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Tea Leaf Disease Segmentation by using Color and Region's Mean Based Segmentation (CRM)

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Abstract: ***In agriculture image processing and Datamining play an important role. Prediction of crop yield prediction is very important in tea production. Image segmentation is used to segment the disease affected region in the leaf. It segment image into various homogeneous region. In this paper color and Region's mean based segmentation technique is introduced to subtract background and fore ground. This new approach is analyzed and compared based on five performance metrics such as PSNR (Peak Signal to Noise Ratio) Value, Rand Index (RI), precision, recall and accuracy. The proposed method gave better accuracy than other methods.***

Keywords: ***Image Processing, Segmentation, PSNR, Rand Index, Precision, Recall***

I. INTRODUCTION

Tea plant plays an important role in agriculture environment. Growth is most significant quality of a plant character. This external appearance significantly impacts the value of sales and the behavior of consumers when purchasing any item. Hence, quality inspection and grading system are crucial for the cultivation of excellent healthy crops in agriculture. Agriculture sector can experience significant manufacturing and financial losses caused by plant diseases. Managing this disease is a difficult job. Usually it can be seen on the leaves or on the stem of crops the illness or their symptoms such as colored spots or streaks. Most leaf illnesses in crops are caused by fungi, bacteria and viruses. The disease induced by these organisms is defined by various visual symptoms that may be observed in a plant leaves or stem. These symptoms are usually manually identified using image processing automatic detection of multiple illnesses. Image processing plays a vital role in plant disease identification as it delivers best outcomes and decreases human effort.

The image processing could be used for several applications in the agricultural field. It involves detecting diseased fruits, leaf or stem measuring the region infected by the disease, determining the colour of the region impacted.

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Due to plant disease, the degradation of the product's amount and quality is influenced the specialists perform the naked eye observation to detect and identify the crops. This detection and identification in large forms are land region is time consuming. In this publication it was discussed the significance of image processing methods in the identification and evaluation of plant diseases in the previous phases and does the product quality can be improved.

II. SEGMENTATION TECHNIQUES

Some classification is essential to present the methods to segment the image there are lots of techniques available. All techniques have their own style of segmentation. There are two segmentation approaches. Edge and region based approaches. Each approach is applied on various applications to get preferred region. There are large kinds of new methods proposed by various researchers and appropriately here. All the techniques also can be classified into basic three types as follows:

A. Structural Segmentation Techniques

This is one of the techniques of Image Segmentation. By using this image segmentation that depends on the basic information of the image structure of desired portion.

B. Stochastic Segmentation Techniques

The image segmentation works based on the pixel values of the image instead of the structural region.

C. Hybrid Techniques

This image segmentation techniques uses the above mentioned two techniques.

There are some popular techniques also used for image segmentation. They are

A. Thresholding method

This is the simplest segmentation technique. With the help of single threshold, it transforms an image into a binary image.

B. Edge detection-based techniques

It reduces the quantity of data to be processed. But this will retain the very essential data about the shapes and the objects which present in the scene. This process is quiet easy to implement the huge collection of different objects used in the computer vision along with other image processing applications.

C. Region based techniques

Region based procedure that group's pixels or sub regions into larger regions.

Where image characteristics are used to group adjacent pixels together to form regions.

D. Clustering based techniques

The ultimate aim is the group segmentation is similar traits and assigns them into clusters. Clustering is the process of dividing the image points into a number of sub groups such that the image points in the data groups are more similar to other image data points in the same group than those in other groups.

E. Watershed based techniques

The above mentioned techniques are different from each other in the methods and segmenting.

III. RELATED WORK

Qing Yao et al (2009) [1] suggested that rice disease spots be segmented and that the shape and texture characteristics be extracted from these sections. The findings showed that SVM was able to identify and classify these disease spots efficiently to an precision of 97.2%.

Mallikarjuna, P. B. and Guru, D. S. (2012) [2] a fresh seedling leaf segmentation algorithm for frog-eye spot and anthracnose seeding diseases is suggested. The algorithm of segmentation comprises primarily of two steps. The former one is approximate the extraction of lesions using transformation stretching contrast (TSC) and morphological operations such as erosion and dilation using CIELAB color model. The later step refines the first phase result by color segmentation. We also performed a segmentation algorithm performance evaluation by evaluating parameters MOL, MUS, MOS Dice similarity DSM and Error-rate-ER, Precision (P) and Recall (R).

