Detection of Maize Stem and Leaf Diseases using Edge Detection Method to Prevent the Crops from Diseases

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Abstract:

Application of image processing in the area of agriculture has recently gained a surge of interest among the academicians and practitioners from the industry. Recently, Image processing started to set its path in agriculture after its successful application in various fields. Plant diseases cause large amount of critical symptoms for the growth of any crop, which that causes noteworthy loss in agriculture production. Therefore appropriate action is necessary to distinguish and prevent disease occurrence in an imperative way to improve yield of crop. Segmentation of diseased stem in plants and crops is one of the important research content in the field of agriculture using Digital Image processing application.

Keywords:

Plant disease, Digital Image Processing, Image Segmentation, Morphological, Marker Based Algorithm.

1. INTRODUCTION

Agriculture is a key source for livelihood. Agriculture provides employment opportunities for village people on large scale in developing country like India. India's agriculture is composed of many crops and according to survey nearly 70% population depends on agriculture. Most of Indian farmers are adopting manual cultivation due to unaware of technical knowledge. Farmers are unable to find what kind of crops that will grow well on their land. When plants are affected by diverse diseases, their yield will affect production in agriculture and also loss in profit. This leads to reduction in both quality and quantity of

agricultural products. Leaves are important for fast growing of plant and to increase production of crops. Identifying diseases in plants leaves is challenging for farmers and also for researchers. Currently farmers are spraying pesticides to control diseases of the plants but it effects human directly or indirectly by health and also economically. To detect these kinds of different plant diseases, many high-speed techniques need to adopt. A study has done on this paper about the different plants disease and available various advanced techniques to detect these diseases [1]. In India, Agriculture plays an essential role because of the rapid growth of population and increased demand for food. One major cause for low yield is disease caused by bacteria, virus and fungus. It can be prevented by using plant diseases detection techniques. Machine learning methods can be used for disease identification, because it mainly applies on data detection and gives priority to outcomes of certain task.

1.2. Plant Disease Identification

Plants become a very important supply of energy and solely a primary supply to the matter of worldwide warming. The harm caused by rising, re-emerging and endemic pathogens, is very important in plant systems and results in potential loss economically. Additionally, crop diseases contribute directly and indirectly to the unfolding of human infectious diseases and environmental harm. Plant diseases can be broadly classified into Abiotic and Biotic. Diseases that are not caused by any living organisms, it is not progressive, not infectious and will not spread from one species to other. But biotic diseases are caused by any living organisms which can further classified in to Fungal, Bacterial and Viral diseases which affect the several species of the plants [3].

Some diseases do not have any observable symptoms associated and farmers cannot recognize it easily. In those cases, normally some kind of sophisticated analysis, usually by means of powerful microscopes is necessary. In other cases, the signs can only be detected by imaging machine which cover the entire electromagnetic spectrum ranging from gamma to radio waves that are not visible to humans. Farmers use naked eye observation method to detect the diseases with their experience, but it is very hard to detect disease at very early stage by this method. [4]

The primary bacterial diseases that affect the Maize plants are Holcus leaf spot, Goss's wilt,stewart'swilt and bacterial stalk rot[5, 6].The automatic fungal disease detection in plant leaf like Phaseolus vulgaris and Camellia assamicaare done by using image processing techniques[7].Bacterial diseases generally enter the plant through wounds caused by insects, wind hail or blowing soil [8].Black Spot, Botrytis blight, Leaf spot, Powdery Mildew and Rust Spores are different kinds of crop bacterial diseases that can attack plants.


Figure1.Black SpotFigure 2. Botrytis Blight

Black Spotrepresents the diseases affected in Maize plants are highly susceptible to this infectious fungal disease. Black spots, as the name implies, will appear on the leaves, followed by a yellowing surrounding the spots as shown in Figure1. Botrytis Blight represents the fungal disease that affects flowering plants, ornamentals, and fruits and vegetables. This disease is also known as a gray mole, it can cause dying tissue and buds as well as fruit or bulb spot as shown Figure2.


