Image Processing Methods for Leaf Disease Detection: Survey

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Abstract - Agriculture plays a vital role as it is a big financial sector of India, India holds the second position in the world economy in the agriculture field. Using image processing we can detect the disease many researchers have worked on and still working on this area. This paper gives statistics of researchers focusing on different image processing techniques.

I. INTRODUCTION

Image processing techniques targeted to improve the crop production by contributing in crop field monitoring. Computer vision along with computational intelligent techniques/soft computing techniques has been utilized in several researches in the field of plant pathology .Disease detection using Image processing play vital role as it can give us early detection of disease, as well as accurate classification of disease.

II. RELATED WORKS

In this section, we survey the recent methods presented for plan disease detection using the computer vision methods since from last few years.

In [5], author proposed another approach for plant disease detection based on image processing. This paper discussed the methods used for thedetection of plant diseases using their leaves images.

In [7], This paper gives the survey on different diseases classificationtechniques that can be used for plant leaf disease detection andan algorithm for image segmentation technique used forautomatic detection as well as classification of plant leafdiseases has been described later..

In [8], there are mainly four steps in developed processing scheme, out of which, first one is, for the input RGB image, a color transformation structure is created,because this RGB is used for color generation andtransformed or converted image of RGB, that is, HSI is usedfor color descriptor. In second step, by using threshold value,green pixels are masked and removed. In third, by using precomputedthreshold level, removing of green pixels andmasking is done for the useful segments that are extracted firstin this step, while image is segmented. And in last or fourthmain step the segmentation is done.

In [11], author introduced methodology forearly and accurately plant diseases detection, using artificialneural network (ANN) and diverse image processingtechniques. As the proposed approach is based on ANNclassifier for classification and Gabor filter for featureextraction, it gives better results with a recognition rate of upto 91%. An ANN based classifier classifies different plantdiseases and uses the combination of textures, color andfeatures to recognize those diseases.

In [12], histogram matching was used to identifyplant disease. In plants, disease appears on leaf therefore thehistogram matching is done on the basis of edge detectiontechnique and color feature. Layers separation technique isused for the training process which includes the training ofthese samples which seperates the layers of RGB image intored, green, and blue layers and edge detection technique whichdetecting edges of the layered images. Spatial Gray-level Dependence Matrices are used for developing the color cooccurrencetexture analysis method.

III. STATISTICAL DETAILS

It has been observed that maximum work is published after 2014, and the interesting finding is maximum papers before 2014 were from china, after 2014 Indian researchers started working on it.We have found many important observations which helped us in tremendously to carry on our research.

Following table gives statistics about how many papers we reviewed year wise.

Table 1: No of papers reviewed year wise.

Year	No of IEEE survey Papers	Year	No of IEEE survey Papers
2020	18	2008	4
2019	17	2013	5
2018	15	2012	3
2017	25	2011	1
2016	25	2010	4
2015	14	2009	2
2014	11		

IV. PHASES OF PLANT DISEASE DETECTION SYSTEM

A: Image Acquisition and prepossessing

In this phase, images of plant leaves are gathered using digital media like camera, mobile phones etc. with desired resolution and size. The images can also be taken from web.The formation of database of images is completely dependent on the application system Developer. The image database is responsible for better efficiency of the classifier in the last phase of the detection system. In this phase, first of all, we perform the imageConversion and later image enhancement techniques are applied. Various pre-processing techniques like Transformation, contrast stretching, scaling, rotation, smoothening etc can be applied as pre-processing.

