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Image Processing Based Disease Detection for Sugarcane Leaves

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Abstract: Sugarcane is one of the most important crops in India. Indian sugar industry is the second largest agro based industry, next only to the textiles. But, being a long durational crop, sugarcane is prone to the number of disease caused by pathogens viz. fungi, bacteria, viruses and phytoplasmas like organisms. Image processing techniques have been proved to be changing the scenario of agriculture in India with a number of research and applications like automatic disease detection, drone based pesticides and fertilizer dispensing, estimation of yield, vegetative growth, fruit sorting etc. This research is carried out to study the effectiveness of Image Processing and computer vision techniques for detection of disease in sugarcane plants by observing the leaves. Few major diseases in sugarcane plant like red rot, mosaic and leaf scald have been studied and detection algorithm for the same has been implemented in this research work.

Keywords: Sugarcane, Leaf Disease Detection, Computer Vision, Segmentation, Image Processing.

I. INTRODUCTION

Plant diseases are of critical importance to humans because they damage plants and reduce plant production on which human relay for fundamental food supply [1]. Therefore, continuous and accurate disease detection is in great need and as a prerequisite to providing essential disease information, by which effective plant protection such as the optimal decision of fungicide spraying [2, 3], detailed analysis of plant pathology [4], efficacy evaluation of fungicide application [5] can be facilitated. However, variations and complexities from real environments caused by natural daylight, living plant growth and movements, and complex field background are of great challenge for image algorithms. Thus, this thesis proposes a novel algorithm which can cope with the variations and complexities for robust and continuous disease detection. In this chapter, we introduce this research from both aspects of agricultural needs and image-based techniques. Since non-chemical disease control managements such as plant resistant cultivates, crop rotation or multiple fungicide application do not provide adequate disease prevention. Alternative fungicide spraying is the most important tool for managing disease spread [9]. Usually, optimal and profitable decisions for the timing and frequency of the adaptive fungicide spraying are made in terms of disease severity and local weather conditions [3], by which both economic losses and chemical usage can be reduced for precision plant protection. Therefore, information of disease severity assessment is a fundamental premise for the decision-making process of fungicide sprays [10, 11]. The traditional way for CLS severity assessment is manual field monitoring. It is a process that specialists or trained assessors first walk into a field with time intervals, and then assess the disease severity by naked eye observation based on a certain rating criterion, such as a single leaf scale based [3] or a whole plant scale based [12]. However, this human eye and hand operation based filed monitoring have limitations of laborious, discontinuous, some degree of subjective with the large-scale field, and imprecise with subtle disease variations. Especially, the discontinuous monitoring may cause high possibilities to late fungicide sprays and over extended spray intervals, resulting in inefficient plant protection.

Sugarcane is responsible for 75% of the global sugar production and India is the largest consumer and second largest producer of sugar in the world. Indian sugar industry is the second largest agro based industry, next only to the textiles. But, being a long durational crop, sugarcane is prone to the number of disease caused by pathogens viz. fungi, bacteria, viruses and phytoplasmas like organisms. Amongst all the diseases, red rot and smut are causing the major outbreaks in the recent years causing 30-100% yield loss in commercial sugarcane cultivars throughout India [12].

This interdisciplinary research linking image processing with an agriculture-oriented application for detecting a leaf disease in sugar cane plant.

II. LITERATURE REVIEW

Red rot disease is so devastating in nature that it has been referred to as cancer of sugarcane. The first time, red rot is observed in the cultivars of Red Mauritius in the Godavari delta of Andhra Pradesh. The outbreak in Co 419 and Co 658 in Andhra Pradesh, Tamil Nadu, and Pondicherry indicated that those virulent races of the pathogen have got their foothold in these areas. The quest for the new varieties has probably been responsible for the migration of the pathogen from one state to another. In India, red rot is chiefly the disease of standing cane and caused by **Colletotrichum falcatum Went**. The red rot disease is a major constraint for sugarcane production in India and the subcontinent faced many epidemics in the past resulting in the elimination of many popular varieties from cultivation[14]. It is because the pathogen has gained virulence in last. Prevalence of variation in C. falcatum Went. (Perfect state: Glomerella tucumanensis (Speg.) Arx and Muller) pathotypes are well known. The pathotypes exhibit distinct differential host interaction where certain pathotypes specifically infect their adapted host cultivars.

