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# Support Vector Machine Based Classification of Leaf Diseases

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**Abstract:** Myanmar is well known for agricultural country; wherein about 65% of the labor force depends on agriculture. Since the leaf diseases are microscopic organism, cannot be detected normal human eyes. Leaves are special indicator to distinguish the diseases because the image information of the leaf are changed when the leaf surf the diseases. So, the image processing techniques can be used in agricultural sector. The research work presents a support vector machine classifier algorithm by using MATLAB R2017a for the classification of leaf diseases such as Alternaria Alternata, Cercospora leaf spot, Bacterial Blight and so on. In this research work, RGB color space is converted into HSI (Hue Saturation Intensity) color space. In segmentation step, k-means clustering is used to select the defected area, and it is extracted the features by using GLCM (Gray Level Co-occurrence Matrix). Prior to the features extraction, the median filter is used for getting noise free feature results. Finally, the leaf disease is classified by using support vector machine (SVM) and computes the accuracy. From the obtained results, the maximum accuracy of the system is 83%.

Keywords: leaf diseases; median filter; k-means clustering; gray level co-occurrence matrix; support vector machine

## 1. INTRODUCTION

Most of the diseases symptoms are found in leaves, stem and fruit. The image processing can be used in the leaf diseases detection and classification system. The common diseases of leaf are Bacterial Blight, Anthracnose, Alternaria Alternata, and so on. Such diseases are commonly found on mango, rice, watermelon, and others leaf. Leaf diseases can decrease the yield. These diseases may cause by pathogen such as fungi and bacterial. These diseases can be automatically detected and classified by using multiclass support vector machine (multiclass SVM). The main purpose of this research work is to design, implement and evaluate an image processing based software solution for classification of leaf diseases. The diseases of leaf features are as follow.

1. Alternaria Alternata: small reddish brown circular spots appear on the leaves.
2. Anthracnose: Appears as small regular or irregular dull violet or black leaf spots with yellowish halos. Leaves turn yellow and fall out.
3. Bacterial Blight: Appearance of one to several small water soaked, dark colored irregular spots on leaf.
4. Cercospora: Leaf spots are minute, brown with yellow halo. Spots are scattered, circular or irregular and become dark brown with age [1].

## 2. LITERATURE REVIEW

Some papers are describing to detection leaf disease using various methods suggesting the various implementation ways as follow. Visual Analysis, Image Processing and Optical Sensor are mainly implemented in three ways as the disease detection method. By using these three methods, the system can be developed to detect the disease earlier and that can overcome the challenges and disadvantages. By means of the methods comparison, disease detection by using visual analysis does not give the accurate output while in case of optical sensor, the system is not easy to implement and costly. So, image processing is the only way to build the simple, robust and accurate disease detection system [2]. While working with image processing, on the other hands, the database collection is the most challenging task. For database collection, it is necessary to collect the basic information about the crop and its diseases as the important task. Therefore, a detail study should be done on the types of disease, their symptoms on crop and the patterns of disease. By observing the patterns of disease, the system will get designed. The mainly occurring diseases on leaf are Bacterial disease, Fungal disease, Viral disease and diseases due to insects. The paper gives the detailing of these diseases [3].

## 3. METHODOLOGY

The methodology of the research work can be divided into four stages such as image preprocessing, image segmentation, feature extraction, and disease detection and classification. Block diagram of the system is shown in Figure 1 [4].

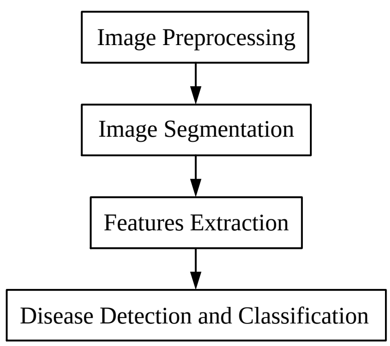



Figure 1. Block Diagram of the System

The flow chart of the leaf diseases detection and classification system is shown in Figure 2 [5].