Hanife Kebapci, Berrin Yanikoglu & Gozde Unal(2010)[12] using max-flow mean-cut(MFMC) graph cut mthod to segment the plant images from the background. MFMC technique has recently become one of the most popular segmentation approaches in computer vision.For solving MFMC problem directed weighted graphs, the augmenting path algorithm on ford and Fulkerson.the segments reports precision rates of 0.92 at top-5 and 0.88 at top-10 retrieval ranks.

Shantharajah, S., Kalaivani, S., & Padma, T. (2019)[4] Approach to segment leaf blight illness based on histogram intensity indexes. Segmented algorithms are used to validate the splitted portion and the most popular similarity measurements are DI (DiceIndex) measurements, Jaccard coefficient measurements, Cosine measurements, Asymmetric measurements, Dissimilarity measurements, etc. With 98.025 percent precision, the introduced technique effectively segments the impacted region also have 0.964 percent of mutual information in the segmented region.

IV PROPOSED WORK

COLOR AND REGION'S MEAN BASED SEGMENTATION (CRM)

Step 1: Input the Image

In this step preprocessed and noise removed image is given as input to this method.

Step 2: Size and Color Conversion

In the second step RGB color image is converted to CMY Color Conversion

Step 3: Region's Mean

Region is developed by evaluate the all unallocated adjacent pixels into the region. To measure the similarity difference between intensity of pixel and color region's Mean is used. Pixel with small difference is used to allocate for region's are grown.

Step 4: Splitting region:

This procedure stops at the intensity difference among region mean and new pixel turn into better than a certain threshold. Back ground subtraction applied to subtract the background and fore ground.

Step5: Remove the background and disease affected region:

In the proposed method noise removed image is given as input to this image and the RGB image is converted into CMY color. Then region is grown by comparing the adjacent pixels. To finding the similarity difference between intensity of pixel is used and to find the similarity and difference between region region's mean is used. When the difference is larger than a threshold value it stop the process. When dissimilarity is larger than a threshold, a segment containing a pixel is predictable as an object.

V. EVALUATION MEASURES

In this paper four metrics are used to evaluate the efficiency of the proposed method they are PSNR value, Sensitivity, Specificity, Accuracy, Entropy.

(i) PSNR (Peak Signal to Noise Ratio)

PSNR is corresponding to region homogeneity of the ultimate division. The upper the assessment of PSNR the better is segmentation. PSNR in decibels (dB) is computed by using following equation (1):

$$PSNR = 20\log_{10}\frac{255}{RMSE} \quad \rightarrow (1)$$

RMSE (Root Mean Square Error) is calculated through the square root of MSE.

$$MSE = \frac{1}{M*N}\sum_{J,K}(f(j,k) - g(j,k))^2 \quad \rightarrow (2)$$

(ii) Rand Index (RI)

This metric is used to measure the similarity between two clusters. Newly it has been used as a measure the performance of segmentation, because segmentation can be considered as a clustering of pixels. It is applied to measure and compare the accuracy of the segmented and original image. This measure represents the difference and closeness of the original and segmented image. The following formula is used to compute the difference is followings formula

$$RI = \frac{TP+TN}{TP+FP+TN+FN} \quad \rightarrow (3)$$

Where TP is number of True positives, TN is number of True Negatives, FP is number of False Positive, FN is Number of False Negative.

(iii) Precision

It is used for finding the reliability of the measurement. The consistency and the number of major figures are the uniqueness of the precision. If precision value high then the result will be considerable. If low precision the values of the measurement differ. It is calculated by using equation (4)

$$Precision = \frac{True\ Positive}{True\ Positive + False\ Positive} \quad \rightarrow (4)$$

(iv) Recall

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Recall is a statistical method to measure the percentage of total significant results correctly classified by your algorithm. It is calculated by using the equation (5)

$$Recall = \frac{True\ Positive}{True\ Positive + False\ Negative} \quad \rightarrow (5)$$

(v) Accuracy

Accuracy is to find the segmented spot of the image. The original factors are not affected and the level of accuracy is gathered.

$$Accuracy = PSNR + RI + Precision + Recall \quad (6) \rightarrow$$

VI. RESULTS AND DISCUSSIONS

The proposed method is tested and simulated with tea leaf images obtained result prove the efficiency of proposed method. The proposed approach is discussed with help of test image graph tables and accuracy, PSNR graphs. This new approach is evaluated by statistical metrics such as PNSR, Rand Index (RI), Precision, Recall and Accuracy. Table 1 shows the result of these metrics and compared with existing segmentation methods K-Mean Clustering Segmentation and Fuzzy C mean(FCM). The proposed method gave better accuracy than existing. The corresponding graph is plotted as shown in figure 2.

