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A DETECTION OF WEED IN AGRICULTURE USING DIGITAL IMAGE PROCESSING

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Abstract:

Agriculture is the backbone of every human life in this world. In India agriculture plays an important role in economy development. Now a days we need more agriculture productivity to meet uncountable population demands. In olden days farmers used cow dung as a fertilizer to increase enough productivity to meet the requirements of the growing population. Sometime they use herbicides to detect the weed, But it leads to more cost and labour. In this paper we discussed image processing using matlab to detect weed in an image, which is we took from the different field. A method of weed detection based on color difference of green plant and soil. In my paper some type of weed is used to differentiate the crop and weed. Because weed type is different from one cropfield to another cropfield even the country. Depends on type of soil weed nature is change. Images are acquired by using Digital camera, then applied mean filter, contrast stretching, histogram to enhance the image, after that I used otsu threshold edge detection techniques prewit, sobel, canny, Robert to detect weed area from crop field. Finally measure the quality of result by using SNR&MSE values to find best segmentation techniques to detect the weed area. HereI explained how image processing technique in MATLAB could be employed for weed detection in crop field.

Key Words: Weed Detection, Image Processing Techniques, SNR & MSE.

1. Introduction:

In past decades weed detection was done by employing some people especially for that purpose. They will detect the weed by checking each and every bit of the field. Then they will pluck them out manually, but it is a more time consuming and cost consuming process. Later with the development of the technology, Farmers started using the Herbicides to remove the weeds. But using of chemical herbicides causes negative effects to the environment. It also leads to more manual labour and cost. But to detect the weed farmers still using manual power in many parts of the world. Later in the development of agriculture came few methods to detect the weeds automatically but due to lack of their accuracy, they are unable to reach to the people. Then they started using image processing for this purpose. This paper intends to focus on the application of image processing in agricultural field particularly for weed detection in crop field. Crop and weed have different growth rate, even it varies among different types of weed occurring in same field. So taking photographs can done by manually under different lighting and environment conditions. Then we preprocess the image by using different image processing techniques like contrast stretching, mean filter, histogram etc., and segmentation techniques .finally those techniques used in matlab to detect weeds in the crop field.

2. Background and Review of Literature:

Digital image Processing involves the processing of digital data for improving the image qualities with the help of computer. During this process image clarity, sharpness and details of features of interest towards image extraction and further analysis. Agriculture harvest is reduced yearly because of a plant growth is usually affected by a different type of weeds in different environment and country. Digital image processing techniques are used to early detection of weed and remove it to allow crop growth. To many papers describing to detecting, the plant weed and different methods suggesting the implementation ways as discussed here. [1]. For automatic weed monitoring in cultivated crops, two general approaches have typically been used , The first is to detect certain geometric differences between the crop and weeds, such as leaf shape or plant structure. The second general approach is based on differences in spectral reflectance.[2]. There may also be a difference in location of the crop compared with the weed .It describes the feasibility of using leaf shape for plant identification. The initial investigation was limited to individual plants (three crop and five weed species) viewed against a soil background, in laboratory conditions.[3]. The differences between vegetation and soil reflectance in the near-infrared region, proved successful for segmenting plants from a soil background. This reviewed the potential use of remote sensing techniques for crop protection in the field, and suggested that one way to distinguish between weeds and crops was by examining the temporal patterns of vegetation indices throughout the growing season.[4].Brown reported that there appeared to be potential for distinguishing weeds from agricultural crops based on their relative spectral reflectance characteristics. However, they added that it might be necessary to look at identifying groups of weeds rather than individual species, in real agricultural environments.[5].Zhang & Chaisattapagon (1995) have studied three different approaches to identify weeds in wheat fields using machine vision: colour analysis, shape analysis and texture analysis. They used spectral measurements of visual and near infrared reflection combined with spatial information black-white digital images with various colour filters, under laboratory conditions. The red and green filters were effective in detecting reddish stems of some weed species. Shape parameters were effective in distinguishing single leaves of broadleef weeds from wheat leaves.[6] Ferez Ruiz&Upadhaya2012 explained full realization of physical weed control(pw)with automatic machine within the RHEA project.[7] Guancin, Liu Zhenzhogwuquiufeny, wang lu used texture features and their colours to extract weed from crop field.[8].I Ahmed, I. Ahmed, A. Adnan, M. Islam, and S. Gul, discussed about recognition of weed by using Edge based Real-Time Weed Recognition System for Selective Herbicides.[9]. K. H. Ghazali, M. M. Mustafa, and A. Hussain, explained how to classify weed on the basis of colour and feature by using different image processing techniques.[10]. Kartika fridausy, Tolesutikno, Eko prasetyo discuss image enhancement using contrast stretching on RBG & its Digital image.

