Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

Disease Segmentation in Citrus Plants using Image Processing

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Abstract: **Citrus plants are mostly affected by citrus canker, which is caused by bacterium Xanthomonas axonopodis. Citrus canker results in fall of crop yield and becomes severe due to the spreading over the entire field with wind and rain. This work presents efficient method for the automated detection of canker in initial stage of the infection. Various samples of citrus leaves were collected which consists of 75 samples of healthy leaves and 200 samples of citrus canker affected leaves from Nagpur (India) region. Initially background is removed by using global thresholding to get better results in further analysis. The noise is reduced from images using bilateral filter, adaptive histogram equalization is used for image enhancement. Effective enhancement and segmentation algorithm is presented for the classification of diseased and healthy plants based on unsupervised learning. Segmentation results are evaluated based on area. Results and analysis presents better accuracy in Lab domain.**

Keywords- Citrus Canker, Bilateral Filter, Detection, Affected, Background, Adaptive Histogram Equalization, Unsupervised Learning, Area, Lab domain.

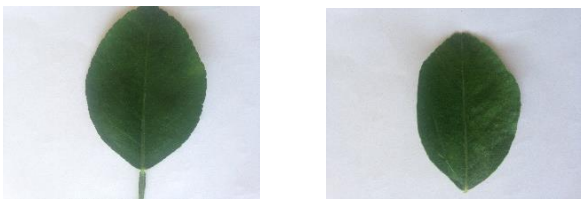
I.INTRODUCTION

In India farmers are totally dependent on agriculture production. If a single plant is affected by disease there are huge chances of spreading the disease in the entire field. It will lead to huge loss to the farmer. Plant disease diagnosis is useful for detection of disease in plants in earlier stage, so that the disease does not spread in the entire field. Farmers spray pesticides by just visual observation. So, the technology support is necessary to identify the plant disease. We are using citrus plants for disease detection as they are mostly found in Nagpur region.There are several diseases found in citrus plant some of them are alternaria citri, citrus canker and citrus scab. We are considering citrus canker as it is the most noticeable disease in citrus plants. It causes yellow and brown like spots on the leaf which is easily visible. Citrus canker causes the citrus trees to continuously decline in health and fruit production until the tree produces no fruit. It can be spread by wind and rain. We have samples of citrus leaves which consists of healthy leaves and disease affected leaves. This method will detect if the leaf is healthy or unhealthy.

II.DATA COLLECTION

The data set has images of citrus leaves. The images are taken from iphone camera of 8Mega pixels. The leaves are collected from national research center of citrus plants which are affected with citrus canker. The leaf is kept on white paper to get a white background and then the image is captured. There are four samples in this data set, the first two are citrus canker affected leaves and the next two are healthy citrus leaves. There are 50 samples of healthy leaves and 200 samples of disease affected leaves. This data set is further used for the image processing.

Citrus Canker Affected Leaves



Citrus Healthy Leaves

III.BACKGROUND SUBTRACTION

Background is removed using global thresholding method. For further efficient analysis of image. Threshold value is obtained using otsu's thresholding algorithm. Mask is obtained using this threshold value, which is used to subtract background from image.

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Original Image Background eliminated

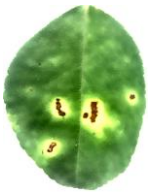
IV.DE-NOISING

Noise is an unwanted fluctuation in image. To get original information of image de-noising is must. There are different types of noise like Gaussian noise, salt and pepper noise, Thermal noise etc. Generally our database has Gaussian noise. It can be removed by various de-noising methods. That is filters are used in de-noising methods. They are Median filter, Mean filter, Weiner filter, Bilateral filter. From this type of filters we used bilateral filter. As bilateral filter smoothes the image while preserving edges. We are using Bilateral filter for removing noise from the leaf image. A Bilateral filter is a non linear, edge preserving filter used for smoothing of image. It replaces each pixel by weighted average of intensity values from near by pixels. It is mainly used in noise removal, HDR compression and image abstraction due to smoothing of image while preserving edges.