Red rot can affect many commercial varieties during its course of infection and epidemiology. Eventually, all the varieties fell prey to red rot and had to be withdrawn from the general cultivation or had to be replaced by the new more tolerant genotypes.

Figure 1: A disease Affected Plant
Figure 3: Image Processing Algorithm [8]

Mosaic disease of sugarcane has been known for long in many countries. It is continuously observed on the widely grown variety Co740 in Maharashtra although it is not known to have caused any serious damage to yields, due probably to the absence of virulent strains of viruses ans tolerant nature of the varieties. Its annual recurrence is primarily through the planting of infected seed material and secondary infection is through insect vectors. Mosaic in association with RSD cause reported being more damaging in terms of yield and recovery.

Figure 2: Mosaic Disease

The symptoms as under:

•The characteristic symptom of the disease appears more prominently on the basal portion of younger foliage than the older ones. Generally, chlorotic or yellowish strips alternate with the normal green portions of the leaf giving the mosaic pattern.

•When young affected leaves held against bright light we observe yellowish spots of uneven stripes.

•In severe infections, the chlorotic area considerably increases over the normal green and symptoms also appear on the leaf sheath.

•Sometimes necrotic lesions are regularly produced in the parenchymatous tissues of the internodes and the entire plant becomes stunted and chlorotic control.

Leaf scald is a bacterial disease that has made its impact in the country in recent years. In India, it was first recorded in April 1961 by Egan during his short stay at I.A.R.I., New Delhi. However, this disease remained almost unnoticed till 1974 when it was reported from Anakapalle (A.P.). Hereafter, the disease has been recorded from different north Indian States, like Punjab, Haryana, Bihar, Uttar Pradesh, Uttarakhand and natural occurrence of this disease was noticed in several commercial genotypes. Prominent among the susceptible genotypes are BO 17, BO 70, BO 90, BO 109, Co 419, Co 1158, Co 62399, Co 7301, Co 8312, Co 8315, Co 8334, Co 93016, CoS 767, CoS 90269, CoLk 7710, CoLk 7901, CoLk 8001, CoLk 8102, CoLk 8901, CoJ 64, CoJ 81, CoH 56, CoH 72, CoH 92201, CoH 94201, CoPant 84211, CoPant 84212, CoPant 84213, ISH 40, etc.

The disease is caused by the bacterium Xanthomonas bilinears. There are two distinct phases of the disease viz. (i) chronic phase – the most common phase, (ii) acute phase/ wilting phase – it is of rare occurrence. The distinguishing symptom of chronic phase appears on the leaf as a 'white pencil line'. The white lines are prominent in young leaves. Usually, one or two vascular bundles turn albino and appear as a white line. This is due to the effect of toxin 'albicidin' produced by this pathogen. The 'white pencil line' increase sideways with age and depending on the prevailing weather conditions scalding/drying of the leaves takes place. Occasionally some patches of the red area may occur on the white pencil line. The other most conspicuous symptom of the disease is the development of side shoots (germination of buds) in an acropetal fashion. The crown of the affected plants show inward curling of leaves and in canes having severe infection die prematurely.

III.PROPOSED WORK

This section discusses the implementation details of the proposed work. The Proposed work use the K-Means clustering method to make the cluster of some data.In the Leaf, if there is no disease the whole color of the leaf is same there is very less possibility of the cluster and if there is more another color then it has more cluster. So for testing of the leaf we make the Training set which includes all the possible disease that can occur in the desired leaf and then start to check the testing leaf.

