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A REVIEW PAPER ON TECHNIQUES TO IDENTIFY PLANT DISEASES

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Abstract: To increase crop productivity, recognition of a plant disease is a very pivotal task. The prior identification of plant diseases helps farmers to prevent losses occurred by various types of plant diseases. Manual observation and identification of plant diseases is a very tedious task as it requires a lot of time, money, efforts etc. therefore an automated system is required that efficiently identifies plant disease in a minimum span of time without requiring much efforts. Plant disease have been identified using various techniques such as image segmentation, clustering, convolution neural network, decision trees and many more by determining the patterns of plant images based on their colour, spots, light intensity over a certain period of time by various researchers. This paper aims to portray the techniques formulate in this area. This work infers the major challenges that thus far not explored.
Keywords: Image processing, Plant diseases identification techniques, Microbial diseases, Classification algorithms

1. INTRODUCTION

The most common method adopted by farmers to spot plant diseases is examination through naked eyes. It is hit and trial approach and requires much human efforts particularly when the size of land is reasonably big. Moreover, due to lack of expertise at farmers end many of the times diseases are not identified corrected or identified late. Consequently, the quality and quantity of crop is affected.

Black spots, downly mildew, early bright, late bright, wheat leaf rust, puccinia recondite are some of the plant diseases which does not cause spectacular damage but in a survey it is recorded the average loss of 16% occurred only by microbial diseases (and 70-80% of these losses were caused by fungi) by year 2019. Various methods have been devised in past to study/detect plant diseases/symptoms using Image Processing, Convolution Neural Network(CNN), Support Vector Machine(SVM), Decision Trees(DT), Naïve Bayes(NB), k-nearest Neighbours (KNN), Deep Learning Neural Network (DNN) and Random Forest. But it has been observed that all aforementioned techniques aims at maximizing crop production and minimizing human subjectiveness in detection of plant diseases.

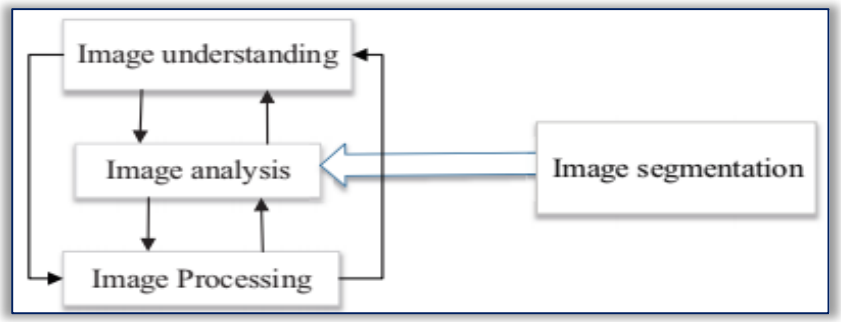

Figure: Image Segmentation

A plenty of interest has been induced in the field of image analysis in recent past years and is seems to be very imperious. One of the interest is to recognize the plant diseases to prevent crop losses. Image segmentation is a systematic approach that facilitate to render the image and extract important findings to identify diseases in agriculture domain.

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Various types of image segmentation studied including Edge segmentation, Histogram thresholding, Clustering based approaches, Region based segmentation and Soft computing techniques. These techniques are applied on plant images to infer which type of disease plant has and at what frequency so that preventive measures can be taken.
The cluster analysis divides the input data into groups or clusters on behalf of some similar characteristics. Certain criterion that can be used in clustering comprises distance, connectivity and intensity. The resultant partition enhance the understanding of human beings and helps them in knowledgeable decision making.
Several clustering approaches have been exercised, like hard clustering and fuzzy clustering, each of possess its specific characteristics. Hard clustering splits the input data into a number of class and each class is fit to exactly one cluster. This is the drawback of hard clustering. On the other hand, in Fuzzy clustering each class possess a degree of membership.
Fuzzy clustering techniques provides a fruitful research area in the applications where pixel values have been classified correctly as there are no crisp boundaries between object in an image. Image segmentation using fuzzy clustering technique provides a way to classify pixel values with a great extent of accuracy.
The paper is organised as follows: Section 2 provides the different clustering techniques that have been implemented in various domain by different researchers. Section 3 concludes the paper.