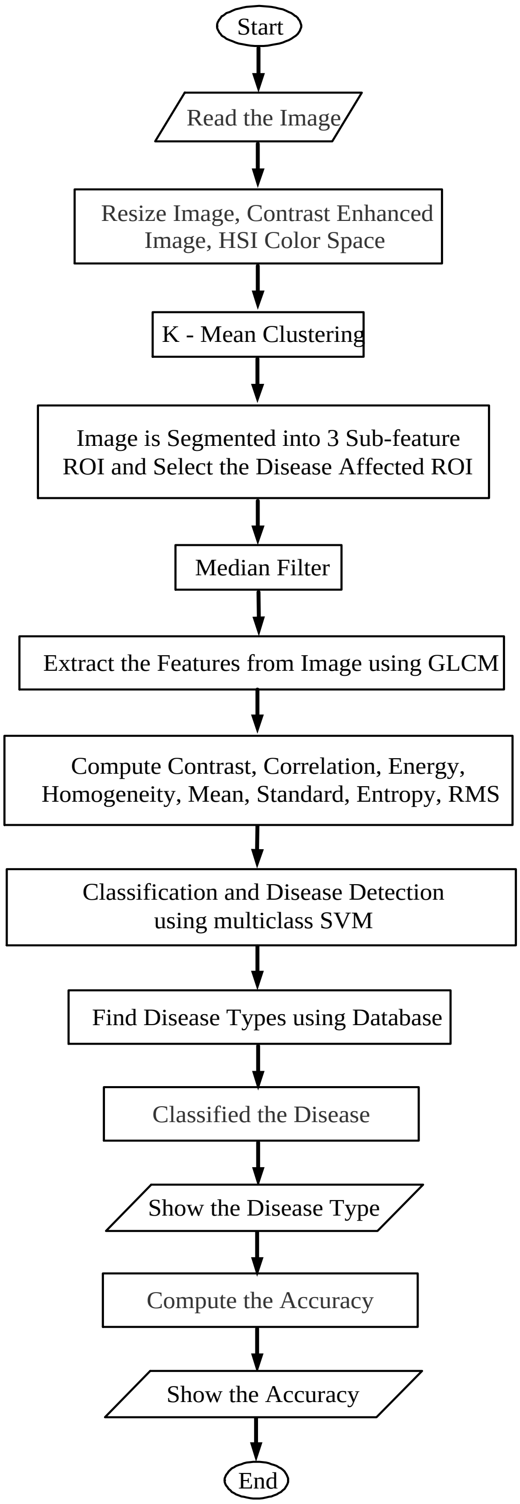



Figure 2. The Flow Chart of Leaf Diseases Classification System

The purposes and the advantages using image analysis are as follow [6].

1. To identify diseased leaf,
2. To measure affected area by disease,
3. To find the boundaries of the affected area,
4. To find out the color of the affected area,
5. To identify the diseases correctly.

The procedure of leaf diseases detection and classification system is the following.

1. Read input image.
2. Resize image.
3. The resized image is contrasted enhancement.
4. Converted RGB color space to HSI color space.
5. Apply k-mean clustering operation.
6. Image is segmented into three sub-features.
7. Select the disease affected area.
8. Filter the image by using median filter.
9. Extract the feature from the image using Gray-Level Co-occurrence Matrix (GLCM).
10. Compute contrast, correlation, energy, homogeneity, mean standard, entropy, root mean square.
11. Classify the diseases using multiclass support vector machine.
12. Compute the accuracy.
13. Show the accuracy.

## 3.1 HSI Color Space

HSI model is proposed to improve the RGB model. The Hue Saturation Intensity (HSI) color model closely resembles the color sensing properties of human vision. The HSI color space was developed to be 'intuitive' in manipulating color and was designed to approximate the way humans perceive and interpret color. HLS (Hue, Lightness, and Saturation) color space is similar to the HSI, the term light is rather than intensity. HSI color space is best for traditional image processing functions such as convolution, equalization, histogram and so on, which operate by the manipulation of brightness values since I is equally dependent on R,G, and B. The arccos function to compute H, arccos always gives you a value between 0 and 180 degrees.

However, H can assume values between 0 and 360 degrees. If B > G, then H must be greater than 180 degrees. Therefore, if B > G, just compute H as before and then take (360 degrees – H) as the actual hue value. The saturation is the distance on the triangle in the rgb-subspace from white relative to the distance from white to the fully saturated color with the same hue. Fully saturated colors are on the edges of the triangle. Hue is a color attribute that describes a pure color (pure yellow, orange or red), whereas a saturation gives a measure of degree to which a pure color is diluted by white light.

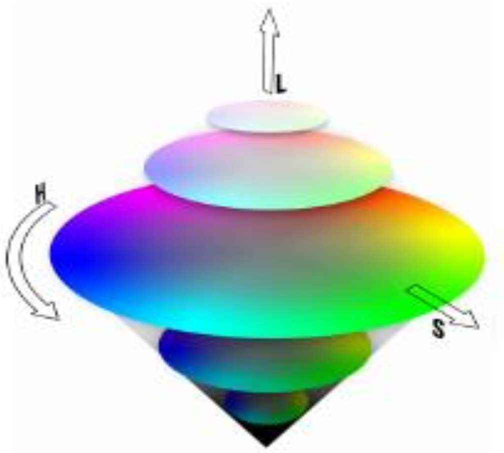



Figure 3. HSI Color Space

**Table 1. Some Colors and Three HIS Intensity Value**

| Color | H | S | I |
|---|---|---|---|
| Red | 60º | 1 | 0.375 |
| Green | 120º | 1 | 0.375 |
| Blue | 240º | 1 | 0.375 |
| Yellow | 60º | 1 | 0.375 |
| Cyan | 180º | 1 | 0.375 |
| Magenta | 300º | 1 | 0.375 |
| White | - | 0 | 0.75 |
| Black | - | 0 | 0 |

The HSI color model owes its usefulness to two principle facts. Firstly, the intensity component, I, is decoupled from the color information in the image. Secondly, the hue and saturation components are intimately to the way in which human being perceive color. HSI color space is shown in Figure 3 [7] and HSI intensity of some colors is shown in Table 1 [8].