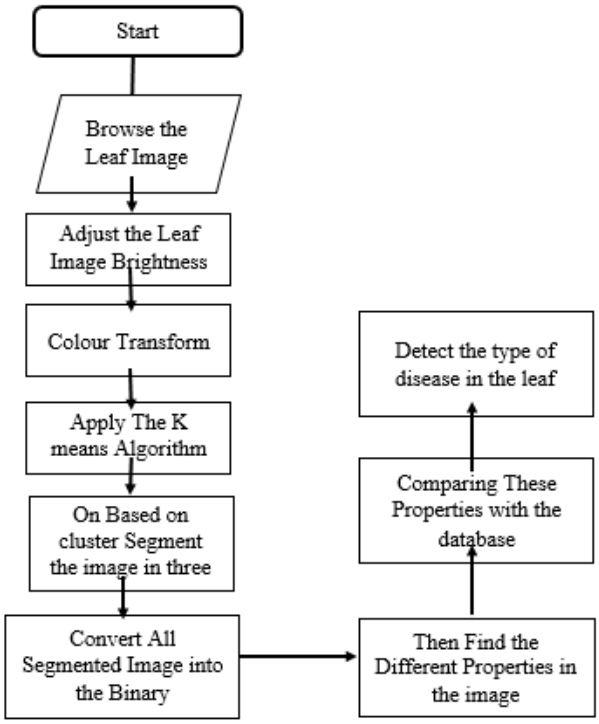


Figure 3: Flowchart of the Leaf Disease Detection Algorithm

To detect the disease we first the take the image of the leaf and then enhance the image and then make the color transform and detect the color that is not visible by the human eyes, after that our next process is to apply which is k means clustering whose work is to make the cluster of images of the same type of color.

IV. SIMULATION RESULTS

The algorithm has been implemented using MATLAB 2013a software tool. Following are the details of the simulation results obtained.

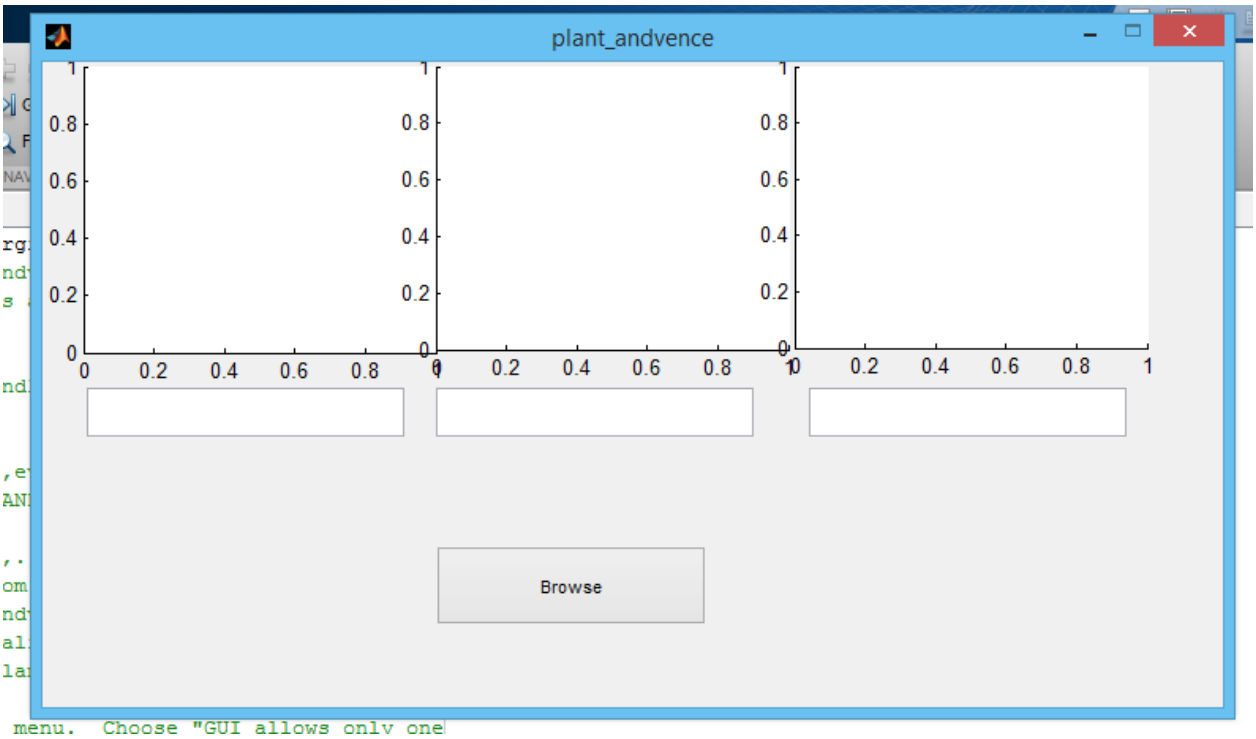
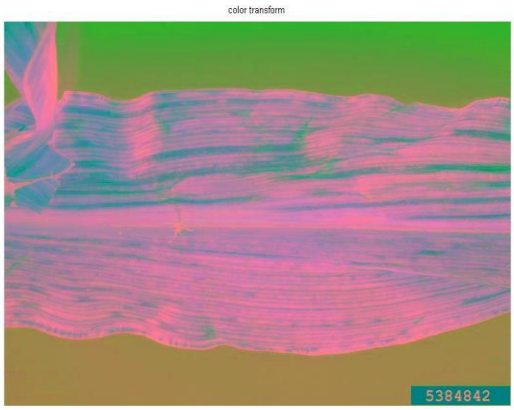


Figure 4: Leaf Disease Detection GUI

The GUI for the system is shown in figure 4. It has three axes which show the three part of the image based on clustering and one browse button which is used to read the file from dataset of the leaf. Browse button is used to select the diseased leaf from the dataset of disease and select our first leaf which has Mosaic Disease and Leaf Scald Disease.