Figure3.Leaf SpotFigure 4. Powdery Mildew

Figure 5. Rust Spores

Leaf Spot represents the leaf spot diseases affects many different types of plants, but most commonly attacks trees and shrubs. In large clusters or rows, it may also be referred to as anthracnose as shown in Figure3. Powdery Mildew shows the numerous strains of fungi are commonly referred to as powdery mildew. Since this disease removes essential nutrients from the plant, leaves may become yellow, stunted or drop off prematurely as shown in Figure4.

Rust Spores represents the rust spores travel through the air and land on plants, spreading the fungal disease. Although plants do not die from rust, it can contribute to the plant's decline as shown in Figure5 [9, 10].

The section one explains about the brief introduction about the agriculture and different plant diseases with its identification methods. Section two describes the available and related literature review to the plant disease identification. Section three defines the proposed methodology and its related implantation techniques. Section four illustrates the acquired results from the proposed methodology with concern output images. Section five provides the conclusion statement and its related scope of future work.

2. LITERATURE REVIEW

Plant diseases have turned into a dilemmas it can cause significant reduction in both quality and quantity of agricultural products. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring fields of crops, and thus automatically detect the symptoms of diseases. The most significant part of research on plant disease to

identify the disease based on Content Based Image Retrieval (CBIR) that is mainly concerned with the accurate detection of diseased plant [11]. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves.Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithm [12]. Fast processing time is required for edge detection since it is needed to be carrying out in a real time. The real-time edge detection technique for identifying Hevea leaves diseases (rubber tree leaves) in images and its hardware implementation. Three major Hevea leaves diseases which are Corynespora Leaf Spot, Bird's Eye Leaf Spot and Collectotrichum Leaf Disease used in this study for image comparison. The disease on the leaves can be detected through edge detection by using Sobel edge detection algorithm [13].

3. METHODOLOGY

First, the digital images are acquired from the agriculture field using a digital camera. Then acquired images are applied with pre-processing techniques to extract useful features that are necessary for further analysis. After that, edge detecting methods like Sobel and Prewitt are applied for further systematic techniques that are used to segment the Maize leaf and stem images according to the specific diseases. In ancient days, crop disease identification processes are done in the laboratories. However, this involves constant monitoring of experts which might be expensive in case large farms. Further, in some developing countries, like India, farmers may need to travel long distances to contact experts, and this makes expensive and time consuming for consulting with experts. Existing techniques discussed yields low precision rates, high dimensionality, identification of disease consumes more time. The basic problems regarding high error rate and low accuracy, a fast and accurate segmentation of the diseases is required by inspecting the infected leaf spot images and identifying the severity of the diseases

3.1. Block Diagram of Proposed Methodology

The proposed work related workflow is illustrated and displayed as in the following Figure 6, and also this will be considered as proposed system methodology.

The proposed work is divided into three levels. In the first level: image acquisition process, image pre-processing and removal of noise using SOBEL filter are need to be done. At the second level pre-processed image need to be applied with the watershed segmentation Algorithm. When the watershed segmentation process is done, then it is applied with the marker based watershed algorithm. This will be the third level process of the proposed research work.

