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Image segmentation using clustering for detection of diseases in sugarcane

Chellammal Surianaranayanan,
[1]Dept of Computer Science
[2] Bharathidasan University Constituent Arts & Science College
Navalurkuttapattu, Tiruchirappalli-620009, TN, India,
chelsrsd@rediffmail.com

Vijayabharathi Durairaj,
[1]Dept of Computer Science
[2]Research Scholar, Bharathidasan University Constituent Arts & Science College
Navalurkuttapattu, Tiruchirappalli-620009, TN, India,
vijayabharathiphd@gmail.com

Abstract*—Sugarcane is one of the main cash crops of India. Sugarcane Industry remains one of the main pillars of the Indian economy, though it is facing many problems. Sugarcane plant disease is one of the important factors that reduces quantity and degrades quality of the agricultural products. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants leaves and finding out the diseases plays a key role in successful cultivation of plants. Mostly diseases are seen on the leaves or stems of the plant. Different researches are being carried out using image processing techniques towards easy and efficient way of preventing these diseases. In our research work, it is proposed to develop an approach for the detection of diseases sugarcane. The proposed approach includes 4 steps, namely, preprocessing, segmentation, feature extraction and detection. In preprocessing stage the image under test is converted to Grey Scale image. In segmentation stage, the image is segmented into different clusters using clustering algorithm. In feature extraction stage, the essential features are extracted from the segmentation image parts/clusters. The features are compared against the standard normal and abnormal images that are stored in the database. Based on the comparison, it is concluded that whether an image is diseased or not. As the proposed research work is in progress, in this paper, the first two steps (preprocessing and segmentation) are presented along with idea of overall approach. Various types of diseases that can occur in sugarcane are highlighted along with their images. The images are preprocessing using built-in functions of MATLAB. They are converted into Grey Scale images. Then they are segmented using K-Means Clustering algorithm. The results of segmented images are presented. Plan of last two steps of the approach are presented.

Keywords— Clustering, Detection of diseases, Image processing, order, sugarcane.

I. Introduction

Sugarcane is an important crop in India and many countries. Everyday human being need to have sugar to enrich their food items. The sugarcane Industry remains one of the main pillars of the Indian economy, though facing many problems. Nowadays there are different diseases which affecting the sugarcane plants in diverse areas [1]. Detecting disease in a plant plays a major role in the field of agriculture. Monitoring of health and detection of disease in plants and trees is critical for sustainable agriculture. Farmers detect disease through their observation of naked eyes, which is very difficult and require continuous monitoring of the plant. There is also possibility of inaccurate result and this method is expensive for large farms. In some places, farmer may have to go long distance to contact experts, which is very expensive and time consuming. Every time it is not feasible to call experts for diagnosis. So, automatic detection of plant diseases is an important research topic as it may prove benefits in monitoring large field of crops, and thus automatically detect diseases from symptoms that appear on plant. Different researches are being carried out using image processing techniques [2] towards easy and efficient way of detecting the diseases with required accuracy for disease management.

In our research work an approach is proposed to detect various types of diseases such as bacterial, fungal, viral, nematodes, phytoplasma and other miscellaneous diseases and disorders. These diseases occur in the leaves and stem areas of sugarcane. In order to detect the diseases, the leaves of sugarcane are captured are .jpeg, .bmp, .png, and … formats.

The proposed approach consists of 4 steps, namely, preprocessing, segmentation, feature extraction and detection. As the detection of diseases in color images are time consuming, the image is converted into grey scale image in preprocessing. In segmentation step, the image is segmented into various regions or clusters using K-Means clustering. These clusters represent essential features of the image. In feature extraction step, essential features like homogeneity, entropy, correlation, etc are found out. In detection step, the extracted features are compared with the standard normal and abnormal images of diseases. Based on the comparison, it is found that whether the image is normal or affected with disease.

As the development of the proposed approach is under progress, in this paper, the first two stages are presented with an overview of the entire approach. In Section I, the significance of detection of diseases in sugarcane and approach for detecting those diseases is presented. In Section II various diseases that can occur in Sugarcane are discussed. In Section III, research works related to our research work are highlighted. In Section IV, an overview of proposed approach with its first two steps is described.