Table 1 Assessment of Proposed Method

Test image	*Method*	*PSNR*	*Rand Index*	*Precision*	*Recall*	*ACCURACY*
Image 1	**Proposed**	**1.987**	**0.977**	**1.988**	**0.975**	**96.83**
	K-Mean	0.765	0.776	0.885	0.877	68.47
	FCM	0.644	0.788	0.786	0.896	78.27
Image 2	**Proposed**	**1.978**	**0.997**	**1.958**	**0.966**	**96.78**
	K-Mean	0.723	0.831	0.776	0.844	63.43
	FCM	0.678	0.743	0.789	0.767	74.21
Image 3	**Proposed**	**1.995**	**0.978**	**1.989**	**0.987**	**96.75**
	K-Mean	0.673	0.759	0.756	0.797	65.43
	FCM	0.676	0.756	0.698	0.687	75.21

The Figure 2 shows the comparison of accuracy of Color and Region's Mean Based Segmentation (CRM) and existing methods such as FCM and K Mean segmentation Methods. When evaluate with other methods this method gave better accuracy than existing. Proposed method acquired 96% of accuracy as overall with tested images. Figure 3 shows the comparison of PSNR Values of segmented images. Proposed algorithm gave higher value.

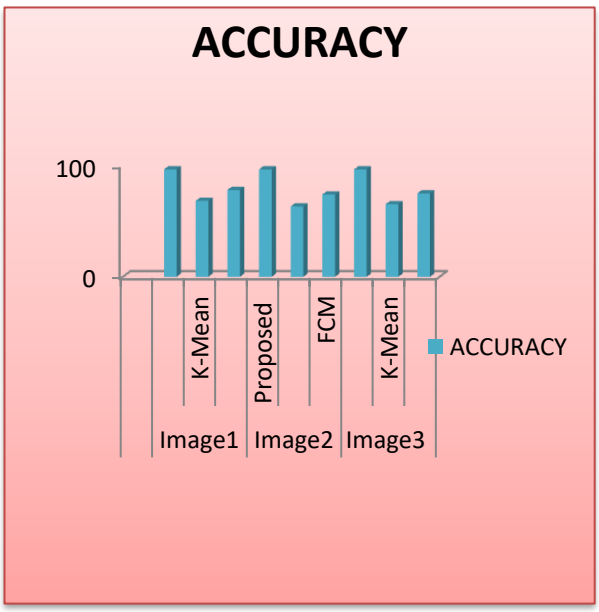

Figure 2. Comparison of Accuracy

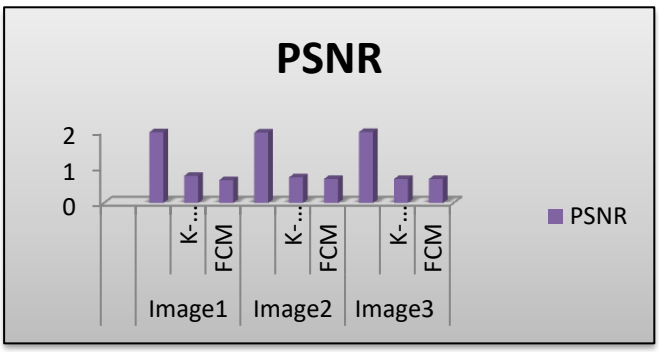

Figure 3 Comparison of PSNR Value

VII. CONCLUSION

This paper introduced the new segmentation method to segment the disease in tea leaf. By comparing the results it proves the efficiency of the new approach. Performance checked by applying statistical metrics. The metrics calculate the following PSNR value, Rand Index, Precision, Recall and Accuracy to measure the efficiency of proposed method and it achieved better value than FCM and K-means. It exactly subtracts the segment region from background. The proposed method achieved 96% of accuracy and it score good PSNR Value.

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