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Image Processing Techniques In Agriculture For Plant Disease Detection And Weed Detection

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ABSTRACT

Agriculture is that the backbone of human sustenance on this world. Now a days with growing population we would like the productivity of the agriculture to be increased tons to satisfy the stress . In olden days they used natural methods to extend the productivity, like using the trash as a fertilizer within the fields which resulted increase in the yield of the product to meet the requirements of the people. But later they started thinking of making more incomes by getting more outcomes. So, then came a revolution called the "Green Revolution". After this period the use of toxics such as herbicides has increased to aextreme level. Due to this there was an increase the productivity but we've forgot about damage done to the surroundings, that result in the damage done to our beautiful earth. In our country 70% of the population rely on Agriculture as their main occupation, and it is vital for the constant increase in growth of the nationhence the disease detection and diagnostics processes must occur in a faster pace.

KEYWORDS: Segmentation,Plant disease detection,Weed detection,Otsu's Classifier,Feature Extraction.

1. INTRODUCTION

Image processing as aenabler would increase the extent of approval of scientific based systems because it can donate in many facets of the Agriculture sector. The use of machine has proven to be effective on spotting disease on fruits, insects and food categorizing. Weeds are often injurious from a farm viewpoint because it contests with our yield crop for water, light, nutrients and space, therefore the development of various methods based in Image processing is very popular and it uses techniques like detection of edges, colour and other characteristics of weeds to acknowledge it.At the present time, Image processing plays a key role within the numerous fields. Particularly, the extent of these applications in agriculture is developing gradually with the supply if higher quality measurements with the smart algorithms and therefore the enlarged possibility to quite one sources of data from both the sensors placed and satellite in fields.

Visualization – Observe the objects that aren't invisible

Image sharpening and restoration – To develop a far better image

Measurement of Pattern – To measuring the several objects in a picture

Image recognition – Distinguish the objects in a picture

Image Retrieval – search for the image of interest

2. IMAGE PROCESSING IN TERMS OF AGRICULTURAL USAGE

Image processing holds an efficient set of tools for analyzing the imagery utilized in agriculture. To automating this analysis is especially rational management plan which saves both the cash and time. Agricultural image processing is one among the hugely innovative and essential image processing areas recognize. Because there's a huge range of associated in sub domain it's having the eye of the researches. also as, it's also explored the popularity model with a broader view.

Image processing techniques are often wont to enhance agricultural practices, by improving accuracy and consistency of processes while reducing farmers' manual monitoring. Often, it provideselasticity and successfullyalternates the farmers' visual deciding .Some of the image processing terminology applicable in agriculture.The steps in Image processing are

Image acquisition: The process of retrieving of a digital image from a physical device to capture the image using sensors.

Gray scale conversion: The process of altering a colour or multi-channel digital image to a single channel where image pixel holds a single intensity value.

Image background extraction: The separation of image background and retrieving foreground objects

Image enhancement: The improvement in observation of image details for human and machine analysis

Image histogram analysis: The pixel plot analysis in terms of peaks and valleys formed by pixel frequency versus the pixel intensities.

Binary image segmentation: The foreground objects separation from background from a binary (black-and-white) image

Colour image segmentation: The image objects separation in a colour image, using regions.

Image filtering: The process of altering an image in a desired way using a filter

Feature extraction: The process of defining a set of features, or image characteristics that competently or profoundly represent the information needed for analysis and classification

Image registration: The process of converting different sets of data into one coordinate system

Image transition: The process of changing the state or defining a condition between two or more images

Image object detection: The process of discovering cases of real-world objects such as weeds, plants, and insects in images or video sequences

Image object analysis: The process mining reliable and meaningful information from images.

In this paper we are going to see about how image processing techniques can be used for plant disease detection and weed detection in an agricultural field which helps us in preventing losses in yield and quantity with quality of our agricultural product.

3. PLANT DISEASE DETECTION

If the plant leaves gets affected, the leaf become totally covered with diseased spots, disease determines the quantity, quality, stability of yield. Excessive use of pesticides increase the danger of toxic residue level on products it has been identified as a major contributor to ground water contamination now days pesticides price are increasing day by day. To achieve highest production with less cost they need to use modern technique to enhance productivity with minimum time more Profit [10].

Below are the steps for which an input image of a plant leaf is processed and tested if disease exists.