## 4. TEST AND RESULTS

In this section, tests and results of automated leaf diseases detection and classification system using gray-level co-occurrence matrix (GLCM) and multiclass support vector machine (multiclass SVM) are expressed. The performance of the algorithm as a whole is analyzed and discussed. Tests were carried out to find the best segmentation result, so that the error measurement is minimized, and to confirm that leaf diseases detection and classification can perform accurately. As were as confirming that the system provides accurate detection, experiments were also conducted in order to confirm the detection by extracting the properties of the images. In the image preprocessing step consist of three parts such as read the image, resize image and contrast enhanced image. The image preprocessing is shown in Figure 4.

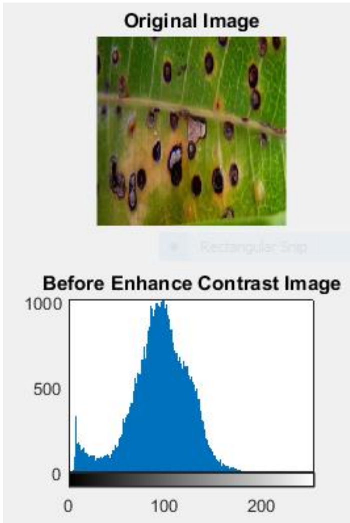
(a)

(b)

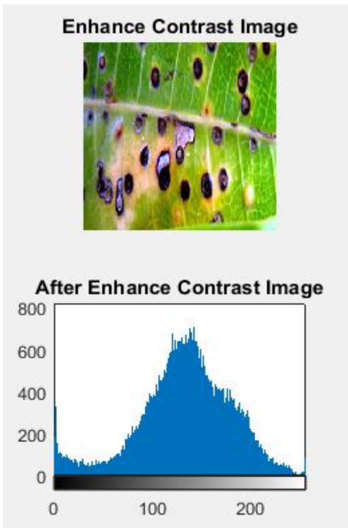
(c)

Figure 4. Image Preprocessing (a) Original Image, (b) Resize Image, and (c) Contrast Enhanced Image

Histogram equalization is a consideration for the image enhancement. It is a traditional approach of image contrast adjustment then the histogram equalization is shown in Figure 5.



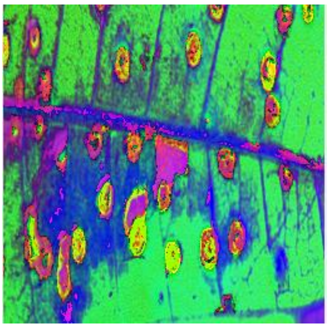

(a)



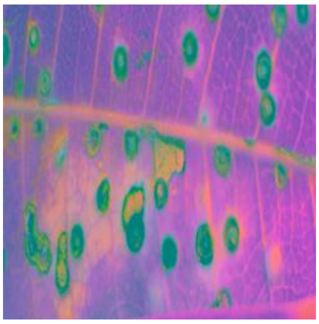

(b)

Figure 5. Histogram Equalization Image (a) before contrast enhancement, (b) after contrast enhancement

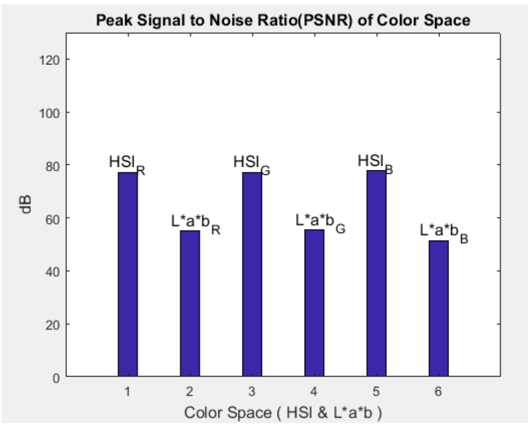
After making the preprocessing, the RGB color space is converted into HSI and L*a*b (a luminosity layer 'L*', chromaticity-layer 'a*' and 'b*'). The HSI color space is higher peak signal to noise ratio than L*a*b color space. The results are shown in Figure 6.



