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Review of Plant Leaf Disease Detection Using Image Processing

H.D.Gadade[1], Dr. D.K.Kirange[2]

[1]Government College of Engineering, Jalgaon,
NH-06, Maharashtra-India

[2]J.T.Mahajan College of Engineering,Faizpur
Dist. Jalgaon Maharashtra-India

Abstract: ***Indian economy is based on agriculture and Indian farmer's life is linked with farming. Crop in the India is very prone to various viral attacks. It is important to prevent such attack and give more accurate solution to the farmers. To detect disease, leafs are essential parts of crop. Image processing technique is used to detect the leaf disease more accurately since necked eyes observation cannot provide accurate solution and also every person cannot be perfect in finding leaf disease. It is done in five stages like image acquisition, image preprocessing, feature extraction, classification and result. In this paper, we have presented a survey on the existing methods of plant leaf disease detection.***

Keywords: Image processing, feature extraction, acquisition, segmentation.

1. INTRODUCTION

Agriculture plays a vital role in the increasing of Indian economy and agriculture is the major necessity for human being on the Earth. Therefor farming is mainly depend on quantity of crop and quality of crop production. In India, varieties of crops like cotton, rice, brinjal, tomato, potato, fruits, mango, banana, guava etc is being cultivated. The crops are prone to various types of diseases and symptoms of the diseases are visible on leaf, fruit and stem in most of the cases. Detection of diseases with necked eyes is very complicated and it needs very expert person to identify the correct disease and to give correct solution. Even though in India, many farmers take suggestions from expert nut every time it is not feasible if crop is in very huge amount and also in this case we need continuous monitoring. Therefore image processing techniques are used as an effective way to recognize and classify the plant leaf diseases quickly.

The factors that will affect the plants are of two types; one is living (biotic) agents which includes insects, bacteria, fungi and viruses and second, nonliving (abiotic) agents including excess temperature and moisture, insufficient sunlight, nutrients and poor soil pH. Sample image of infected leaf is shown in fig 1

2. LITERATURE SURVEY

Anand R et al. [1] proposed a method for identifying plant leaf disease and an approach for careful detection of diseases.The goal of proposed work is to diagnose the disease of brinjal leaf using image processing and artificial neural techniques. The study of interest is the leaf rather than whole brinjal plant because about 85-95 % of diseases occurred on the brinjal leaf like, Bacterial Wilt, Cercospora Leaf Spot, Tobacco mosaic virus (TMV). The methodology to detect brinjal leaf disease in this work includes Kmeans clustering algorithm for segmentation and Neural-network for classification.

Figure 1 Sample Infected Leaf

Auzi Asfarian et al. [2] proposed a research that attempted to identify the four major paddy diseases in Indonesia (leaf blast, brown spot, bacterial leaf blight, and tungro) using fractal descriptors to analyze the texture of the lesions. The lesion images were extracted manually. The descriptors of 'S' component of each lesion images then used in classification process using probabilistic neural networks. This techniques achieved at least 83.00% accuracy when identifying the diseases.

Arya M S et al. [3] proposed an idea of detecting plant diseases using image processing. Image processing toolbox of Matlab is used for measuring affected area of disease and to determine the difference in the color of the disease affected area. This concept can be extended to detect the symptoms of any type of plant diseases that is affected on different horticulture crops. The algorithm can be used to classify the leaves and the classified outcomes are separated using Arduino based conveyor belt system. This reduces an important task of monitoring of farms crops at very early stage itself to detect the symptom of diseases appear on plant leaves.

Siddharth Singh Chouhan et al.[4] introduced a method named as Bacterial foraging optimization based Radial Basis Function Neural Network (BRBFNN) for identification and classification of plant leaf diseases automatically. For assigning optimal weight to Radial Basis Function Neural Network (RBFNN) authors use Bacterial foraging optimization (BFO) that further increases the speed and accuracy of the network to identify and classify the regions infected of different diseases on the plant leafs.

The region growing algorithm increases the efficiency of the network by searching and grouping of seed points having common attributes for feature extraction process. Authors worked on fungal diseases like common rust, cedar apple rust, late blight, leaf curl, leaf spot, and early blight. The proposed method attains higher accuracy in identification and classification of diseases.

Mrunmayee Dhakate et al. [5] proposes an image processing and neural network methods to deal with the main issues of phytopathology i.e. disease detection and classification. The Pomegranate fruit as well as the leaves are affected by various diseases caused by fungus, bacteria and the climatic conditions. The system uses some images for training, some for testing purpose and so on. The color images are pre-processed and undergo k-means clustering segmentation. The texture features are extracted using GLCM method, and given to the artificial neural network.