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3. The Proposed Work:

The proposed work consists of image acquisition, preprocessing and various segmentation techniques which is used in my paper. By using this methods the quality of image is measured and weed is detected. The flow of work is shown on figure

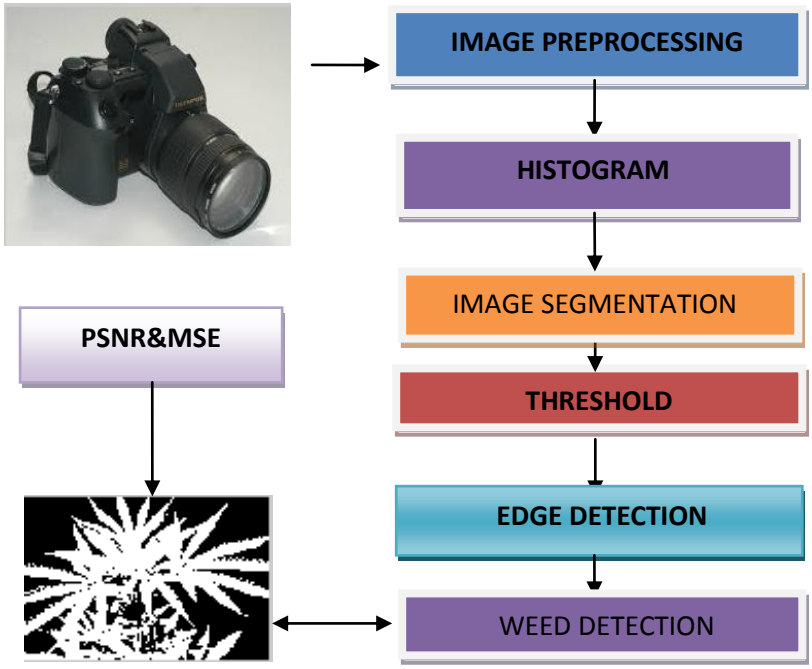

Figure 1: The Basic Procedure of the Proposed Approach

4. Weed Detection:

A weed is also a plant which affects crop growth in the field. But it different from field to field depends on type of crop. The nature of weed is, It always grown between any plant and reproduces aggressively in the crop field. The term weed is occasionally used to broadly describe unwanted plant type in the plant kingdom which can live in diverse environments and reproduce quickly. These have seeds that persist in the soil seed bank for many years. They compete with the desired plants for the resources that a plant typically needs, namely, direct sunlight, soil nutrients, water, and (to a lesser extent) space for growth sometimes it didn't need resources like water, nutrients. Weed detection and classification is a serious issue in the agricultural research. Weed classification is a necessity in identifying weed species for control. Generally weed classified into 2 categories. They are Narrow leaf and Broad leaf depends on surrounding and soil and moisture content. For example

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Figure 2: Example of Broad and Narrow Leaves