Figure 5(a) shows the result after image enhancement and figure 5(b) shows the image after colour transform from RGB to HSI.

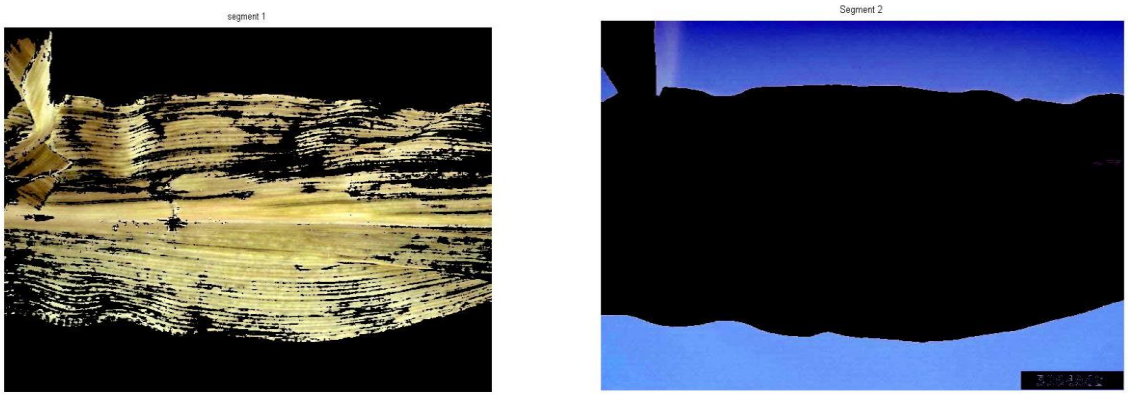
(a)



(b)

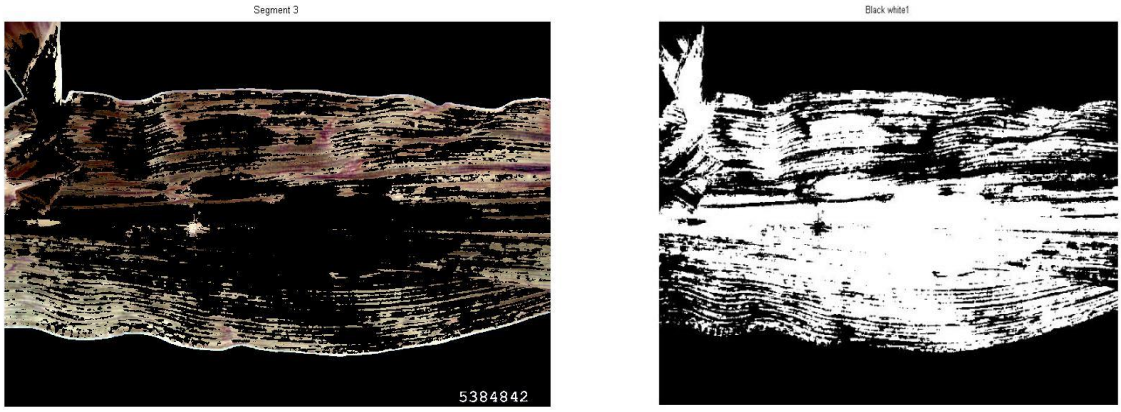
Figure 5: a) Image after Enhancement b) Image after Colour transform

K-means clustering is then applied to form clusters of same colour pattern. Figure 6(a) shows image after segmentation is then applied to obtain three different segments of the image as shown in figure 6(a), 7(b) and 7(a) respectively.