Halil Durmus et al. [6] work is to detect diseases that occur on plants in tomato fields or in their greenhouses. For this purpose, deep learning was used to detect the various diseases on the leaves of tomato plants. In this study, deep learning methods were used to detect diseases. Deep learning architecture selection was the key issue for the implementation. So that, two different deep learning network architectures were tested first AlexNet and then SqueezeNet. For both of these deep learning networks training and validation were done on the Nvidia Jetson TX1. Tomato leaf images from the PlantVillage dataset has been used for the training.

Jobin Francis et al. [7] provides an evaluative study on the existing disease detection systems in plants.

Rutu Gandhi et al.[8] presents an image-based classification system for identification of plant diseases. Since existing datasets have diluted focus across several countries and there are none that pertain to India specifically, there is a need for establishing a local dataset to be of use to Indian farmers. It uses Generative Adversarial Networks (GANs) to augment the limited number of local images available. The classification is done by a Convolutional Neural Network (CNN) model deployed in a smart phone app.

Ganesan P et al.[9] proposed the fuzzy based method for the early identification and segmentation of disease affected plant leaves is proposed.

Maung Zaw [10] proposed an innovative set of statistical texture features for classification of plant diseases images of leaves. Authors derive texture information probability density function called Generalized Pareto Distributions from Scale-invariant feature transform (SIFT) texture feature. The main focus of proposed feature is to reduce computational cost of mobile devices.

Chit Su Hlaing and Sai Maung Maung Zaw[11] classify tomato plant disease using two different features: texture and color. For a texture feature, authors extract statistical texture information (shape, scale and location) of an image from Scale invariant Feature Transform (SIFT) feature. As a main contribution, a new approach is introduced to model the Scale Invariant Feature Transform (SIFT) texture feature by Johnson SB distribution for statistical texture information of an image.The proposed feature is a combination of statistical texture and color features to classify tomato plant disease.

Monzurul Islam et al.[12] present an approach that integrates image processing and machine learning to allow diagnosing diseases from leaf images. This automated method classifies diseases (or absence thereof) on potato plants from a publicly available plant image database called 'Plant Village'. The segmentation approach and utilization of support vector machine demonstrate disease classification over 300 images with an accuracy of 95%. Thus, the proposed approach presents a path toward automated plant diseases diagnosis on a massive scale.

Jagadish Kashinath Kamble[13] developed Mobile app for automatically detecting plant disease through image processing technique with the objective of providing fast, accurate, ease of use and inexpensive solutions to farmers.

Authors	Method	Plant Leaves	Limitations
[1]	K-means clustering algorithm for segmentation and Neural Network for classification	Brinjal Leaves	This work has to be extended to identify all possible diseases of brinjal leaves
[2]	Fractal descriptor with Probabilistic Neural Networks	Paddy leaves	Method can be extended for detecting two diseases with relatively Same color involved.
[3]	Ostu based image segmentation	sample of plant leaves like pepper plant, potato, tomato with late blight and leaf spot	Improving method for fast and accurate detection of leaves with disease
[4]	Bacterial foraging optimization based Radial Basis Function Neural Network (BRBFNN)	270 images are selected from crowdAI.org (PlantVillage Disease Classification Challenge)	worked with only fungal diseases, in future, this work can be extended working on with different databases with dissimilar diseases like bacteria or viruses
[5]	K means clustering segmentation, GLCM	Pomegranate Fruit and leaf images	The work can be extended for helping import and export of

	and Neural Network		fruits
[6]	SqueezeNet: deep learning with neural network	Tomato leaf images	The work can be extended on leaf extraction from the complex background to complete the system.
[7]	Back propogation Neural Network with GLCM	Peeper leaves	In future the images taken in varying lighting condition is taken for the further modification of the algorithm. Since the shape of the leaf determines the quality as well as the species of a plant by the shape identification the type of the plant also can be identified.
[8]	Convolutional Neural Network (CNN)	Sample leaf images taken from camera	Currently, the model is deployed on the farmer to physically move through pictures. The future scope could be drones that navigate the field. The drone would capture several images and sent back to the server on which the classification done.
[9]	fuzzy C-means clustering algorithm	Sample leaf images taken from camera	the CIELuv color space can be replaced by the device independent, perceptually uniform and linear color space like CIELAB, CIELch or HSI for further improvement
[10]	*SIFT texture feature with SVM classification*	The Plant Village Dataset	the proposed feature can be improved by considering and cooperation with other image processing methods
[11]	Statistical features with multiclass SVM	Tomato plant diseases	we need to try to improve the proposed feature by considering and cooperation with other image features
[12]	Ostu segmentation , GLCM feature extraction and SVM	Potato plant leaves	automatically estimating the severity of the detected disease
[13]	Neural Network	Sample leaf images taken from camera	automatic, efficient, fast and accurate system which is use for detection of disease and provide the solutions

Future Aspects and Possible Solutions to current limitations

The problem associated with automatic plant disease identification using visible range images has received considerable attention in the last two decades, however the techniques proposed so far are usually limited in their scope and dependent on ideal capture conditions in order to work properly. This apparent lack of significant advancements may be partially explained by some difficult challenges posed by the subject: presence of complex backgrounds that cannot be easily separated from the region of interest (usually leaf and stem), boundaries of the symptoms often are not well defined, uncontrolled capture conditions may present characteristics that make the image analysis more difficult, certain diseases produce symptoms with a wide range of characteristics, the symptoms produced by different diseases may be very similar, and they may be present simultaneously.

