

Advance App Design Methods of Leaf Disease Detection using Image Processing Approach – A Review

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ABSTRACT: Agriculture is the main element of economic growth in developing countries. The crop quality depends on the everyday growth of plants. Disease detection in early stages can be improving the production percentage. Recently, numerous image processing techniques are developed to detect the leaf diseases. This paper presents, a review on different technologies of leaf disease detection using image processing approach and classified them based on the type of analysis tool and applications. Almost, fundamental technologies used in leaf disease detection system are critically reviewed and discussed in brief; comparison of available approaches are examined and presented. The main issues and challenges in leaf diseases detection are underlined.

KEYWORDS: Leaf disease detection; Image processing; segmentation; classification; feature extraction.

I. INTRODUCTION

High quality crop production is the big challenge for farmers, especially in India. In villages, cultivation is the main occupation of farmers. Their subsistence is entirely depends on the crop production. The crop production rates are directly proportional to the each day plant growing progress so that plant disease detection is very important. Therefore, plant leaf disease detection is very essential in earlier stage and take necessary steps prevent it from spreading to others parts of the field. Farmers recognize the disease by their experience and observations. Regular observations and good experience leads to the accurate disease detection with remedies. This is practically not possible for the large fields. Lack of experience causes wicked quality crop. Various diseases occur in different parts of the plant can be identified by observing the change in symptoms, spots, colour etc. The less time consuming and automatic diagnosis technique is the major requirement in agriculture to improve the crop production rate. Recently, android applications are designed using image processing approaches to find the different solutions of problems rise in agriculture such as disease detection in stem, leaf, flower and fruit [1-2]. Various scientists had described different leaf disease harshness measurement and detection methods using image processing [3-6]. Few researchers also designed android application to detect diseases in plants [9, 16-17] that will help farmers in determining detection diseases of leaves without bringing an expert to the field.

In this paper, an comprehensive review of leaf disease detection system using image processing techniques is discussed. The basic steps to design android application by using image processing techniques to detect the leaf diseases and related work are given in section 2. An overview of recently used image processing techniques in leaf disease detection is described in section 3. Section 4 deals with the comparisons of various approaches. The main issues and challenges are underlined in section 5 and finally concluded in section 6.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

II. RELATED WORK

Various android application design using image processing techniques has been described in literature to detect the leaf disease [38-40]. The block diagram of android application design of leaf disease detection system using image processing is given in Figure 1. The leaf database consist unhealthy and healthy leaves, which are captured from digital camera [7-8].

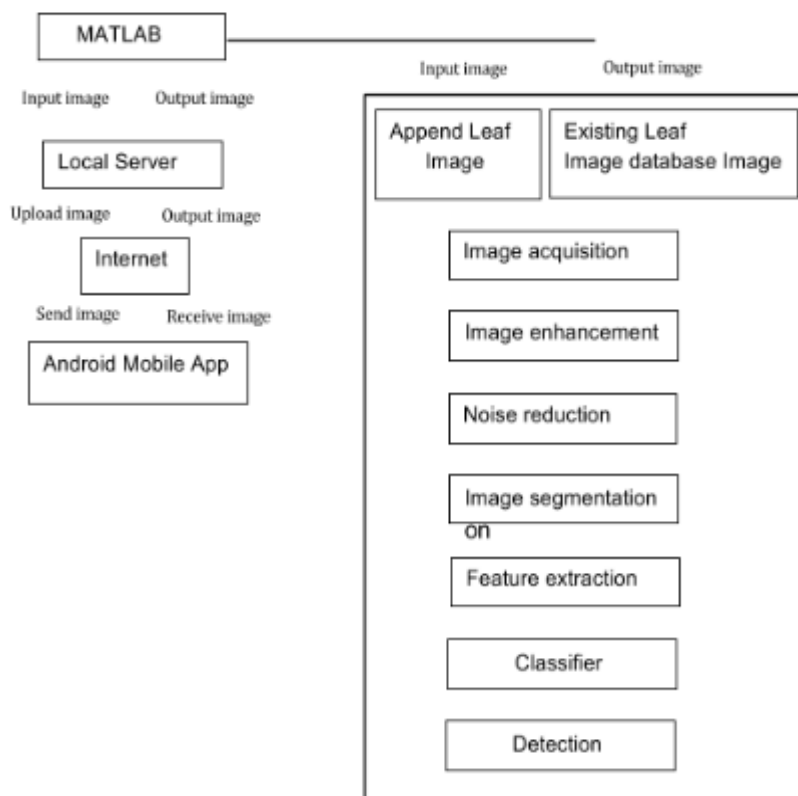


Fig. 1: Block diagram of leaf disease detection system using image processing

Leaf image capture by android mobile phone and send to local server through internet. Local server is connected to the personal computer or laptop having MATLAB software. Image processing toolbox is used to detect the leaf disease. Initially unhealthy and healthy leaves are processed in image acquisition [9]. These unhealthy and healthy leaves dataset is called the training dataset. The train images of leaves saved in proper format and size with suitable light intensities [10-11] to reduce the reflection. Once training dataset has been organized in desired format, and then append the test leaf image. Image enhancement process used for further image analysis for more suitable display [8]. Noise could be introduced during the image acquisition process or electronic transmission of the images. Noisy image changes the pixel values of the original that affected the real image intensities.

