iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** V **Month of publication:** May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5010

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

A Review on Detection of Plant diseases through Various Methodologies

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Abstract*: *In present scenario, agriculture plays a crucial role in world's economy. It is an important aspect in both social and economic sectors. The ancient practice of detecting plant disease is by naked eye observation by both farmers and by experts. In olden days, farmers in order to find the root cause of the disease affecting the plant had to approach the experts for solution. Experts with their experience and knowledge about the disease he used to provide suggestions for the disease cause. At times the searching of the experts for their suggestions is time consuming and expensive also. At times farmer's experience as well as experts view may fail in detecting the diseases and fail to provide the best solution to the disease cause. There are systems developed in monocot plant and dicot plant family. The recent trending and emerging technologies are image processing, data mining, soft computing etc. Here in this survey paper it gives the different detection and classification techniques. The recent various classification techniques that are present are Probabilistic Neutral Network, Genetic algorithm, Artificial Neutral Network, Back propagation neutral network, support vector machine and some of the segmentation techniques like thresholding, watershed, region growing, clustering etc. In this paper there is a brief introduction given to an overview of methods that will detect the both monocot and dicot plant disease. These methods will helps to diagnose the disease with more accuracy.
Keywords*: *agriculture, experts, technologies, image processing.

I. INTRODUCTION

Agriculture is one of most important occupation and it is the main source of our economy and also it is very important source of income to farmers as well. Hence there is a need to develop facilities in order to make more yields out of it. There are various reasons in which the yield is becoming low and some of them are natural calamities like draught, cyclones, floods, earthquakes, uncertain Monsoons and inadequate irrigation facilities, decline in soil fertility, lack of support services like marketing and there is a population pressure. Up on all the above which are the reasons for low yield, the plants which are affected by the diseases will yield very less in amount and this is one of the most common reasons. Hence the detection of disease in plants plays an important role. The identification and classification of diseases in plants is a very important factor to prevent a heavy loss of yield and to improve quality of the product. Therefore identification and classification of plants disease are very essential task to enhance plant productivity and economic growth.

The leaves show the symptoms like changing color, changing the texture and sometimes showing spots on it. Basically the identification of diseases in crops is done by manual observation that is by naked eye observation where it consumes more time and may prove costly too and sometime those suggestions or results which have got may not prove or predict the root cause of the disease correctly. The manual observation of detecting disease is carried out by naked eye observation by experts or by the farmer where with their experience they will find out the disease and cause for it and remedy for it. In such situations going for an automated systems which will be very useful to detect and identify the disease which consumes very less time and proves very less cost and also user friendly. Here in this paper there is an overview of various technologies and methodologies present for various different types of plants which are adopted to predict the disease of the plant. Hence nowadays detecting the diseases with the use of technology is very productive and hence it is now one of the hot research topics as it is very beneficial and it will provide a very appropriative solution to the problem just by the symptoms shown from the leaves.

II. BACKGROUND WORK

There are various techniques and methodologies followed in order to identify and classify the disease in plants and one of the most important, easy to use and which takes very less time is image processing. Here follows the overview summary of the image processing technique. Fig 1 will clearly shows the basic flow diagram of image processing technique.

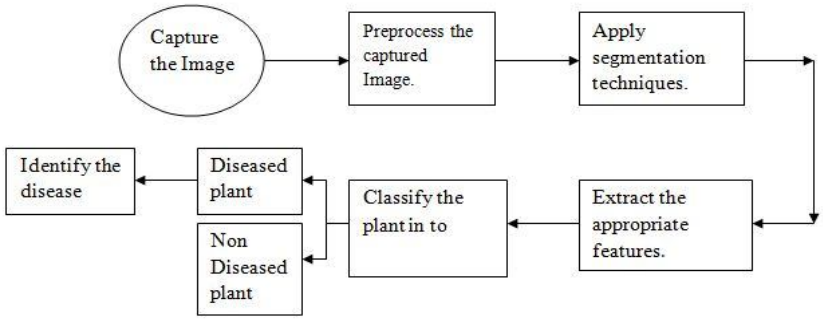

Fig 1: Basic flow diagram of image processing technique

A. Image Acquisition Phase

The first and foremost step or the action that need to be taken is image acquisition i.e. here we will capture the image of the diseased leaf with help of a digital camera. These images will be in RGB (Red, Green, and Blue) form. Once the images are captured then these images are stored in database and this set is called training set.

B. Image Pre-processing Phase

In pre-processing phase the noise in the image or other objects which are not appropriate is removed. In pre-processing phase the techniques that are applied to reduce the noise are:

(1) Image clipping: Usually the captured images will be having a complex background hence to obtain the region of interest we go for clipping technique. Here the unwanted part of the leaf image is removed and therefore the desired part of the image is obtained.

