order derivative or by a zero crossing in the second-order derivative. Since the first stage in processing images is edge detection, To acquire the greatest results from the matching process, it is vital to highlight the real edges. It is crucial to select edge detectors that are best suited to the application for this reason. This is why I went with the cunning edge detector. The Canny edge detection algorithm is likewise referred to as the best edge detector. Cranny intended to improve the image's numerous edge detectors [4]. These criteria are used by the clever edge detector to smooth the image in order to remove noise.

The gradient of the image is then found to emphasise areas with large spatial derivatives. Fig.e.

Following these regions, the algorithm uses non-maximum suppression to suppress any pixels that are not at their maximum. Hysteresis is now used to further lower the gradient array in order to eliminate streaking and thin the edges.

CONCLUSION

For Phaseolus vulgaris and Camellia assamica plant leaf tissue, the current work uses image processing techniques to automatically detect illnesses. Images are acquired as well as preprocessed before being segmented, extracted, and classified. Farmers can be assisted in recognising diseases at an early or beginning stage and getting beneficial information for their treatment by using cutting-edge computer technology, such as image processing, to construct automatic detection systems. Medicinal leaf identification is another capability of this activity. Grayscale, canny edge detector, neural network, and morphological techniques were combined to provide a revolutionary individual leaf extraction computer programme. The use of computers improves the efficiency and practicability of the use of medicinal leaf plants. The recognition rate was achieved by using the rapid recognition for a number of medicinal plants.

REFERENCES

1. Khirade SD, Patil AB (2015) Plant Disease Detection Using Image Processing. Int Conf on Comp Communication Control and Automation IEEE 153: 768-771
2. Surya Prabha D, Satheesh Kumar J (2014) Study on Banana Leaf Disease Identification Using Image Processing Methods. Int Jour of Res in Comp Sc and Inf Tech IJRCSIT 2(A): 89-94
3. Weizheng S, Yachun W, Zhanliang C, Hongda3 W (2008) Grading Method of Leaf Spot Disease Based on Image Processing. Int Conf on Comp Sc and Soft Eng, IEEE 491-494
4. Phadikar S, Sil J (2008) Rice Disease Identification using Pattern Recognition Techniques, Proce of 11th Int Conf on Comp and Inf Tech, ICCIT, Khulna, Bangladesh, IEEE 420-423
5. Sabah B, Sharma N (2012) Remote area plant disease detection using image processing. IOSR J Electron Commun Eng 2(6): 31-4
6. Sanjay B, Patil et. al (2011) Leaf Disease Severity Measurement Using Image Processing. Int Jour of Eng and Tech 3(5): 297-301
7. Phadikar S, Jaya S (2008) Rice Disease Identification using Pattern Recognition Techniques. Proceed of 11th Int Conf on Comp and Inf Tech ICCIT, Khulna, Bangladesh
8. Al Bashish D, Braik M, Bani-Ahmad S (2010) A Framework for Detection and Classification of Plant Leaf and Stem Diseases. Int Conf on Signal and Image Processing IEEE

9. Bin Husin Z, Bin Abdul Aziz AH, Bin Md Shakaff AY, Mohamed Farook, RBS (2012) Feasibility Study on Plant Chilli Disease Detection Using Image Processing Techniques. Third Int Conf on Intelligent Sys Modelling and Simulation IEEE
10. Wan Mohd Fadzil WMN, Shah Rizam MSB, Jilani R, Nooritawati MT (2014) Orchid Leaf Disease Detection using Border Segmentation Techniques. Conf on Systems Process and Control IEEE, Kuala Lumpur, Malaysia
11. Schwartz HF, Pastor Corrales MA, Singh SP (1982) New Sources of Resistance to Anthracnose and Angular Leaf Spot of Beans (Phaseolus Vulgaris L.). Euphytica 31:741-754
12. Hagedom DJ, Inglis DA (1986) Handbook of Bean Diseases. Madison, Wisconsin.
13. Zhou LX, Xu WX (2014) First Report of Alternaria alternate Causing Leaf Spots of Tea (Camellia sinensis) in China. https://doi.org/10.1094/PDIS-10-13-1086-PDN
14. Chakraborthy BN, Biswas RD, Sharma M (2006) Alternaria alternate – A New Foliar Fungal Pathogen of Tea in North Bengal, India. Plant Pathology Doi:10.1111/j.1365-3059.2005.01264.x
15. Thangadurai K, Padmavathi K (2014) Computer Vision Image Enhancement for Plant Leaves Disease Detection. World Congress on Comp and Communication Tech
16. "Evolutionary Artificial Neural Networks in Neutron Spectrology", Jose Mauel OrtizRodriguez, Ma. Del Rosario Martinez-Blanco and Hector Rene Vega-Carrillo.
17. S.Bashir,N.Sharma,"Remote Area Plant disease detection using Image Processing", IOSR Journal of Electronics and Communication Engineering , Volume 2, Issue 6 ,pp.31-34,2012.
18. S.Arivazhagan,R.N.Shebiah, S.Ananthi,S.V.Varthini ,"Using texture detection features, recoginizing unhealthy region of plant leaves and classification of plant leaf disease", AgricEngInt: CIGR Journal, Vol. 15, No.1,pp.211-217,2013.
19. Z.,Husin, A.Y.M.Shakaff, A.H.A.Aziz, R.S.M.Farook, M.N.Jaafar, U.Hashim, A.Harun "Embedded portable device for herb leaves recognition using image processing techniques and neural network algorithm".
20. Odimir Martinez Bruno, Rodrigo de oliveira plotze,Mauricio Falvo, Mario deCasstro "Fractual Dimension applied to plant identification".
21. Jinkya park, Eenjun Hwang, Yunyoung Nam, "Utilizing Venation feature for efficient leaf image retrieval".
22. Canny,j., 1986,"A Computatinal approach to edge detection".IEEE Transactions on pattern Analysis and machine Intelligence 8(6), 679-698.
23. James S.Cope, Devid Corney, Jonathan Y.Clark,Pado Remagnino, paul wilkin, "Plant spices identification using digital morphometrics, A review".
24. Luigi Cinque, Sergio Sellers Canizares steven Tanimoto "Application of a transparent interface methodology to image processing".