Different noise reduction methods are available in literature to eliminate the unwanted noise of the leaves images [12]. These images are divided into small multiple segments or sets of pixels using image segmentation process [13]. The dimensions of subdivision depend on the problem image and segmentation has to be stop if desirable image isolated. Then extract optimized features from the segmented image to reduce the image data by using feature extraction process [14]. These extracted features are input to a classifier for classifies leaves images. Then disease detection process identified the disease name and gives the expert suggestion to overwhelm the disease. The disease name and expert

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

suggestions are send back to the local server. Local serve send the output in the form of image or SMS to the android mobile phone.

III. LEAF DISEASE DETECTION SYSTEM USING IMAGE PROCESSING TECHNIQUES: AN OVERVIEW

The healthy crop production is the main requirement of the farmers. Therefore, disease diagnosis and correct treatment essential for the healthy crop production process as early as possible. The farmer's wrong diagnosis of crop disease causes insecticides spray inappropriately. Various image processing techniques are significantly applied to observe the crop growth progress and disease diagnosis. The plant occur diseases in several parts. Generally, unhealthy plant leaves change their shape, colour, size, texture etc. Hence, disease detection and proper expert treatment suggestions can be find by using image processing techniques and everyone can be apply these techniques by using android application very easily.

Traditional methods such as neural network, back propagation and other pattern recognition concepts described by Kaur and Singla (2016)[16]. The responses of traditional methods are accurate but slow. Hence, there is a need of some nature inspired technique for the high speed detection efficiency of the results.

The innovative, efficient & fast interpreting machine learning algorithms could be developed by Patil and kumar[15] in 2011 for detecting plant disease. They suggested that the speed and accuracy of disease detection method must be achieved by applying machine learning methods.

It is difficult to determine the accurate disease in noisy image. Image should be noise free for processing. Therefore, noise reduction techniques and image enhancement are required for desirable processing. Valliammai and Geethaiaakshmi (2012)[12] have found that the appropriate feature extraction of leaf can be possible if input image is noise free. The leaf vein edges not exactly visible in Gaussian noise method. The speckle noise affected the leaf size, shape and pattern. Therefore, Gaussian and speckle noise removal techniques are essential to restore the noise free leaf images for further process. These Hybrid filter method is developed to eliminate the noise, improve the quality of image and thereby produces better results compared to other traditional filters.

An automatic genetic algorithm based image segmentation and classification technique have explained by Singh and Mishra (2016)[13] for leaf diseases detection with very less computational efforts. This method can be identified the plant diseases at early stage or the initial stage. Artificial Neural Network, Bayes classifier, Fuzzy Logic and hybrid algorithms can also be used to increase recognition rate in classification process.

The android applications to control the irrigation system and plant disease detection are also developed [17]. The Android Software Development Kit (Android SDK) consist the tools and Application Programmable Interface (API) to start developing applications on the Android platform using the Java programming language. This application used the GPRS [General Packet Radio Service] feature of mobile phone as a resolution for irrigation control system and GSM (Global System of Mobile Communication) for communication. This communication was established using the miss call and SMS.

In 2015, Xia and Li [18] have proposed the android design of intelligent wheat diseases diagnose system. In this process, users collect images of wheat diseases using Android phones and send the images across the network to the server for disease diagnosis. After receiving disease images, the server performs image segmentation by converting the images from RGB color space to HSI color space. The color and texture features of the diseases are to be determined by using colour moment matrix and the gray level co-occurrence matrix. The preferred features are input to the support vector machine for recognition and the identification results are fed back to the client.

The comparative results of RGB and Grayscale images in leaf disease finding process suggested by Padmavathi and Thangadurai (2016) [19]. Color could be change for infected leaves so that color of the leaf is an important feature to find the disease intensity. They have considered Gray scale and RGB images. The median filter for image enhancement and segmentation for extraction of the diseased portion are used to identify the disease level.

The deep neural networks for classification have used to develop for plant disease recognition model [20]. 13 kinds of diseases are identified from the healthy leaves with the capability to differentiate leaves from their surroundings.

The different classification techniques such as K-Nearest Neighbor Classifier (KNN), Probabilistic Neural Network(PNN), Genetic Algorithm, Support Vector Machine(SVM) and Principal Component Analysis, Artificial neural

International Journal of Innovative Research in Science, Engineering and Technology

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network(ANN), Fuzzy logic etc. have implemented for classification of images[21]. The knowledge of initial stages of premature crop can be control the spreading the leaf diseases.