(2) Image smoothing: smoothing is performed in order to reduce the noise within the image or this is used to obtain a less pixilated image. In order to enhance the image the smoothing technique is applied. Some of the smoothing algorithms that can be used are (a) Gaussian Smoothing (b) Edge preserved Filtering (c) Bilateral Filter (d) Optimization-Based Image Filtering etc. (3**)** Image Enhancement**:** For more suitable display image enhancement is performed. Some of the image enhancement methods are (a) Filtering is performed by morphological operations (b) Histogram Equalization. (c) De correlation stretch. (d) Linear contrast adjustment etc

C. Image Segmentation Phase

Table 2.1: Advantages and Disadvantage of different segmentation methods.

Segmentation Method	Advantages	Disadvantages
Threshold based Method	* This method does not insist to know about the image properties in advance. *The computation process is inexpensive. * It's developed in an easy and quick manner. * It is very appropriate for real time use.	* When the segmentation process is not continuous this method neglects the spatial information of an image. * Highly noise sensitive.
Region based Method	* When compared with other methods it gives the best outcome. * It provides the flexibility in choosing the technique between the automatic and interactive method. * Clear object boundaries are generated when there is a flow from inner point to outer region.	* It follows Sequential procedure and it is quite expensive in terms of computation time and memory wise. * Finding out the stopping criteria for the segmentation process is very difficult. *Because of presence of noise there may cause the segmentation fault.
Cluster based Method	* It proportionally faster for small values of k. * Noisy regions are removed in the processed image. * False blobs removed. * Better regions that are homogeneous in nature are obtained.	* With fixed number of clusters, prediction of k value becomes tough. * It is more dependent on initialization condition of cluster number and centre. * It Computationally extortionate in nature.
Fuzzy C – means Method	*K- means is not as good as FCM.. * FCM Unsupervised and converge very well.	*It is proportionately expensive and noise sensitive.

D. Image Feature Extraction Phase

Feature Extraction is the process that is achieved after segmentation step. This plays an important role in identifying the object of interest. Usually features like color, texture, morphology, edges etc are considered in the process of detection of disease. Upon all the morphological features gives the best results. Basically we consider three types of features they are as follows:

1) *Texture Features:* This feature is extended using Gray-Level co-occurrence matrix. GLCM is a statistical analysis tool of gray level image. Basically GLCM measures the distribution of gray levels which is based on the spatial relationship between the pixels by using the distance and directions in their image.
2) *Shape Features:* These features are usually represented by geometrical view of characteristics of an object. The characteristics include area, perimeter, circularity, and complexit
3) *Colour Feature:* Colour features are acquired by the methods like colour histogram, colour structure descriptor, and colour moments. Colour Feature is obtained from L*a*b colour space and it also includes mean, variance, standard deviation

E. Image Classification Phase

Table 2.2 : Advantages and Disadvantage of different classification methods.

Classification method	Advantages	Disadvantages
K- Nearest Neighbor (KNN)	* It is simpler as here exclusion of any training process is performed very easy. * This is applicable for small data sets which are not trained also.	* As number of trained samples increases the speed of computing distance increases. * KNN is too sensitive to irrelevant data and therefore when each time testing is performed it is expensive at all the time.
Radial Bias Function (RBF)	*Here training phase is quick. *Interpretation of Hidden layer is in a simple way.	* When we talk about speed it is slow in execution wise.
Artificial Neutral Network (ANN)	* The performance and accuracy of classification is greatly depended on the number of input size and structure of the network. *Noisy inputs are tolerable. * For one input instance there will be multiple output instances.	* Training time is more here. * Complex Network Structure. * Consumes more memory to store training data set.
Support Vector Machine	*Geometric interpretation is done in a easier manner with sparse solution is given. * It basically uses Non Parametric with Binary Classifier approach. * It is robust in nature even when the training set has some bias.	*The performance of training is slow. * The structure of the algorithm is complex in nature to understand. * For performing classification technique large number of support vectors is needed from the training set.
Back Propagation Network (BPN)	* Implementation of BPN is simpler in nature. * BPN can be applicable to large variety of problems. * Able to form arbitrarily complex non linear mappings.	* Learning is very slow in nature. *For performing classification process, it's very difficult to find the count of neurons as well as layers.
Probabilistic Neural Networks (PNN).	* Noisy inputs are not much discarded. *Instances classified too many output adaptive to change data.	* Takes more time to train the data. * The structure of algorithm is complex in nature. * Training data consumes more memory.