(a)



(b)




(c)

Figure 6. Color Space (a) HIS Color Space, (b) L*a*b Color Space, and (c) Peak Signal to Noise Ratio (PSNR) of Color Space

The image is segmented into three sub-features by using k-mean clustering. And then, select the disease affected area. The results are shown in Figure 7.


Figure 7. k-mean clustering

In the feature extraction, the segmented image is converted into gray scale image, then filter by using median filter and GLCM is used to extract the feature [9]. The segmented image is as shown in Figure 8. The gray scale image and median filter image are shown in Figure 9 and Figure 10. After that, the affected area of leaf can be calculated. The affected area of leaf is shown in Figure 11. Finally, the leaf diseases can be classified by using multiclass support vector machine. The disease type is shown in Figure 12. The accuracy is shown in Figure 13.

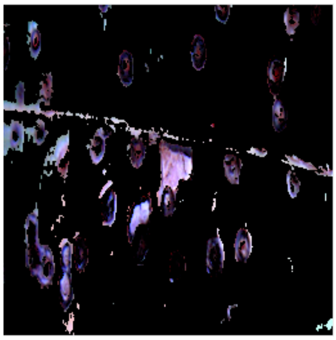


Figure 8. Segmented Image

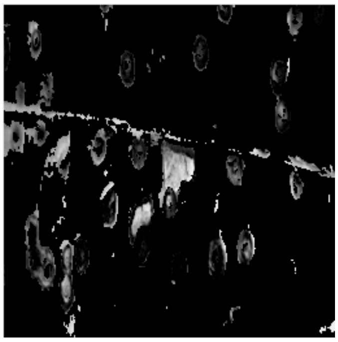


Figure 9. Gray Scale Image

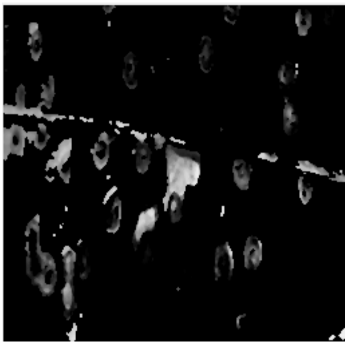


Figure 10. Median Filter Image

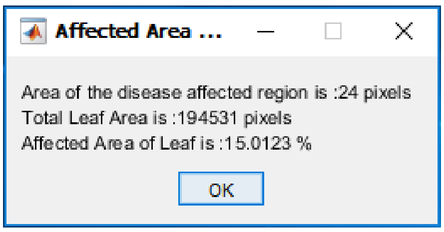



Figure 11. Affected Area of Leaf

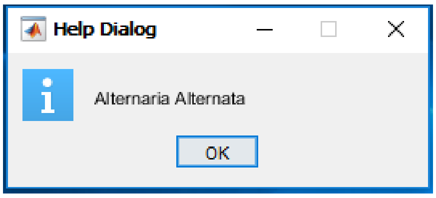



Figure 12. Disease Type of Leaf

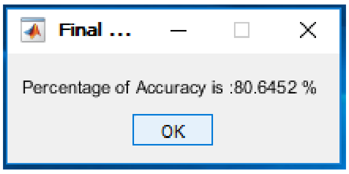



Figure 12. Disease Type of Leaf

This system elaborates the evaluated results with proper discussion. Windows 10 based system 4GB DDR4 Memory, 1TB of HDD, Core i5 is used for conduction the experiments. And then, MATLAB R2017a is used for the simulation of work. The total program execution time is shown in Figure 14.

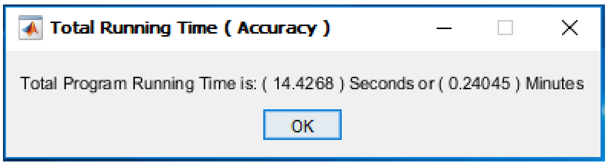



Figure 14. The Total Program Execution Time

Accuracy is defined as the ratio of the number of correctly recognized samples to the total number of test samples [10]. The percentage values of accuracy of each disease are shown in Table 2.

**Table 2. The percentage values of accuracy of each disease**

| Sr. No | Disease Type | Percentage of Accuracy |
|---|---|---|
| 1. | Alternaria Alternata | 80.6452 % |
| 2. | Anthracnose | 82.2581 % |
| 3. | Bacterial Blight | 80.6452 % |
| 4. | Cercosporal Leaf Spot | 82.2581 % |
| 5. | Healthy Leaf | 83.8710 % |

## 5. CONCLUSION

From the results shown in above, the total program execution time takes 0.24045 minute and the maximum accuracy is 83.8710%. Furthermore, this system can be applied for the other leaf diseases to get the peak signal to noise ratio. When the total program execution time is less, the system can be assigned the higher performance.

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