B:Image Segmentation

This phase aims at simplifying the representation of an image such that it becomes more meaningful and easier to Analyze. As the premise of feature extraction, this phase is also the fundamental approach of image processing.Segmentation is applied to get the desired spotted/ lesion regions from the infected original image.Image segmentation is used for partitioning the image with the aim to find interested regions. It aims to separate the region having abnormalities: This simplified representation of the image is easy to analyze and more meaningful to differentiate the infected and non-infected regions. Image segmentation is the important part of almost all image processing or computer vision applications as a crucial technology and critical issue in image. There are various methods using which images can be segmented such as k-means clustering, Otsu, region growing, watershed algorithm etc. The k-means clustering classifies objects or pixels based on a set of features into K number of classes. The classification is done by minimizing the sum of squares of distances between the objects and their corresponding clusters.From survey it is observed that 67Researchers focused mainly on pre-processing and segmentation following are the details for the same

Table 2: Image Segmentation statistics

Prepossessing and segmentation	No of times used
K means	26
Threshold	12
Region Growing	2
OSTU	4
RGB	13
LAB	1

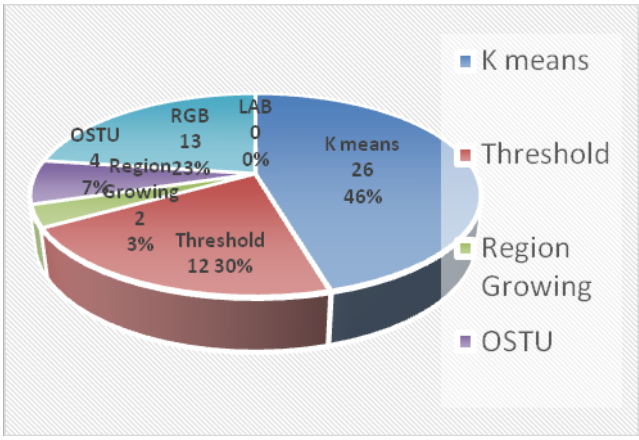


Fig. 1Image Segmentation statistics

C: Feature Extraction

Feature extraction and selection Features represent relevant & discriminating attributes/ information associated with objects, distinguishing one object from other objects. Features are helpful to identify objects and to assign the class label to an object. The feature extraction step is very important in constructing the classification/recognition model and aims at the extraction of relevant attributes characterizing each class. Feature sets are extracted from segmented lesion area and these features are used to train the classifier, hence , in this step the features from this area of interest need to be extracted. These features are needed to determine the meaning of a sample image.Features can be based on colour, shape, and texture. Recently, most of the researchers are intending to use texture features for detection of plant diseases. There are various methods of feature extraction that can be employed for developing the system such as gray-level co-occurrence matrix (GLCM), colorco occurrence method, spatial grey- level dependence matrix, and histogram based feature extraction. The GLCM method is a statistical method for texture classification. From survey it is found that 27 Researchers focused on feature extraction following are the details for the same

Table 3: Feature extraction statistics

Feature Extraction	**No of times used**
GLCM	16
Color co-ocurance	4
Wavelet Transform	1
Gabor Filter	1
SOM	2
SGDM	3

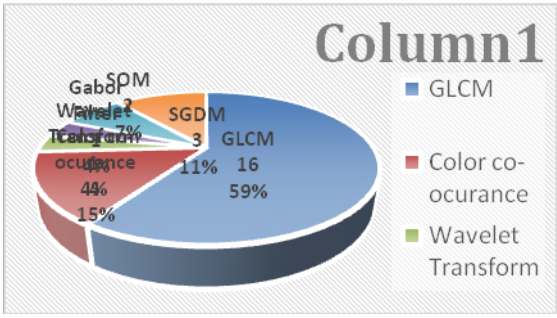


Fig 2 Feature extraction statistics

D:Classification

Disease classification step is the most important stage of plant disease detection using computer vision and image processing.The classification phase implies to determine if the input image is healthy or diseased. If the image is found to be diseased, some existing works have further classified it into a number of diseases. For classification, a software routine is required to be written in MATLAB, also referred to as classifier.