III.LITERATURE SURVEY

NO	CROP	DATASET	DISEASE	PREPROCESSING	SEGMENTATION	FEATURE EXTRACTION	CLASSIFICATION	ACCURACY
[1]	Wheat	Digital camera Cannon A3500,16 mega pixels	Powdery Mildew	Noise is removed by 3*3 median filters.	K-means clustering	Texture Shape Color	● Neutral Network ● Support Vector Machine	89.23 89.23
[2]		CCD camera Cannon A3500,16 mega pixels	Fungal diseases	Noise is removed by median filter with 3*3 rectangle filter window.	Ostu thresholding	Texture Shape Color (mRMR)	RBF Neutral Network	98.3
[3]	Rice	Images are available at IIRI	Leaf Blast, Brown Spot, Sheath Blight	RGB color model is converted into HSV color model. Weiner filter is used to remove blurring effect	● Based on discontinuities(Edge detection) ● Based on Similarities (Ostu thresholding)	Texture(Kurtosis,skewness) Shape(edge,line) Color(Mean & Standard deviation)	Support Vector Machine	Not Specified.
[5]		Digital camera with 18.1 mega pixels.	Blast and Brown Spot diseases	RGB color model is converted into HSV color model. HUE component is obtained.	Otsu segmentation method with global threshold	Geometrical feature like Area, Major Axis, Minor Axis	kNN classifier has been used for	76.59
[6]	Maize	Simon Cs Techno (16 MP) mobile phone camera	Maize common rust, maize leaf blight and leaf spot.	* Image enhancement. *Noise is removed by Gaussian filters. * Grey scale conversion.	k-means clustering	Texture Color Morphological features	K-nearest Neighbour and Artificial Neural Network	(With KNN) 82.50 (With ANN) 94.40
[7]		digital camera under sun light condition.	Brown spot and corn rust.	Gray transformation *Histogram transformation	Global threshold	Mean, standard deviation, area, circularity, width.	Genetic algorithm with support vector machine	88.55
[8]	Turmeric	digital camera	Rhizome Rot, Leaf spot, Leaf Blotch, Dry Rot, Bacterial wilt.	● Images are normalized by Histogram Equalization. ● RGB color component is separated.	Not Specified	● RGB color component ● Mean, standard deviation.	Statistical based analysis *Histogram based analysis * Neural based analysis	Not Specified.
[9]		digital camera in Coimbatore dist.	Leaf Blight, Rhizome Rot, Leaf spot.	● RGB images are resized and converted into Hue Saturation Intensity representation . ● Green pixels are removed by masking	k-means clustering	Texture (Energy,Entropy,contrast). Shape (solidity,perimeter, Eccentricity) Color(meanR, meanG, meanB)	Support Vector Machine	93.75

[10]	Banana	Digital camera with 16 mega pixels.	Black Sigatoka, Yellow Sigataka, Bunchy top, panama Wilt.	*Image Croping *Image Resizing *Image color Conversion.	Not specified	* Color features (mean,Standard Deviation) * Histogram of Template features.	Artificial Neural Network	Not Specified.
[11]		Embedded linux Board interfaced with camera	Banana streak virus	picture division and Histogram equalization	Open CV software is used for segmentation	Hue and saturation values are used for separating green color from the image by setting constant Hue value for green.	HSV Algorithm	81.6 % moderately affected and 84.8% fully affected
[12]	Tomato	VGG16 deep model	Tomato bacterial spot, early blight, late blight and leafmold	Rotating Flipping, Inverting, Scaling etc	Thresholding segmentation	Texture, color, shape .	VGG16 + SVM	89%
[13]		Accelerometer sensor is used to capture image	septonia and fungal(bu ckai rot) disease	Pixels of the image is converted into BITMAP abd stored one by one.	Ostu thresholding	Tomato total leaf area, leaf perimeter, fungus location, fungal leaf area	Masking process	Mobile app development
[14]		Digital camera	Septoria, Cerocospo ra leaf spot.,Ant bracnose	The RGB image is converted into L*a*b for better vision clarity.	Threshold and K-means clustering	color and shape features	Not specified	Infection rate found is 32.7%
[15]	Ground nut	Digital camera	Cercospor a.	RGB image formed	Not specified	color and texture features	Back Propogation algorithm	97.41%
[16]		High resolution digital camera	Early leaf spot, late leaf spot and alternaria leaf spot.	The resizing of image to 256x256 pixels, color space conversion and region of interest selection.	Lloyd's Clustering algorithm.	Color, texture and geometric features of the image are extracted by the HSV conversion, GLCM, Lloyd's clustering respectively.	VGG16 + SVM	92%
[17]	Potato	Digital camera	Late blight and Early blight	Noise and redundancy is removed.	Masking process	Spectral, Textural and contextual	Support Vector Machine	95%
[18]		From different knowledge base	Early blight and Insect damage.	Resize and filtering method. Histogram transformation	K means clustering algorithm	Color Textual Area	Masking process	92%