(a) (b)

Figure 6: a) Segment 1 b) Segment2



(a) (b)

Figure 7: a) Segment 3 b) Binary Converted Segmnet 1

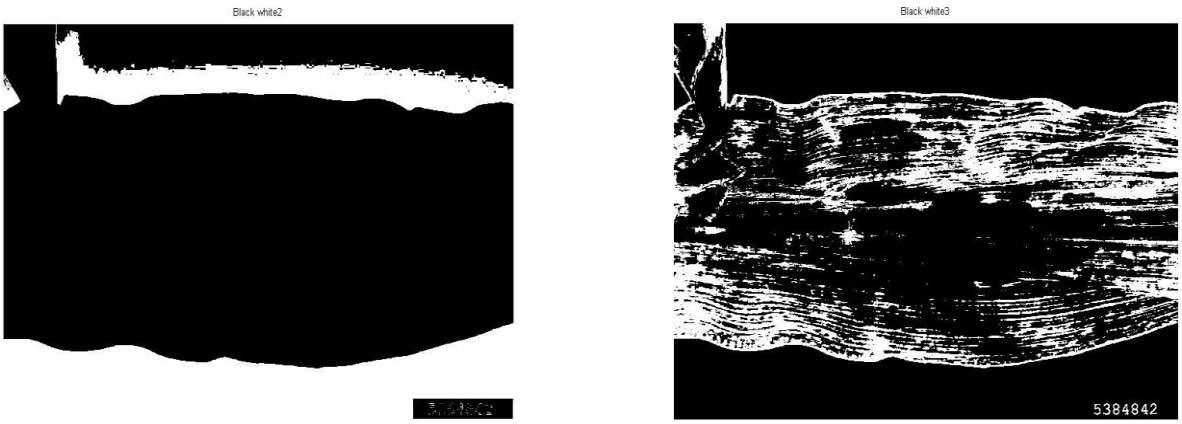


Figure 8: a) Binary Converted Segment 2 b) Binary Converted Segment 3

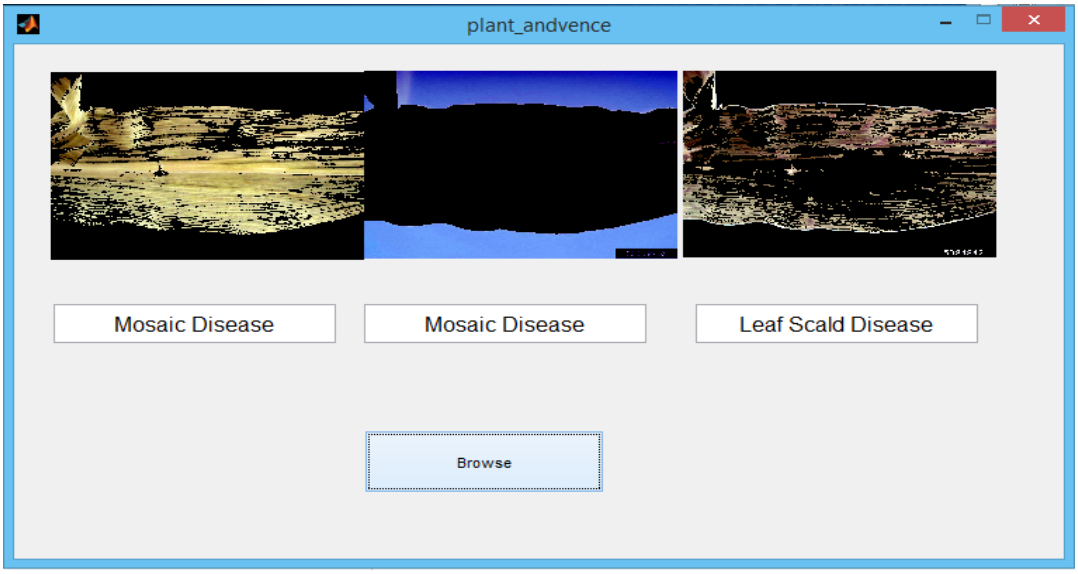


Figure 9: Disease Detected

As shown in figure 9, the disease existing in the input leaf image is detected and is shown as the output as Mosaic Disease and Leaf Scald Disease.

CONCLUSION

In this paper, a computer vision based technique to detect leaf disease in sugarcane plant has been implemented. Image processing is nowadays for a number of applications in agriculture. The combination of feature extractions like color, size, and shape with different classifiers has added accuracy to these applications. Red Rot disease, leaf scald disease, and mosaic disease are three most common diseases occurring in sugarcane plant in India. A thorough study of the causes and symptoms of this diseases is presented in this research paper. Image processing techniques along with k-means classification have been used to classify the leaf dataset, according to the disease. The leaf image is compared with this database to detect the type of disease existing in the plant.

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