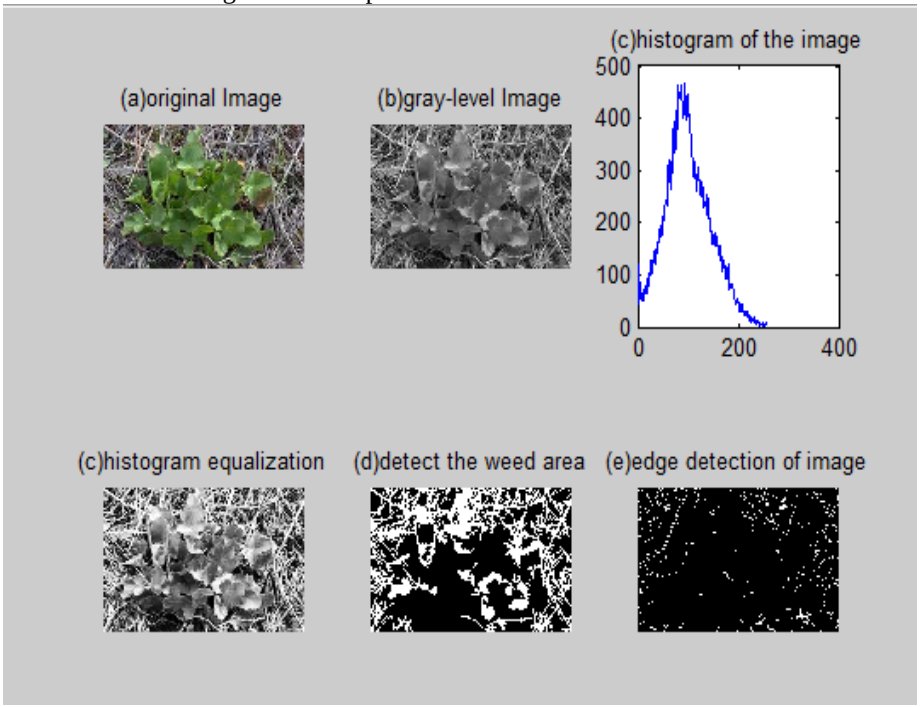

Figure 3: Output of Weed Detection

3.1 Image Acquisition: It refers to the stages of Capturing real-world pictures of weed and crops. Digital cameras which we used to capture the images directly in digital form and these images are taken for processing.

3.2 Image Pre-processing: Contrast stretching is an image enhancement technique that improves the contrast in an image and intensity values it contains. Mean filter is used to smoothening and reduce noise from the image.

3.3 Image Segmentation: Image segmentation is the technique of dividing or partitioning an digital image into multiple segments. It is generally useful for applications like image compression or object identification. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

3.4 Histogram Method: Histogram-based methods are very efficient compared to other image segmentation methods because they typically require only one pass through the pixels. In this method, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. It is measure by using Color or intensity.

3.5 Thresholding: The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. There is also a balanced histogram thresholding. The key of this method is to select the threshold value (or)values when multiple-levels are selected. Here we used Glopal threshold method. This is done by any approriate threshold value T.This value of T will be constant for whole image. On the basis of T the output image q(x,y) can be obtained from original image q(x,y)= $\begin{cases} 1, if\ p(x,y) > T \\ 0, if\ p(x,y) \leq T \end{cases}$

Advantage of this method ,it does not need any previous information. Otsu(1,N)segments the image 1 into N classes by means of Otsu's N thresholding method. Its returns an array IDX containing the cluster indies(from 1 to N)of each point. IDX =OTSU(1) uses 2 classes(N=2 ,default value).[IDX,sep]=OTSU(1,N)also returns the value(sep) of separability criterion within the range[0,1].zero is obtained only with data having less than Nvalues where as one (optimal value)is obtained only with N-valued arrays.

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Figure 4: Output of OTSU Threshold

Figure 5: Output of Threshold After Gray

3.6 Edge Detection: It is a fundamental tool for image segmentation. It transform original images into edge images like Gray tones. Basically it detects the object and its boundaries and its background in the image. Edge detection implements set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. So Edge detection is a fundamental for machine vision and computer vision, particularly in the areas of feature detection and feature extraction. Here different type of edge detection method used to find weed.