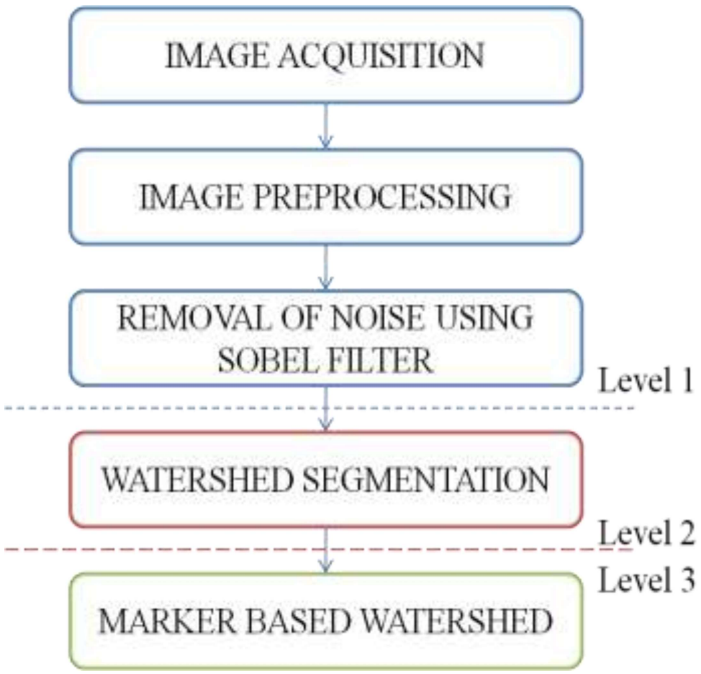

Figure 6: Proposed System Block Diagram

3.2.Sobel Edge Detection

The gradient based Sobel Edge detection is the first order derivates. It calculates first orderderivates of X and Y axes of the image separately. The 3X3 kernels of operator convolved with original image helps to calculate the derivates approximations, one for horizontal changes and other for vertical [14, 15]. The Sobel operator is differential operator which is used for computing the approximate values of the gradient using image intensity levels [16, 17].Efficient and accurate plant disease detection and classification technique can be done by using MATLAB for Image processing Techniques [18].

3.3. Prewitt Edge Detection

Prewitt operator is used for edge detection in an image. The prewitt edge detection helps to identify two types of edges, they are: Horizontal edges and Vertical edges. The Prewitt edge detection operator is similar to Sobel edge detection operator and is used for detecting vertical and horizontal edges in images. Conversely, unlike the Sobel, this operator does not place any emphasis on the pixels that are closer to the center of the mask.

4. CROP ANALYSIS AND DETECTION

Crop disease identification using deformable models are normally semi-automatic. However, two issues can appreciably affect their performance and therefore, need to be well defined: the initial conditions and the values of the parameters used. The RGB color space is converted so that the color information contained in the images can be used effectively to differentiate normal crop image and affected images. The differences in the color channels are combined to define the speed function and to stop criterion of the deformable model. These processes will be done in the level two and level three of proposed methodology.

5. COMPARISON PARAMETERS

The comparison parameters are used to verify the efficiency and performance between the different methods. Based on the comparison, the obtained results will lead to finalize better method. The MSE and PSNR are two common comparison parameters that are used in this research work. The main goal of Mean Square Error is less in every case in the entire algorithms [19]. The PSNR (Peak Signal Noise Ratio) is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation [20].

6. RESULTS AND DISCUSSION

Images are included for edge detection with the help of two traditional operators such as Sobel and Prewitt. The figure1 to figure 5 illustrated and discussed in the section one were processed in the Matlab using Sobel method which is one of the edge detection method. The

results obtained after applied that Sobel edge detection method were illustrate in the following Figure 7 -11. The results obtained after applied that Prewitt edge detection method were illustrated in the following Figure 12 -16.

Figure 7. Black Spot after SOBEL Filter Process Figure 8.Botrytis Blight after SOBEL Filter Process

Figure 9.Leaf Spot after SOBEL Filter Process Figure 10.Powdery Mildew after SOBEL Filter Process

Figure 11.Rust Spores after SOBEL Filter Process

Figure 12. Black Spot after PREWITT Filter Process Figure 13.Botrytis Blight after PREWITT Filter Process

Figure 14.Leaf Spot after PREWITT Filter Process Figure 15.Powdery Mildew after PREWITT Filter Process

Figure 16.Rust Spores after PREWITT Filter Process

Table 1. Comparison of MSE and PSNR between Sobel and Prewitt

S. No.	Disease Name	MSE		PSNR	
		Sobel	Prewitt	Sobel	Prewitt
01	Black Spot	88.25	92.18	28.29	24.58
02	Botrytis Blight	75.65	79.27	27.48	23.57
03	Leaf Spot	83.87	86.24	25.84	24.21
04	Powdery Mildew	79.21	83.62	27.12	25.65
05	Rust Spores	80.52	85.64	24.89	23.15