IV. CONCLUSIONS

Agriculture is one of the most important occupations because food is needed for every individual hence the agriculture must be considered very seriously. When comes to agriculture most commonly we finds the diseases which will adversely affect the yield. Basically the identification of the disease of the plant is done by manual observation, which can consume more time and may prove costly and the manual observation is also done by naked eye check-up which may not provide the appropriate solution and sometimes it may adversely affect the environment when wrong pesticides are used. Sometimes the experts were called to the farm and they were made to check the field but this is also very tedious work and may seem to be costly also. As in case of naked eye check-up by experts or by the individual throughout large fields is very difficult and tedious work. Hence in this technology era there are many techniques like Image processing, Probabilistic Neural Network, Genetic algorithm, Artificial Neural Network, Back propagation neural network and Support vector machine (SVM), thresholding, watershed, region growing, clustering etc are making the work of farmers easy and cheap.

Hence there is very much need to provide an idea of using of these systems to farmers. If every individual tries to prevent, detect and take remedial actions towards the diseases then the economical status of both farmer and the country will increase.

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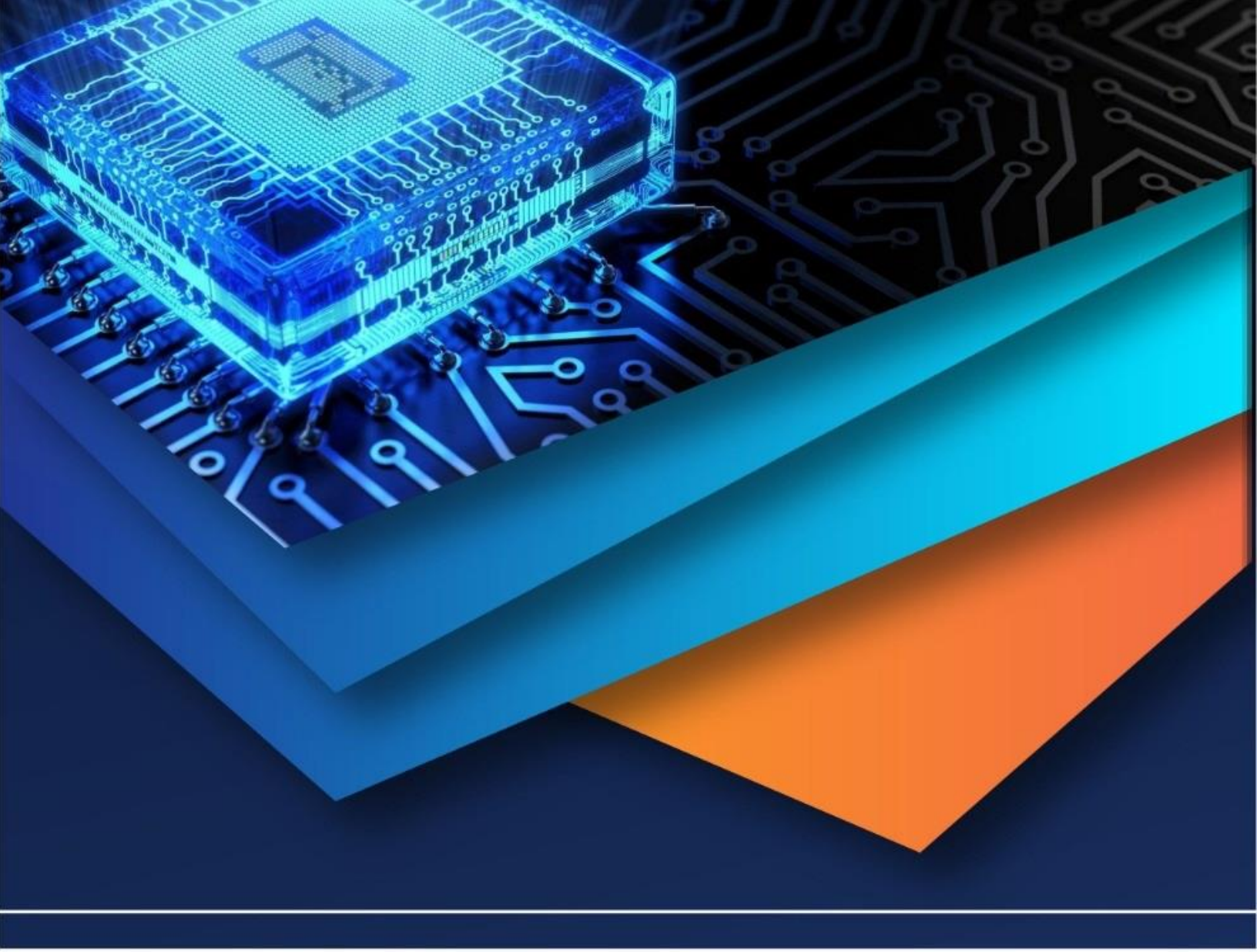

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