2. LITERATURE REVIEW

The literary work from the years to 2019 has been studied and reviewed. A brief description about the related work in disease identification by various researchers are as follows:
The author Trimi Neha Tete & et.al [1] discussed about the different techniques used for segmentation to identify plant disease. Techniques used are threshold, k-means clustering and ANN algorithm to classify the plant disease. Results showed that k-means clustering have better performance as compare to threshold and ANN algorithm and gives best outcome for distinct data set.
The author Shabari Shedthi B & et.al [2] proposed a comparative study of K-means and Fuzzy c-means clustering techniques to identify plant disease using segmentation. In this paper, disease of Arecanut and Iris leaf are identified. Both above clustering techniques are applied on the images and results are observed which showed that k-means executes faster than fuzzy c-means.
The author G.Sasibhusana Rao & et.al [3] worked on the unsupervised learning algorithms for MRI Brain Tumor segmentation. Clustering techniques like K-means (KM) and Fuzzy c-means(FCM) are used to locate the tumor and extract it. Above techniques get compared on various parameters like segmented area, relative area, mean squared error and peak signal to noise ratio. Experiments showed that FCM has better performance than those k-means clustering. The same idea can be reflected for plant diseases detection.
The author Mrs. Gaganpreet Kaur & et.al [4] surveyed various plant disease that attack on the leaf. This paper performs various steps that are observed in image processing like image acquiring, pre-processing of image, segmentation, feature selection and categorization to spot the leaf disease. The proposed work helps researchers to provide informational knowledge in the domain of agriculture to detect the disease at early stage.
The author Noureddine Ait Ali & et.al [5] implemented the two parallel versions of Bias-Correction Fuzzy c-means algorithm namely PBCFCM-v1 and PBCFCM-v2 using parallel graphics cards (GPUs). These variants get executed for segmentation of MRI images. The PBCFCM-v1 showed better results for large image densities whereas the PBCFCM-v2 is better for any image size range. The same concept can be adopted to identify the plant diseases that gives a new direction to researchers.
The author Dante Mujica-Vargas & et.al [6] performed image segmentation using robust Gaussian-based radial kernel fuzzy clustering algorithm. To enhance the performance of fuzzy c-means algorithm, author modify its objective function and derive the update expression of FCM for the membership matrix and the vector of centroid. Results showed that images are segmented with a low noise density and has superior performance using only colour information.
The author Shivanand B Lamani & et.al [7] proposed the identification and remedy of pomegranate fruit disease using Fuzzy c-means (FCM) algorithm. Different characteristics of fruit are excerpt using fuzzy c means and k-means schemes to detect fruit diseases. Distinct classifiers like Probabilistic Neural Network (PNN), k-Nearest Neighbors (KNN), and Support Vector Machine

(SVM) are applied to classify diseases. Experiments showed that performance observed with high accuracy. KNN and PNN approaches provide better results.
The author Long Qi & et.al[8] proposed an image segmentation method that used to analyzed diseases of rice seedlings in paddy fields using Fuzzy c-means(FCM) clustering. The DVI (Difference Vegetation Index) are calculated that reduces the noise from images and highlights the seedlings in a multispectral image of paddy field. Results showed that higher accuracy is obtained.
The main findings from the literature review are listed in Table 1 and Table 2.
Table I shows the comparison of various algorithms on the basis of their basic criteria, parameters used, advantages, disadvantages and their usage.

Table 1: Comparison of algorithms

S.no.	Algorithm	Basic Criteria	Input Parameters	Advantages	Disadvantages
1.	Threshold Algorithm	Gray scale conversion into binary form. Distinguish foreground from background	Threshold value	Reduces the complexity of data and simplify identification and classification process.	Since information is get reduce to binary variable therefore it will never reuse again.
2.	K-Means Clustering	Task is to categorize a set of items into groups.	Mean of cluster, Point represents a given object, Sum of square error for all objects in database	Good in capture structure of data if clusters have spherical shape.	Data points in smaller cluster left away due to more concentration on big clusters.
3.	Artificial Neural Network(ANN) Algorithm	Mechanized model based on biological neural network in terms of structure and functions.	Transfer function, Number of input nodes and output nodes, Number of hidden layers	Are more general and approximate complicated relationships.	Less guidance in analysing number of hidden layers.
4.	Fuzzy C-Means Clustering	Objects are classified into groups based on degree of belonging to clusters.	Number of clusters, Fuzziness exponent	Gives best solutions for overlapped dataset.	Sensitive to noise and a priori specification of number of clusters.
5.	Gaussian-Kernel Fuzzy C-Means Clustering	Use FCM approach so that noise get reduce.	Spatial control parameters, Fuzzification parameters	Noise insensitiveness and detail presentation of image.	Long computational time.
6.	Bias-Correction Fuzzy C-Means Clustering	Allows labelling of an image pixel by modifying standard FCM.	Cluster center, Fuzzy weighting exponent parameter	Overcome drawback of FCM as all points do not have membership value of 1.	Computing neighbourhoods may take too much time.