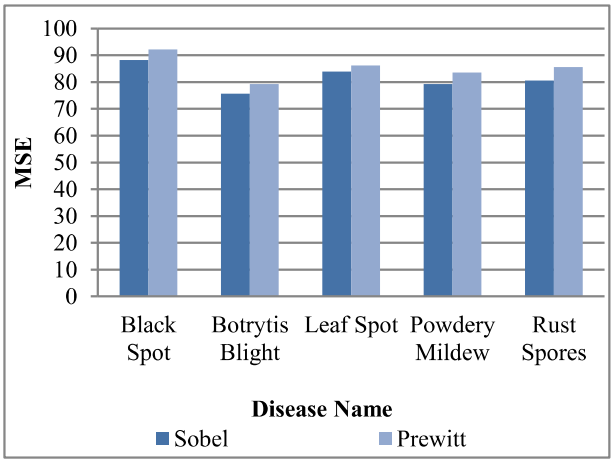

Figure 17.MSE Comparison

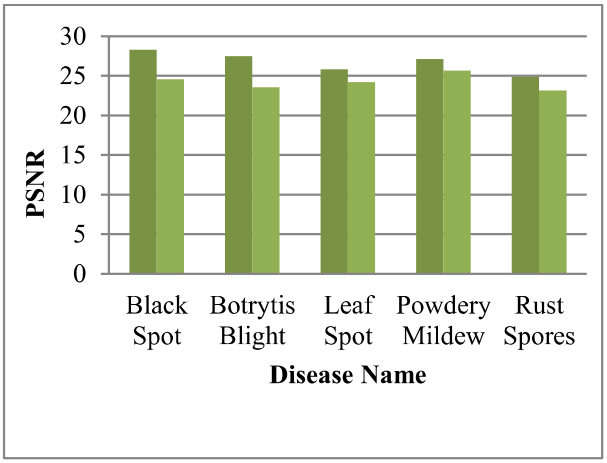

Figure 18. PSNR Comparison

Table 1 explains the comparison value between the Sobel and Prewitt edge detection in identifying the leaf related diseases. Figure 17 and Figure 18 illustrates the MSE and PSNR comparison between the Sobel and Prewitt edge detection and the results will help in identifying the leaf related diseases. For MSE, Sobel operator possesses less value which indicates lower error rate while compared to Prewitt. In the case of PSNR comparison, higher the value, better the quality of Compressed Image by applying Sobel, which indicates the higher quality rate, so Sobel performs out well against Prewitt.

The results are processed using Matlab simulator and obtained output images were illustrated in this chapter. The proposed methodology contains three levels: level one is processing the image with Sobel edge detection, level two is watershed Segmentation and level three is Marker Based Watershed. From the above comparison between the two different edge detection methods with the help of picture quality measures such as MSE and PSNR, the results

explained that the Sobel Edge detection gives better result than Prewitt Edge Detection. Further, it will be processed and implemented which helps to identify the leaf diseases. The level one is processed and its related results were illustrated in this section.

7. CONCLUSION AND FUTURE WORK

The progress in improvement of science and technology is a hysterical process for new things in which technology are being invented. The proposed automated system will able to detect the Maize leaf disease through image processing. When the user fed a leaf image, the proposed methodology will be capable of detecting the earlier mentioned diseases of the Maize plants. The proposed methodology contains three level of processing methods. This paper deals with the level one method i.e. detecting the edge of the input image by using the Sobel Edge detection method. The five images of Maize Leaf Diseases are used as input and those five image edges were detected and illustrated in this paper. In next level, those edge detected images need to be processed with the remaining two levels. In future, those two levels will be extended to obtain the better results to detect the plant diseases in earlier stage itself.

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