Table 4: Classifiers statistics

Classifiers	**No of times used**
SVM	**33**
ANN	**8**
BPNN	**4**
KNN	**2**
NN	**2**
CNN	**3**

A number of classifiers have been used in the past few years by researchersare as listed k-nearest neighbour (KNN), support vector machines (SVM), artificial neural network(ANN), back propagation neural network (BPNN), Nave Bayes and Decision tree classifiers.The most commonly used classifier is found to be SVM. Every classifier has its advantages and disadvantages, SVM is simple to use and robust technique.The classification accuracy is greatly depending on good pre-processing, feature extraction, and feature vector preparation followed by selection of most suitable feature according to the problem.We found that 52 Researchers focused on Classification following are the details for the same

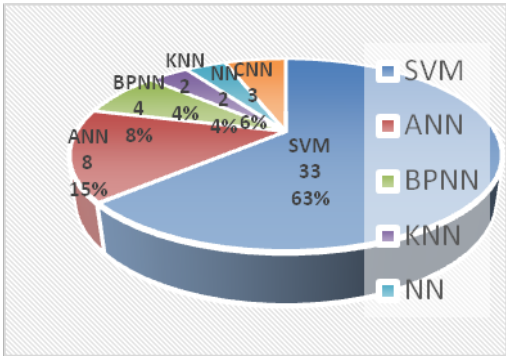
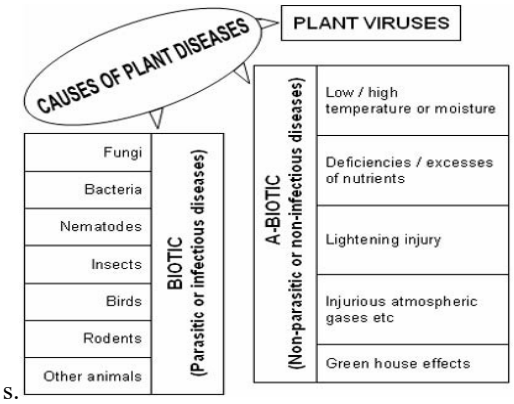


Fig 4 Classifiers statistics

Following are main causes which are responsible for various diseases which occur on plant leaves some are occurred due to biotic reasons and some due to A-biotic reason



s.

Fig 5 DifferentDiseases on plants

As per survey done by us 33 researchers worked on fungi disease detection, 1 researcher worked on deficiency in nutrients, 1 researcher worked on virus 2, on other symptoms and rest all researchers has not mentioned specific disease

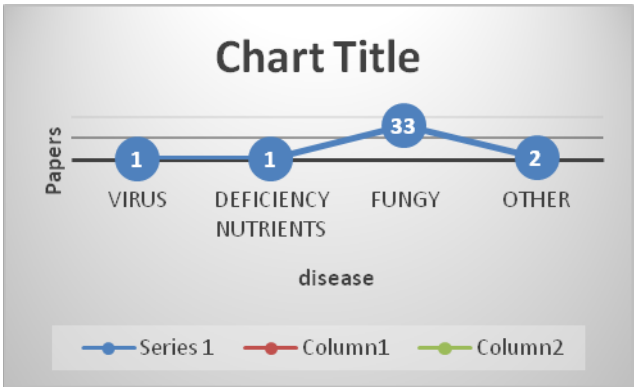


Fig 6 Diseases severity on plants

Following statistics shows frequency of particular crop being selected for disease detection, for example seven researchers chose grape leaf for disease detection.

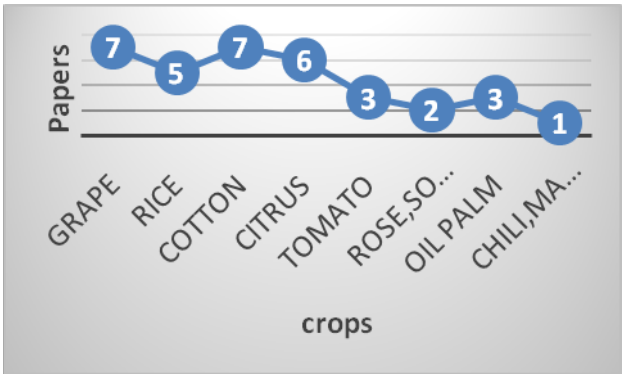


Fig7 Different crops used by researchers

Above diagram will give us detail idea about the work which has been carried out in last 15 years , from that we will come to know that research on leaf disease has no of dimensions, and one can decide the angle for research using below table.

CONCULSION: It has been observed that many researchers have worked and still working on this area, we can achieve required accuracy by doing different trials and can find optimum solution as per the application

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