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Digital Image Processing Techniques for Early Detection and Classification of Different Diseased Plants

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Abstract

The proposed paper surveys different techniques for early spotting and classification of diseased plant using digital image processing. As in agribusiness, agriculturists detect plant diseases straight through the bare eyes. This type of detection requires continuum supervisory which can be expensive as well as time consuming on large farms. Therefore, recognizing the disease on plants is of extreme importance in agriculture sector. The selected proposal is divided into three classes: detection, classification and extraction. The three classes are further sub divided according to the different algorithm. This paper provides an overview of different image processing techniques and classification methods.

Keywords*: Disease Detection, Image Processing, Support Vector Machine (SVM), Crop Diseases, Neural Networks*

1. Introduction

Plants and crops are the most crucial source of energy as they play an important role in both human life and the other lives than exists on the earth. In recent times, plant and crop cultivation in agriculture is being used much more than just feeding the population. In this regard, diagnosing the disease in timely and accurate way is most important [1].

Plant pathology can be detected through several ways. Visible symptoms associated with some diseases cannot be detected always and some of them appear only when it is too late. General approach in this is diagnosing the signs that are not easily visible to humans [2]. This is usually achieved by the use of remote reusing techniques and the methods adopted often employ digital image processing tools. But in majority of cases diagnosing the diseased plant is done through bare eyes by humans [3]. The agriculturists may be proficient in detecting the diseased plant, but still they may suffer with some shortcomings as listed below:

- Loss of concentration in agriculturists, may decrease the accuracy.
- To maintain quality, training may need to be repeated. Agriculturists are expensive.
- Standard area diagrams need to be developed to aid assessment.
- Various illusions that the agriculturist may be prone to can be one of the shortcomings (for example, localized abnormal structural change) [4,5].

Apart from these disadvantages the agriculturist may find it a challenging task if the diagnosis is done for extremely large areas. By use of digital image processing many of these problem can be solved or reduced [6].There have been many ways and algorithms projected in last few years and this paper presents those systems as will be seen in the next section. As shown in below Figure 1, the flow chart for early detection of disease in plant leaf. The steps include: Image acquirement, Segmentation of image, Extraction of features and Categorization.

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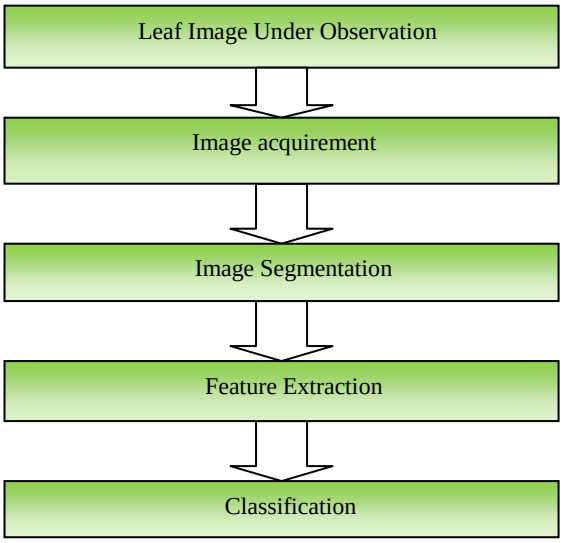

Figure 1. Flow chart of the General System for Extraction and Classification of Disease in Plant Leaf

2. Literature Review

In the last ten years, many researchers have attempted the use of applications in agriculture that use digital image processing. Classifiers based on texture, color and functions for shape matching are some of the common methods that have been proposed by researchers in the past few years [7]. The following sections will discuss some past work done using these methods. The literature review is divided into two subsection based on the different technical solutions that are employed in digital image processing. Summarization of the different digital image processing techniques is presented in a tabulated form in the concluding section. Swift and precise useful information on detecting plant diseases is provided by diseases detection through digital image processing.

Following are some proposals that describe the techniques for the same.

Literature based on Segmentation Techniques

The classification and identification of leaf diseases is important as it can prove detrimental to the yield. The classifier needs most discriminating features to improve the effectiveness and efficiency of analysis and classification for that reason feature extraction and segmentation is a decisive step in diseases recognition.

Piyush Chaudhary &*et al*. in 2012, [15] used Colour transform of RGB image for segmentation of diseases spot by. In their work a YcbCr colour space, CIELAB and HSI effect comparison was done for diseases spot detection. For image smoothening and to obtain a noise free algorithm median filter was used. Finally for applying method on color component threshold technique was used. An algorithm was developed which was experimented on different leaves of dicot and monocot plant.

