Detection of Cotton Leaf Disease Using Image Processing Techniques

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Abstract. In the area of research, diagnosis of disease symptoms in the plants duly applying image processing methods is a matter of big concern. The need of the hour is to prepare an efficient plant disease diagnosis system that can help the farmers in their cultivation and farming. This work is an attempt to prepare a framework of plant disease diagnosis system by using the cotton plant leaves. The digital pictures of cotton leaves are obtained to undergo a set of image processing techniques. Thresholding based segmentation techniques are used to remove the region of interest (ROI) i.e., infected part from the enhanced images. Consequently, diseases are detected from the region of interest by using an accurate set of visual texture features. At last treatment actions are taken to supervise the diseases found in the plants. This work will help the farmer’s society to take effective measures to protect their crops from diseases.

1. Introduction
India is famous in the world for agriculture and farming. Most of the population depends on agriculture and farming. Varieties of crops are produced in India in different areas in different weathers and seasons. So, a lot of diseases are seen affecting the plants throughout the country. Detection of plant diseases in its beginning stage is very important to protect the plants from diseases. Farmers required continuous monitoring of their plants by experts to protect the plants which may be expensive and time consuming [1-4]. Therefore, searching for a quick, less expensive and accurate method for automatic detection of symptoms of diseases found in the plant leaf is of great importance. Thus brings the requirement of machine vision for providing image based automatic detection of symptoms of diseases. The focus of this manuscript is to detect the symptoms of diseases found in the cotton plant leaf.
Basically two important techniques are used for detection of plant diseases i.e. (i) image processing and (ii) machine-learning methods. Today there is a basic requirement of developing an automatic diagnosis method applying leaf image processing techniques to detect the symptoms of diseases found in the plants such as automatic disease identification and categorization method. This can alert the farmers in the beginning of the disease in the farms well before spreading over in large areas. A color transformation of the RGB leaf has been created in the first step and application of color space transformation for the color transformation structure has been carried out. Subsequently, the image is segmented. In the second phase unnecessary parts of the leaf i.e. the green areas are taken away. In the third phase the texture features of the segmented objects i.e. the infected parts are further examined. At last, in the fourth step the relevant attributes are passed to the pre-trained neural network [5-7].

The paper is organized as follows. In Section 2, we give a brief representation for previously done works. In Section 3, the proposed model with its different steps is presented. In Section 4, we analyze the materials and methods. Through experiments and inferences we present the performance of our method. At last we finish up by summing up our result in section 5.

2. Literature review
In the process of image restoration, noise removal from the images has been executed. Different kinds of noise with different characteristics can be found in the images [8]. Noise removal techniques are based on the types of noise present in the image. There are many points at which noise can be mixed with the original signal. In the image processing method removal of noise is very important. The output of noise removal has a big effect on the processing of image quality [9]. The technique of the...
noise removal process is totally based on the types of the noises which corrupt the images. In the noise reduction process, various linear and nonlinear techniques have been applied by using various filters like a max filter, min filter, median and many more. Linear filters are not capable of removing impulse noise due to their nature to blur the edges of a picture. Noises are of different types such as salt and pepper, gaussian noise etc. The salt and pepper noise comes into existence when the pixel value is either 255 or 0. The algorithm will evaluate the centre pixel value i.e. whether or not it equals to 255 or 0. If the centre pixel (CP) is having value 255 or 0 then find out the alternative noise free value for CP. At the time of image acquisition (or) image capturing, noise is created in the images [10].

In 2020, S.Tripathy and T.Swarnkar proposed median filter is a reasonable methodology while contrasted with different techniques, since picture quality of median filter is better. A near examination is complete by execution of filters dependent simulated output parameters PSNR and MSE. In 2020, S.Tripathy and T.Swarnkar proposed a mean filter inadequate to clear the excessive amount of impulse noise. It performs well overall anyway it fumbles when the likelihood of impulse noise and non-impulse noise occurrence turns out to be high [7-8].

While obtaining the images some essential operations are performed on the image so as to do its classification and segmentation. Different filtering methods are available to minimize the noise from the complex pictures. Basically filters are used for suppressing the noise to improve the image quality.

3. Proposed approach

There are 5 types of methods that are applied for the detection of disease symptoms present in the leaves. Which are: i) image capturing ii) pre-processing iii) segmentation iv) FE and v) classification.