- The use of digital image processing in agriculture is quickly becoming ubiquitous, emulating human visual capabilities is a fundamental step towards the automation of processes. Creating a computer vision system to perform disease diagnosis and severity measurement is one of the most challenging tasks currently underway.

- One possible way to overcome some of the limitations that still affect this kind of technology is to place constraints to limit the capture condition variations. An undesirable side effect of this strategy is that the additional effort required to meet those constraints may dissuade many potential users from adopting the technology.
- Even with very tight constraints, many challenges will still remain. Some of the main difficulties can potentially be mitigated with the use of more sophisticated techniques borrowed from the areas of computer vision and machine learning
- The underutilization of tools and the relatively limited participation of the image processing and machine learning communities is probably not due to a lack of interest. The likely explanation is the lack of image databases comprehensive enough to allow the research. The few existing databases are either too limited or not accessible to the scientific community.
- A possible hybrid system would couple an automatic image-based module with an expert system, which is a computer system that emulates the decision-making ability of a human expert. In this case, the automatic module would be responsible for narrowing down the set of possible diseases.
- Finally, it is important to note that many farmers who have no access to plant science specialists can greatly benefit from automated, diagnostic image analysis technology, despite its imperfections

3. METHODOLOGY

There are five main steps used for the detection of plant leaf diseases as shown in figure 2.

3.1 Image Acquisition

In this step, the images of various leaves acquired using a digital camera with required resolution for better quality[3].

3.2 Image Pre-Processing

In the second step, this image is pre-processed to improve the image data that suppress undesired distortions, enhances some image features important for further processing and analysis task[5]. It includes color space conversion, image enhancement, and image segmentation. The RGB images of leaves are converted into color space representation[3].

3.3 Feature Extraction

Feature extraction involves reducing the amount of resources required to describe a large set of data[5]. When performing analysis of complex data one of the major problems stems from the number of variables involved[5]. Analysis with a large number of variables generally requires a large amount of memory and computation power, also it may cause a classification algorithm to over fit to training samples and generalize poorly to new samples [4].

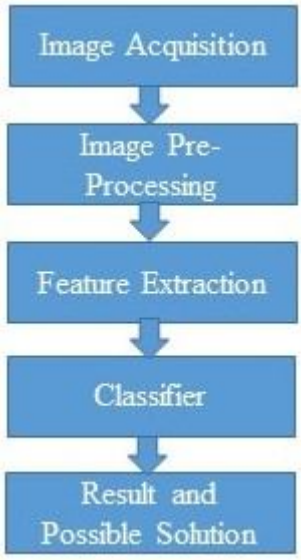

Figure 2: Basic Methodology

3.4 Classifiers

There are many classifiers can be used for classification of leaf images such as K-nearest neighbor, Artificial neural networks, Support vector machine etc. K-nearest neighbor classifier is used to calculate the minimum distance between the given point and other points to determine the given point belongs to which class. Goal is to computes the distance from the query sample to every training sample and selects the neighbor that is having minimum distance. ANNs are popular machine learning algorithms that are in a wide use in recent years[5]. Multilayer Perception (MLP) is the basic form of ANN that updates the weights through back propagation during the training. Support vector machine (SVM) is a non-linear classifier, and is a newer trend in machine learning algorithm. SVM is popularly used in many pattern recognition problems including texture classification[3].

3.5 Results and Probable Solution

The result and probable solution will be given like the probable matching of leaf disease will be displayed along with possible solution.

4. Conclusion

This paper provides a detailed survey on plant disease classification using methods. First step in all papers to identify in the leaf is done by using image processing technique. Different authors have used different techniques to preprocess the diseased plant images and to extract the features to obtain high accuracy. Classifier are used for the accurate classification of the diseases which will help the farmers to reduce the pesticide usage as well as to increase the crop yield

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AUTHOR

Haridas D. Gadade received B.Tech in Computer Engineering from Dr. Babasaheb Ambedkar Technological University,Lonere-Raigad and Master's of Engineering from Pune Institue of Technology, Pune. Currently he is working as a Assistant Professor in Government College of Engineering, Jalgaon-Maharashtra-India.

Dr. D.K.Kirange is Head and Associate Professor in Computer Engineering Department in J.T.Mahajan College of Engineering, Faizpur dist Jalgaon-Maharashtra-India. And also research guide in the KBC North Maharashtra University, Jalgain-Maharashtra.