II. Diseases in Sugarcane and Need for Detection of Diseases

Most common diseases that occur in sugarcane are bacterial diseases (Gumming disease, Leaf scald, Mottled stripe, ratoon stunting disease of sugarcane, Red Stripe), fungal diseases (eye spot, brown spot, yellow spot, ring spot) [3], viral diseases (chlorotic streak, Fiji disease, mosaic), Nematodes(lesion, root not, spiral), parasitic, Phytoplasma diseases(Sugarcane yellow leaf syndrome, grassy shoot and other Miscellaneous diseases(multiple buds, stem galls, leaf stipple, internal stalk necrosis, bunch top, bud proliferation) and disorders. Few samples of diseased leaves in sugarcane are given in Fig .1

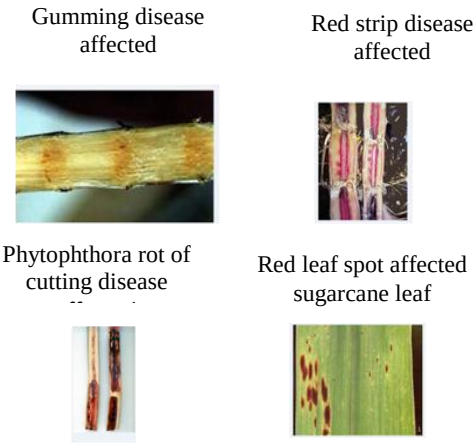

Fig. 1 Sample images

Sugarcane plant disease is one of the important causes that reduces quantity and degrades quality of the agricultural products. The management of sugarcane plant requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the post-harvest life. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants leaves and finding out the diseases plays a key role in successful cultivation of plants. Farmers detect disease through their observation of naked eyes, which is very difficult and require continuous monitoring of the plant. It is time consuming. In case of clarification, the farmers need to discuss with experts. Every time it is not feasible to call experts for diagnosis.

Gradually with technical and scientific advancement, more reliable methods through lowest turnaround time are developed and proposed for early detection of sugar plant disease. Such techniques are widely used and proved beneficial to farmers as detection of plant disease is possible with minimal time span and corrective actions are carried out at appropriate time. Further, automatic detection of plant diseases with image processing techniques provides more accurate result in less time.

III. Related Work

Image processing and data mining techniques are extensively used for plant detection of diseases [4-5]. In [6], a method has been proposed which segments the leaf region using Otsu method. In the HSI color system, H component was chosen to identify disease spot. Then disease spot region has been segmented using Sobel operator in order to examine disease spot edges. Finally plant diseases are graded by calculating the quotient of disease spot and leaf areas.

Computer vision system for monitoring plant has been proposed in [7] The authors concluded that an individual plant can be distinguished by biophysical, biochemical indices and colour eigen values. The approach also presents measuring models to measure full nitrogen content.

In [8] detection of diseases in plant leaf has been performed by first identifying the affected region using clustering, extracting relevant features using color co-occurrence method and detection of diseases using classification algorithms.

The research work presented in [9] discusses how plant disease are detected using image processing techniques and various classification methods like neural network, back propagation, support vector machine, etc. The work presented in [10] detects diseases in sugarcane plant using K-NN based classification after identifying the diseased region using K-means algorithm and extraction of features which help in detection of diseases.