![Block diagram of disease detection in cotton leaf.](image)

**Figure 2.** Block diagram of disease detection in cotton leaf.

The digital picture represents the 2-D function $f(r, c)$, where $(r, c)$ coordinates in two-dimensional space and $f$ is the intensity of that coordinate. Acquisition alludes to the modes of digital image generation.

3.1. Image collection

The images of different leaves are taken by a digital camera with proper resolution for obtaining better quality images. Formation of a picture database mostly depends on the application. To keep uniformity all the pictures are saved in JPEG format [11].
3.2. **Pre-processing**

Image pre-processing consists of two pre-processing phases i.e. (i) image reconstruction and (ii) noise removing. Captured pictures are reframed to an exact resolution. Reframed images are filtered for removal of existing noise. For removal of unwanted noise, a rotational symmetric gaussian low pass filter is applied.

3.3. **Segmentation**

Segmentation is the process of assigning a label to each pixel in a picture, where pixels of the same label share certain visual characteristics. In this process the total picture is separated into groups of pixels which are homogeneous with regard to pixel labelling criterion. Thresholding based masking segmentation has been applied in the present work [12, 13].

Thresholding technique: These methods interpret the color image resulted from k-means unsupervised approach i.e. ROI of leaf image holds spots. The technique starts with reading the pixel values of green, blue and red strip independently. Programmatically result shows that diseased parts of the leaf are prominently distinct in the green band with less pixel intensity than the healthy parts. As such, this value is taken as threshold to attenuate the pixel with larger value in the picture in green strip. In view of, a mask is created with R, G, and B values of pixels representing the diseased portion as 1 and rest being 0. This mask is tested on the input leaf picture to remove only ROI.

3.4. **Feature extraction**

In statistical texture analysis, attributes are calculated from the statistical distribution of observed combinations of intensities at specified positions relative to each other in the picture. Gray level co-occurrence matrix (GLCM) features are produced for each pixel of an infected cluster of an image [13]. The graycomatrix function creates a GLCM by computing how frequently a pixel with the specific intensity rate ‘t’ occurs in a specified spatial relationship(SP) to a pixel with the value ‘v’. By default this SP is the pixel of enthusiasm and its neighbouring right pixel. However we can specify some other spatial relationship between two pixels. Specify an array of offsets the function of graycomatrix to create multiple GLCM[14-17]. This offset defines the pixel relationships of varying directions and distance. Along with two diagonals, directions can be vertical or horizontal.

3.5. **Classification**

Feature vector of input images is compared with the database. The class with which minimum distance is obtained is identified class. The classifier used in this is the Euclidean distance classifier.

4. **Experimental results**

All the experiments are done on Windows 7 in MATLAB 2016(b) . All the images are first converted to Gray scale because it’s easy to process a 2D image with respect to 3D image. We used different combinations of filters and noises to check which combination provides better PSNR.
Table 1. Evaluation of preprocessing techniques

| NO | Preprocessing Technique                        | PSNR(dB) |
|----|-----------------------------------------------|----------|
| 1  | Adaptive Histogram Equalization (AHE)         | 24.32    |
| 2  | Mean Filter (MF)                              | 43.44    |
| 3  | Contrast Stretching (CS)                      | 23.63    |
| 4  | Histogram Equalization (HE)                   | 22.23    |
| 5  | Median Filter (MDF)                           | 47.45    |
| 6  | 2-D adaptive noise-removal filtering (2DAF)   | 21.01    |

Figure 3. Represent PSNR value of different preprocessing techniques.

The PSNR for the MF is 47.45 displayed in Table 1 and figure 3, which is larger while comparing with other techniques. From the above analysis, it is found that the median filter can perform very well on the picture with salt and pepper noise while comparing with other filters.

5. Conclusion

The above plant disease diagnosis system helps the farmer’s society and agriculture industry to increase the crop production capacity by protecting their crops from several diseases found in their farms by identifying the symptoms of disease in its early stage and taking appropriate steps to control them. The model is designed to identify the symptoms of cotton plant disease. The model successfully fragments the affected part of the images of leaf samples using thresholding techniques. The model perfectly identifies the affected area present in the leaves. Finally categorized the type of disease being affected using GLCM features extracted from the diseased portion. The obtained result helps the farmers in creating fruitful determination and to defend their crops from massive damage due to diseases.
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