Original Image Filtered Image

V.IMAGE ENHANCEMENT

Image enhancement is employed to accentuate or sharpen the image properties or features of an image such as boundaries, edges, or contrast to make a display more recognizable. Image enhancement techniques emphasize specific image features to improve the visual perception of an image. Image enhancement technique has its application in two broad categories as Spatial domain method and Frequency domain method. The spatial domain directly operates on pixels and frequency domain operates on Fourier Transform of an image and transforms it back to the spatial domain. Basic enhancement techniques are histogram-based because they are easy, fast and with them appropriate results for various applications can be achieved. Therefore histogram based enhancement has become popular tool to assist in diagnosis. In this project we have used histogram-based colour enhancement to obtain the better results. We have used adaptive histogram equalization instead of basic histogram equalization. As adaptive histogram equalization works on small region unlike basic histogram equalization which works on the entire image. For disease detection in citrus leaves we require only the affected part so adaptive histogram is more suitable in this case. In case of adaptive histogram equalization of a colour image, the histogram is expected to give the number of times a particular colour has occurred in the image. The histogram equalization is performed by first converting the filtered image in LAB colour space format. Then histogram equalization is performed only for luminance component. The A and B components are unaltered. Then in the histogram, the equalized luminance component, unaltered A and B components are converted back to RGB format. The disease part is enhanced for further analysis.



Original Image Enhanced Image

VI.SEGMENTATION

The goal of image segmentation is grouping the pixels that have similar features in image from the standard point of human visual system. As citrus canker is a colour-based disease. There are many techniques for gray image segmentation. But the colour image is a multidimension vector, segmentation technique of gray image cannot be applied to colour images directly .For segmentation of colour image selection of colour space is important. In RGB colour space it is difficult to relate colour appearance because its basis is to device signals and not display luminance value. It is observed that Lab colour space is best for foreground segmentation. It deals with intrinsic colour component therefore shadow and lighting can be managed properly. In CIE Lab is device independent model, there are three coordinates where L indicates lightness of the colour (L=0 is black, L=100 is white), a indicates the position between magenta and green (negative value of a represents green and positive value represents magenta), b indicates position between yellow and blue (negative value of b represents blue and positive value represents yellow). After colour space conversion the ‘a’ component provides the disease part to be segmented for further classification.

Original Image Segmented Image

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VII.RESULTS

Various parameters of original image and enhanced image are calculated and average values are given below are given below.

	PSNR	SNR	SMOOTHNESS	VARIANCE
ENHANCED IMAGE	21.683	20.530	0.27	0.716
ORIGINAL IMAGE	20.89	19.429	80.608	139.779

	KURTOSIS	ENTROPY	STANDARD DEVIATION	MEAN
ENHANCED IMAGE	5.819	0.244	0.961	0.159
ORIGINAL IMAGE	5.682	0.272	0.977	0.188

The PSNR and SNR values are higher in Enhanced image as compared to Original image from the above table.

In segmentation, Area of original and area of segmented image is calculated.

SAMPLES	AREA OF TOTAL LEAF	AREA OF DISEASED PART
SAMPLE 1	4152	17
SAMPLE 2	4653	49
SAMPLE 3	1465	16
SAMPLE 4	2991	27
SAMPLE 5	2829	33

VIII.CONCLUSION

Citrus canker is the most widely spread disease in citrus plants. This study shows a feasible way to detect citrus canker. Initially, background of image is removed using masking. Bilateral filter is used for image de-noising which gives efficient results. Adaptive histogram equalization is used for image enhancement also various parameters are calculated for enhanced image. Segmentation is done using Lab domain and area of entire leaf and segmented part is calculated. Effective results are obtained for image segmentation in Lab domain. More work still needs to be explored if the method will be adopted in practical application.

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