The above table summarizes the various classification algorithms that have been implemented by researchers. Each algorithm has its own pros and cons that give a perception to dive in a particular domain.
Table 2 gives a brief overview about input and output parameters used by various authors along with their problem addressed.

Table 2: Comparison on input and output parameters

Author	Problem addressed	Technique	Dataset	Analytical output parameters
Trimi Neha Tete. Shushma Kamlu.[1]	Detection of plant disease.	Threshold algorithm, K-Means Clustering, Fuzzy C-Means Clustering	Images are acquired from digital camera	Threshold value, Disease name
Shabari Shedthi B. Dr.Surendra Shetty. Dr. M.Siddappa.[2]	Analyse performance of FCM and KM.	K-Means Clustering, Fuzzy C-Means Clustering	Digital camera images	Quality of output image, Execution time
G.Sasibhusana. Rao,B.Srinivas.[3]	MRI Brain Tumor Segmentation.	K-Means Clustering, Fuzzy C-Means Clustering	Random brain MR images	Segmented area, Mean Squared Error(MSE), Peak Signal to Noise Ratio(PSNR), Execution Time
Gaganpreet Kaur. Sarvjeet Kaur. Amandeep Kaur.[4]	Review of various types of plant disease along with explaination of image processing methods.	Image processing	Agricultural websites	Change in leaf colour, Black spot on leaves
Noureddine Ait Ali. Bouchaib Cherradi. Ahmed El Abbassi. Omar Bouattane. Mohamed Youssfi.[5]	Analysis and time processing of MRI brain images.	Bias-Correction Fuzzy C-Means Clustering	Clinical Images MRI-256,MRI-512,MRI-1024,MR-2816	Declaration time, Execution time, Speedup
Dante Mujicavagas. Bianca Carvajal Gamez. Genaro Ochea. Jose Rubio.[6]	Enhanced performance of FCM based on high breakdown points property of redescending M-estimators.	Gaussian Kernel Fuzzy C-Means Clustering	Alpert et al segmentation evaluation, Microsoft research Cambridge object recognition image, Strong Brook University Shadow, ISIC 2018-Skin lesion	Misclassification Ratio(MCR), Dice similarity coefficient for image segmentation, Intersection Over Union(IOU)
Shivanand B Lamani. Ravikumar K. Arshi Jamal.[7]	Pomengranate fruits disease classification.	Fuzzy C-Means Clustering	High Resolution Camera captured images	Accuracy, Precision, Time
Long Qi. Xu Ma. Yanjun Zuo. Xinglong Liao. Hongjiang Guo.[8]	Multispectral image segmentation of rice seedlings in Paddy fields.	Fuzzy C-Means Clustering	Multispectral camera to acquired images at farm of South China Agricultural University	NIR gray value, R gray value, G gray value, Difference Vegetation Index(DVI), Normalized Difference Vegetation Index(NDVI), Ratio Vegetation Index(RVI), Pixel area

The above table infer the spectacular work done by researchers to identify the diseases with the techniques used and output parameters. This can help to optimize the accuracy that obtained during research.

3. CONCLUSION

In this paper, a brief glimpse of various image segmentation techniques by using clustering is presented. Fuzzy C-Means Clustering and its variants like Bias-Correction Fuzzy C-Means & Gaussian Kernel Fuzzy C-Means Clustering are compared on specific parameters such as light intensity, discolouration, black spots etc. Results are analysed on output parameters like accuracy, execution time, mean squared error (MSE), peak signal to noise ratio (PSNR), segmented area.

This paper contains an approach to identify the plant disease so as to reduce load so that farmers doesn't have to worry and roam around in order to take experts advice. By doing comparative analysis of above clustering on the basis of various parameters, a better technique is emerging out to recognise plant disease efficiently and effectively.

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