IV. Overview of the Proposed Approach

The overview of the proposed approach is shown in Fig. 2

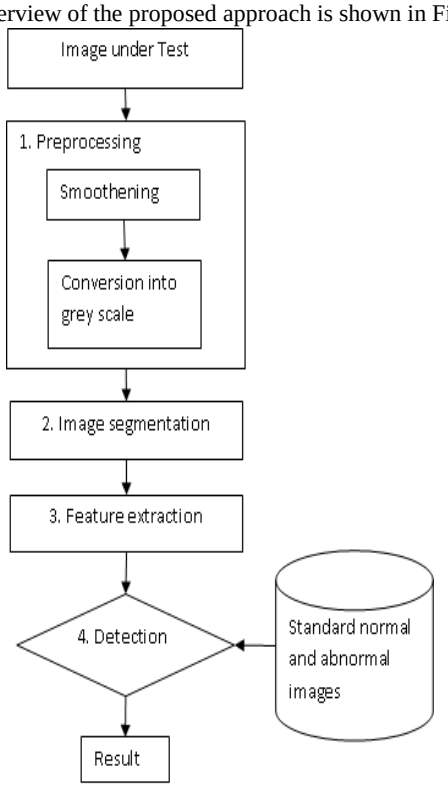

Fig. 2 Overview of Proposed approach

Digital Images of leaves are acquired for detection of diseases. For our present research work, digital images of both standard and diseased sugarcane leaves in different formats such as .jpeg, .bmp, .png, etc., from different websites[please see references]. The images are represented as a matrix of 256×256 matrix representation for analysis. These input images may contain different types of noises such as salt and pepper, Gaussian noise, shot noise, random noise, etc. In preprocessing step, the images are smoothened for removal of noises using different filters. Then the acquired images which are in RGB color format are converted into grey scale format using MATLAB functions using the equation $b = rgb2gray(a)$.

In the above equation, the argument 'a' refers to the input image and the RGB image to gray level is converted and stored in the variable 'b'. In segmentation step, the preprocessed image is segmented into different regions for analysis. In the present approach, the image under test is divided into different segments using K-Means clustering. In our work, K is set as 8. Image is segmented into 8 parts where different parts represent different features of the image such as gray-level co-occurrence, contrast, entropy, and homogeneity. Then in detection step, the extracted features are compared against the standard and diseased references which are stored in a data base. Based on the comparison, the leaf is found as whether it is a good one or affected with disease. Further from the previous knowledge the kind of disease also will be determined.

V. Results and Discussion

Around 40 images have been collected from Internet for analysis. Details of diseases of the collected images are given in Table 1. In the current work, the results are presented with respect to an image, ring spot (a fungal kind disease) affected one. This image is smoothened using mathematical operators in MATLAB. The original and smoothened images are shown in Fig. 3 and Fig. 4 respectively. The smoothened image is converted into grey scale image as given in Fig. 5. The grey scale image is segmented using K Means clustering algorithm. In the example taken, the image is segmented into 8 regions of interest. The segmented image is given in Fig. 6. Similarly the test has been repeated for other images collected from Internet.

Table 1. Images collected from Internet

	Bacterial Dissease	*Specific disease name*
1.	Bacterial Dissease	Gumming disease
		Leaf scald
		Mottled Stripe
		Red stripe
2.	Fungal disease	Phytophthora rot of cuttings disease
		Pineapple disease
		Red rot of leaf sheath and sprout rot disease
		Red spot of leaf shealth disease
		Red rot disease
		Rhizoctonia sheath and shoot rot disease
		Rind disease disease
		Root rots disease
		Sugarcane brown spot
		Sugarcane eye spot
		Yellow spot
3.	Viral disease	Chlorotic streak disease
		Mosaic disease
		Streak disease
4.	Nematodes, parasitic disease	Root-knot disease
		Spiral disease
		lesion disease
5.	Phytoplasma disease	Grassy shoot
6.	Miscellaneous disease	Multiple buds

Fig. 3 Original image

Fig. 5 Gray image

Fig. 4 Smoothened image

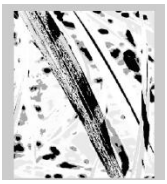

Fig. 6 Segmented image

VI. CONCLUSION

In this paper, an approach has been presented to detect diseases in sugarcane plant. At first various diseases that are common in sugarcane are identified from literature. The diseases are classified into various kinds such as bacterial, fungal, viral, nematodes, etc., Different images corresponding to various images have been collected as test data from Internet. The collected images are preprocessed for noise removal and they are converted from RGB color format to gray format. Then the image under test is segmented into different regions using K-Means clustering. Various Collected images have been tested for segmentation. Results have been presented for a typical image has ring spot.

As mentioned in Section I, the preprocessing, segmentation and clustering step of the approach alone are presented in this paper. As future work, it is proposed to identify features which are relevant for detection of diseases. Then, those relevant features will be extracted and compared against standard and diseased images in order to detect the disease if any present in the image.

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