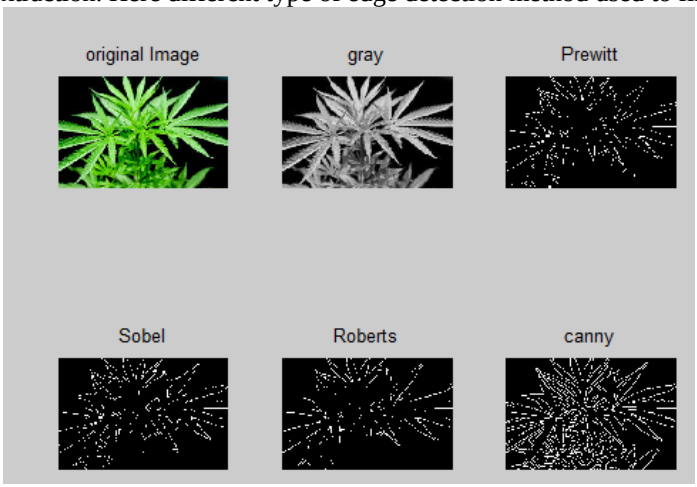

Figure 6: Output of Edge Detection of Weed

3.6.1 Prewitt: Prewitt operator is used for detecting edges horizontally and vertically. Edges are calculated by using difference between corresponding pixel intensities of an image. All the masks that are used for edge detection are also known as derivative masks.

3.6.2 Sobel: The sobel operator is very similar to Prewitt operator. It is also a derivate mask and is used for edge detection. It also calculates edges in both horizontal and vertical direction. Compared to other edge operator, Sobel has two main advantages. It has some smoothing effect to the random noise of the image. Because it is the differential of two rows or two columns, so the elements of the edge on both sides has been enhanced, so that the edge seems thick and bright.

3.6.3 Robert: The Roberts operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. It thus highlights regions of high spatial gradient which often correspond to edges. In its most common usage, the input to the operator is a greyscale image, as is the output. Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point.

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3.6.4 Canny: In industry, the Canny edge detection technique is one of the standard edge detection techniques. It was first created by John Canny for his Master's thesis at MIT in 1983, and still outperforms many of the newer algorithms that have been developed. To find edges by separating noise from the image before find edges of image the Canny is a very important method. Canny method is a better method without disturbing the features of the edges in the image afterwards it applying the tendency to find the edges and the serious value for threshold

Final Output:

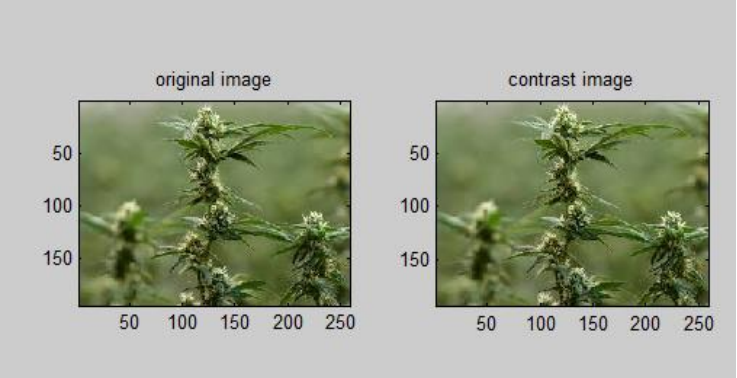

Figure 7: After Contrast Stretching

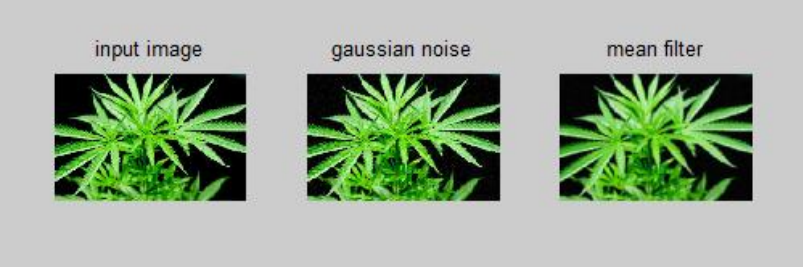

Figure 8: After Mean Filter

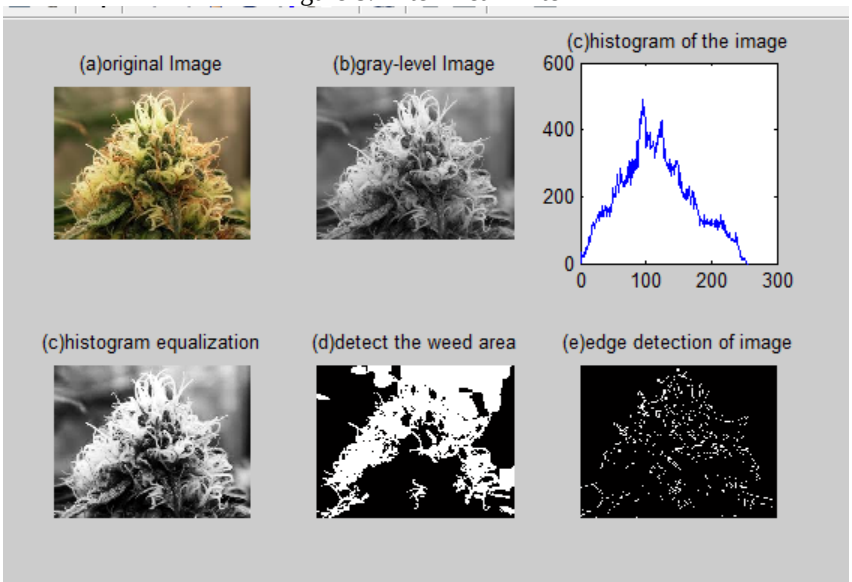

Figure 9: Output of Weed Detection

Image Uuality Measure:

The computational methods are used to measure the image quality. In this paper we compared the various segmentation techniques are applied to the various weeds and measure the quality parameters of snr and mse. This parameter values are used to analysis which segmentation perform better compare to other segmentation techniques.

Signal to Noice Ratio:

The signal-to-noise ratio (SNR) is used in imaging as a physical measure of the sensitivity of a (digital or film) imaging system. Industry standards measure SNR in decibels (dB) of power and therefore apply the 10 log rule to the "pure" SNR *ratio* (a ratio of 1:1 yields 0 decibels, for instance). In turn, yielding the "sensitivity." Industry standards measure and define sensitivity in terms of the ISO film speed equivalent; SNR:32.04 dB = excellent image quality and SNR:20 dB = acceptable image quality.[1]

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Mean Square Error:

The MSE represents the cumulative squared error between the compressed and the original image. The lower the value of the MSE, is represented the high quality of the image. MSE is defined on two images A and B, where N is the total number of pixels in the images assuming the images are of the same size.

$$MSE = \frac{\sum_{i=1}^{N}(A_i - B_i)^2}{N} \qquad (2)$$

Conclusion and Future Work:

The result of this study has shown that the Image processing technique has been perfect and suitable method for weed detection. By using this information farmers can simply reduce the cost for herbicides. So pollution around the environment is reduced. The weeds can be detected by using different segmentation methods, but it only detect weed with broad and narrow types of few weeds. In our world there is so many different shape and colour weeds available and many kind of them still not detected, because they have also same colour and shape like crop(example : rice field weeds , golludhal field weeds, cumin field weeds etc.),. In my future work I expand it based on different weed types based on soil nature.I had also measure my work on the basis of psnr, mse values. So in future Robotics used for image acquisition and take different shapes and colour of weed leafs for Image processing. Here I used PSNR&MSE values to estimate correct weed detection method. The following table.1 shows comparison between Threshold and Canny.Table.2 shows comparison between different edge detection techniques.

Table 1: PSNR and MSE Values

Images	Image 1		Image2		Image3		Image4	
Techniques	psnr	mse	psnr	mse	psnr	mse	psnr	mse
Threshold	7.3994	1.1834	6.9192	1.3217	6.8865	1.3317	7.7705	1.0865
Canny	49.06777	0.6777	48.6835	0.8805	49.2316	0.7761	49.1810	0.7852

Table 2: PSNR and MSE Values

Images	Image2		Image3	
Techniques	psnr	mse	psnr	mse
Robert	49.3118	0.7619	48.2903	0.9639
Prewitt	49.3550	0.7544	48.3645	0.9476
Sobel	49.3577	0.7539	48.3668	0.9471
Canny	49.8203	0.6777	49.2316	0.7761

Based on above PSNR&MSE values canny is best edge detection method.so the weed is accurately detected. These images are taken from internet.

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