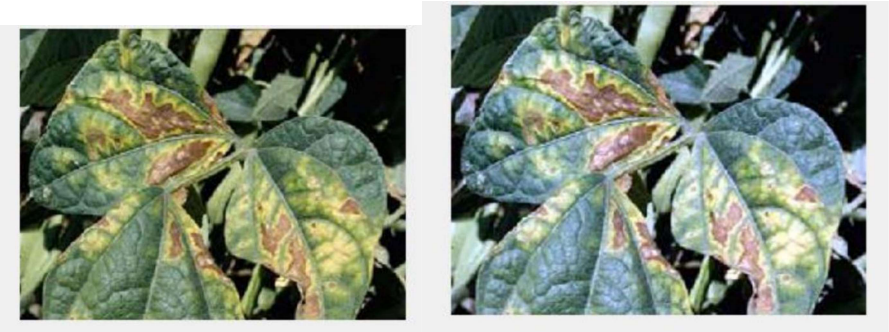
- Image acquisition
- Image pre-processing and enhancement
- Image segmentation using k means and Otsu classifier
- Feature extraction

3.1 Image Acquisition

Image acquisition means to collect different types of samples for the formation of the input dataset. Dataset images further undergo the varied steps. In order to provide best solutionto any problem it is necessary that dataset cover majority of the different type of inputs. Wehave covered different plant leaves. Different image formats are taken in our dataset. Anyother image excluding dataset are often utilized in our algorithm provided its size is matching and format is understood. Algorithms and its classifier gives the prediction of the disease for thatrandom image[2].

3.2 Image pre-processing and Enhancement

It is the second step of digital image processing. Due to use of MATLAB input image noise is reduced, pixel values get more classified, spot reduction and contrast enhancement is there. The aim of the image pre-processing and enhancement step is that after pre-processing the image its get easy to separate the infected area. Indirectly the classifier we use works better with pre-processed image without and impurities. Values of the pixels also get adjusted within the pre-processed image. MATLAB provides user number of various filters for the enhancement of the image.



Original Image Pre-processed Image

In the above figure we can see the difference between the two of the images. The first image is the input image and the second one is the pre-processed image in which we enhance noise in the image and overall quality

of the image is improved.Image is also gets separated in the second pre-processed image. Image segmentation is the third step in our purposed methodology and pre-processing we segment the image in to 3 different clusters. It means colour based clustering algorithm and the classification is done through the Otsu classifier. After making three different clusters the user is asked to settle on one among the cluster and then disease is predicted using that particular cluster[3].

4. K-MEANS COLOR BASED CLUSTERING

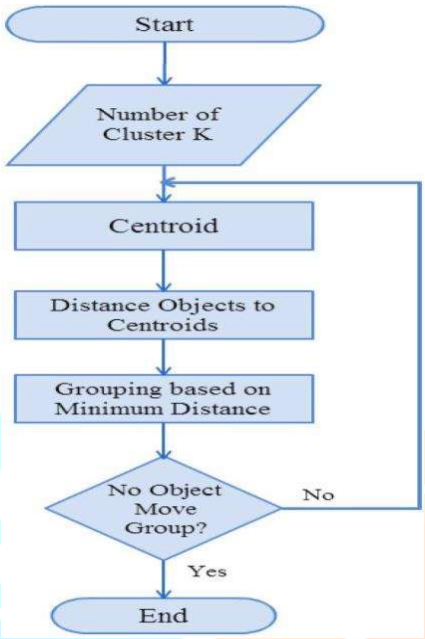


Figure1. K means algorithm

Above flowchart explains the traditional working of the k means clustering algorithm. Acentroid is chosen and distance of the other objects is measured from that centroid using Euclidean shortest distance method [6]. In this way different clusters are made. Implementation of the K mean algorithm is as follows:

1. Input the pre-processed image

2. Convert the given colour space to lab colour space

3. Normal colour space of the image is RGB colour space which contains the first colours red, green and blue.

4. It is easy to extract the different features from lab colour space in comparison to the RGB colour space.

5. Lab colour space is also represented by the L*a*b*, in which l stands for lightness, bstands for the blue/yellow and a stands for the red/green value. This colour space is the way to communicate with the colours and locate them. All the information of colour lies around a* and b* axis.

6. Different clusters are made on the idea of various colour using k mean clustering. Clusters are made using distance between the initial groups and the distance of theother from that group. The nearest one are chosen. For this we use Euclidean shortestdistance formula.

7. Grouping of the clusters is based on the minimum distance from the centroid.

5. OTSU'S CLASSIFIER

Otsu method is one among famous method for clustering based image thresholds. It is named after famous scientist Nobuyuki Otsu. This method automatically performs clustering based on Image Thresholding. This method automatically converts and reduces the image from the grey level to the binary one. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the 2 classes in order that their combined spread (intra -class variance) is minimal, or equivalently (because the sum of pair wise squared distances is constant), so that their inter-class variance is maximal.

6. FEATURE EXTRACTION

In order to identify an object, the feature extraction technique is very important. The feature extraction process is used in most of the applications of image processing [8]. In order to detect plant disease, some features like colour, texture, morphology, edges etc. are utilized. In this process, some features of the image are extracted on the basis of segmented information and predefined dataset.