The mixture of discrete cosine transform (DCT), discrete wavelet transform (DWT) and Texture feature extraction techniques offer good results in classification suggested by Akhtar et al. (2013) [22]. They compared the different methods performance of machine learning for automated plant disease analysis. The proposed approach of combining DCT+DWT features for classification with Support Vector Machine (SVM) gives maximum accuracy of 94.45%.

Gavhale and Gawande (2014) [23] reviewed and summarized the various image processing techniques such as back propagation neural network (BPNN), Support Vector Machine (SVM), K-nearest neighbor (KNN), and Spatial Gray-level Dependence Matrices (SGDM) etc. for detecting plant diseases. These techniques are used to analyses the healthy and unhealthy leaves of plants.

Recently, an android application for detection of leaf diseases and monitoring the agricultural resources designed [17]. In this work, an android software development kit (Android SDK) provides the tools and Application Programmable Interface (API) with Java programming language used. This application uses the GPRS [General Packet Radio Service] feature of mobile phone as a resolution for irrigation control system. This application also uses the GSM (Global System for Mobile Communication) for the communication. This communication is established using the miss call and SMS.

IV. COMPARISON OF DIFFERENT LEAF DISEASE DETECTION METHODS

The different advance image processing [23] based leaf disease detection methods are reported in literature. The merits and demerits with potential application of each method are given in Table 1.

TABLE I. COMPARISON OF DIFFERENT LEAF DISEASE DETECTION METHODS

Technique	Key references	Merits	Demerits	Potential application
Android App Design for leaf disease detection	[17]	Detect the plant disease and also control, schedule and monitors the all agricultural recourses	Internet required running the application.	Irrigation system, leaf disease detection
Hybrid method of Noise reduction	[12],[23], [25]	remove multiple noise(Gaussian and speckle)	Assume threshold value in wavelet analysis	Leaf image veins are clear and noise free
Image segmentation using Genetic algorithm	[13],[26], [27] and [28]	Computational efforts are less and the optimum results	Initial chromosomes population generation decides the global optimum	Continuous or discrete function can be optimize and large number of variables compute at the same time
Image classification using K-Nearest Neighbor (KNN)	[22]	The cost of the learning process is zero No assumptions about the characteristics	The model cannot be interpreted (there is no description of the learned concepts) It is computationally expensive to find the k nearest neighbours when the dataset is very large.	Higher resolution remote sensing image classification and computer vision
Image segmentation using K-means	[29], [30], [31]	convergence assured with less false edges	Efficiency depends on the initial clusters and generation	Image segmentation. It can be hybrid with other optimization method easily.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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clustering techniques			assumption of the value K	
Decision Tree classifier (DTC)	[37]	Efficient in feature selection, easy data preparation, simple to interpret and explain	Uncertainty in small variations, no assurance to achieve the globally optimal decision tree.	Classification and prediction, risk analysis
Naive Bayes Classifier for image classification	[32]	Easy construction, high accuracy, and good classification speed with large database	Data distribution and scarcity required strong assumption	Image classification, perfect future prediction
Support Vector Machine (SVM)	[33], [34],[35], [36]	Robust for large biased database, unique solution	Not clearness in result for high dimension data	face and speech recognition, face detection and leaf image recognition, text categorization etc.
Recurrent Neural Networks	[38]	Complex problems solve in less computation time	Nondeterministic outcomes found sometimes because assumption of initial parameters	Speech recognition, signature recognition, leaf disease detection
Android app. for wheat diseases	[18]	Detect the wheat plant disease using SVM	Internet required running the application.	Wheat disease diagnosis
Android App Design for leaf disease detection	[9]	Identify plant leaf disease by using image processing	Internet required running the application.	Leaf disease detection and solution

V. MAIN ISSUES AND CHALLENGES

Many detection techniques of leaf diseases are reported in literature and implemented experimentally. However, some main issues and challenges of these image processing based techniques are as follows:

1. Data collection and image pre-processing take long time.
2. The background of the image affects the resulting image.
3. In the real world field conditions, farmers don't have the technical knowledge. Technical awareness is required to improve the quality of the crop production.
4. Unhealthy plant leaf change colour, size and texture with climate and environment conditions. The field expert suggestions and regular observations are required.
5. The survey and reviews gives the new ideas of plant leaf diseases and some limitations. Therefore, there is scope of improvement in the existing research.

VI. CONCLUSION

This paper presents a comprehensive review available in literature to design advance android application to detect the leaf disease by using image processing techniques. The different methods used in image processing, merits, demerits and potential applications of each technique also described. The main issues and challenges are also explained. These suggestions are useful for researchers and policy makers. The scope of development of hybrid algorithms such as genetic algorithms, cuckoo optimization, and particle swarm optimization and Ant colony etc. in order to increase the convergence and recognition rate of the final classification process.

International Journal of Innovative Research in Science, Engineering and Technology

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