FEATURES	
Mean	48.6186
S.D	74.9293
Entropy	4.69867
RMS	9.88411
Variance	5360.22
Smoothness	1
Kurtosis	3.12776
Skewness	1.28105
IDM	255
Contrast	3.24236
Correlation	0.659386
Energy	0.34533
Homogeneity	0.816415

Figure 2. Features of segmented ROI

Several features such as colour oriented, shape oriented are extracted using MATLAB commands. These features play important role in determining the affected region of the leaves. Various features like mean, standard deviation, variance and others are extracted in order to know the health of the leaf.

7. WEED DETECTION

7.1 Methods of Weed Detection

The weeds are often present in any areas of the sector. But they're mostly present in between the crops and between the rows [4]. In this paper the Weed between the Crops and Weed between the Rows are considered.

7.2 Weed Detection between Rows: In this Weed Detection method, the weeds present in between the rows of the crops are considered and the images are taken in it. Now the image processing technique is introduced to spray herbicides upon them.

7.3 Weed detection Between Crops: during this method of Weed detection the weeds present in between the interval of two crops are taken. Those weeds are removed by sensing them through column weed detection process. If the crops are planted uniformly throughout the sector but if the crops are planted randomly or spread irregularly within the field they're done by the method of image processing.

7.4 Image Segmentation:

The process of image segmentation is partitioning the pictures taken from the sector into set of various segments. These image segments are known as pixels. Segmentation makes the image easy to analyze. The lines and curves which are typically called as Objects and limits respectively are represented through image segmentation by assigning each and each pixel. These pixels share certain visual characteristics. The set of pixels within the output represents the whole image of the weed.

The Image segmentation process will provide good quality output result. Segmentation Process involves many pre processing procedures. The pre processing step has undergone the method of De-Noising and Image Enhancement [4]. The De-Noising process is given a non linear filter called Rank Filter. They ready to identify the weed by the info which we provided earlier as Shape, Edge, Boundary, and Object etc.

7.5 Methods for weed detection using image processing

7.5.1 Image Acquisition: Images of weed are taken from online dataset or from crop field using high resolution camera for more accuracy in RGB format. Each obtained image is stored in respective size and in jpg format.

7.5.2 Pre-processing: Obtained images are suffering from the varied factors like noise, lighting variations, poor resolution of a picture and unwanted background. In pre-processing some tools are used for RGB to Gray scale conversion, Gray scale images to binary image filtering techniques are wont to remove the noise and unwanted objects from background. To remove noise in image or other object, pre-processing techniques is considered. Image cropping of the leaf image to get the required image region Image smoothing is done using the smoothing filter. Image enhancement is carried out for increasing the contrast. Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images. The cumulative distribution function is used to distribute intensity values

7.5.3 Feature Extraction: After pre-processing, features are extracted for detecting the weed. Feature extraction is process of defining a group of features, for the effective depiction of the knowledge for analysis and classification. Different types of features are texture features like entropy, energy, contrast etc., size shape and colour based features are to extract the features.

7.5.4 Classification: Classification techniques are done to classify the weed. Feature vectors are passed as input to the classifiers. In classification classifiers are qualified, authorized and tested using images of different weed. Some of the classifiers are artificial neural network, probabilistic neural network genetic algorithm and edge based classifier etc.

8. RESULTS

8.1 Signals to Noise Ratio (SNR)

It shows the relationship between the real image and estimated image. This ratio indicates how strong the noise corrupted the original image.

8.2 Peak Signal to Noise Ratio (PSNR)

In PSNR we are interested in signal peak. This is more content specific than pure SNR. Here we say how high intensity regions of the image come through the noise and paying much less attention to low intensity regions.

Images	Peak-SNR value	Normalized Absolute Error	Structural Content	Mean-Squared error
Original Image	22.4992	8.5070e-04	0.9991	365.7309
Pre-Processed Image	22.3071	8.5088e-04	0.9993	382.2681

Table 1

The PSNR gets better with the increase in compressed image bit rate as shown in the PSNR curves for test images in Table 1. The results show in Table 1 with increasing trend in PSNR values on the other hand MSE decreases gradually with the improvement in compressed image bit rate. Hence greater the compressed image bit rate, better the quality of the image as well as errors on lower side. A higher value of structural content shows image is of poor quality. A higher Normalized Absolute Error value shows that image is of poor quality.

The estimation of different image quality metrics (PSNR, SNR, and MSE) is essential task in digital image processing as it provides a better way for image quality assessment and its improvement. It can be observed that higher the value of PSNR and lower value of MSE are desired results.

9. CONCLUSION

Using image techniques and data mining algorithms we successfully identified the affected area in the plant leaf. Various features of the image are extracted with their numeric values. The algorithm used here is very much efficient and best case time space complexities are achieved.The weed detection process depends upon the segmentation and has extraction. The various techniques are designed for the weed detection. The region based segmentation and textural feature analysis techniques are the most efficient technique for the weed detection. In future, classification approach will be proposed for the weed detection in the crops. Thus we will conclude that image processing was the non invasive and effective tool which will be applied for the agriculture domain with great accuracy for analysis of agronomic parameters.

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