P.R. Rothe and Dr. R.V. Krhirsager in 2015, [26] developed and evaluated adaptive neuro fuzzy inference system as methodology to identify the leaf diseases on cotton. Digital image analysis combined with neural networks has proven to be feasible approach to identify cotton leaf diseases by using colour layout descriptors as features for training the model.

Proposed research work by **P. Ravathe and M. Hemaldha (2012),** [23] exposes a advance computing technology. The proposed technology tries to detect diseases through

image edge detection. Image features extraction such as color, boundary, shape and texture were drawn out for the detection of diseases spots.

D.S. Guru &*et al.* in 2011, [9] proposed an algorithm for extraction of the affected area and neural network application to classify tobacco leaves diseases. To diagnose and detect the type of diseases, statistical texture features of first order was implemented. Gray Level Matrix (GLCM) based features comparison was done with the extracted features to fetch out their transcendences.

P.R. Rothe & *et al.* in 2014, [28] proposed a cut based approach for segmentation of images of diseased cotton leaves. To remove the noise present in the images for segmentation, gaussian filter was applied. The color layout descriptor was used for content filtering and visualization. The disease that was selected in cotton leaf was Bacterial Blight, Myrothecium and Alternaria.

Literature based on Classifying Techniques

Based on different morphological features, some of the classification tools employed for plant classification is discussed in the following section. K-means clustering, Support Vector Machine and Neural Networks are some of the classifying techniques. Grouping is done in the following section according to the strategy employed in classification.

Tian Youwen & *et al.* in 2008, [2] proposed an algorithm that was based on diseases detection of leaves of cucumber by using support vector machine(SVM). Firstly to remove noise of the adopted cucumber leaf colored image, vector median filter was applied. Static pattern recognition method was then used to segment the leaf images of cucumber. At the end extraction of shape, color and texture was done and method of SVM for classification. Performance of neural networks and SVM was compared for classification and the experimental results favoured SVM over neural networks.

Zhang Jian in 2010, [8] analyzed recognition of cucumber leaf diseases, in which a small number of samples were considered. Instead of taking whole diseased leaf as a sample, each spot on the cucumber diseased leaf was taken as sample. To carry out the experimental tests, Sigmoid kernel functions and Radial Basis Function (RBF) was used. Taking each spot as sample and using SVM method based on RBF function for classification showed best performance for detecting the diseases on cucumber leaves.

A new approach was proposed by **ArunPriya C. & *et al.* in 2012,** [11] for efficient recognition of leaf diseases in which SVM classification was used. Extraction of twelve leaf features was done and five variables were given as an input vector. K-NN approach was compared with this classifier and the results showed that SVM was less time consuming and more accurate than the K-NN method for classification.

Elham Omrani & *et al*.in (2014), [19] used support vector machine for apple leaf diseases detection. For the detection determination three apple diseases were taken. Support Vector Machines (SVM) and artificial neural networks approaches were taken for classification. Firstly to detect the infected region, K-means clustering was used. After detecting the infected region, the features on leaves were extracted and then SVM was compared to ANN for classification purpose. The results indicated that SVM was a better approach for classification of leaf disease as compared to ANN.

Santanu Phadikar and Jaya Sil in 2008, [25] used pattern technique for detection of diseases in rice plants. They made use of a digital camera to capture infected rice plant images and then technique for image segmentation was used to segment the infected part of the rice plant. Then neural network was used for classification of the diseases.

Dheeb Al Bashish & *et al*. in 2010, [6] developed a neural network classifier for plant leaf and stem classification of diseases. The first step towards the detection of diseases included K-means clustering for segmenting the diseased part. The second step included passing the image through a pre-trained neural network. The proposed research indicated that the approach could accurately detect the diseased leaf with an accuracy of 93%.

D.S. Guru & *et al*. in 2011, [9] classified seedling diseases such as frog eye spot on tobacco leaves through neural network. Contrast stretching transformation was used to segment the affected leaf areas with diseases frog eye spot. To classify frog eye spot on tobacco leaves, a Probabilistic Neural Network (PNN) was employed.

Table 2. Summarization of different Methods

Paper ID	Worked On	Technique Used	Efficiency(%)
[6]	Plant Leaf and Stem	For segmentation K-means clustering and neural networks for classification	93
[7]	Plant Leaf	Segmentation uses thresholding	Not given
[8]	Cucumber	Thresholding for segmentation and SVM for Classification	Not given
[9]	Tobacco	Contrast Stretching Transformation for segmentation and neural networks for classification	88.5
[10]	Corn	YcbCr Color Space for segmentation and neural networks for classification	98
[11]	Plant Leaf	SVM for classification	94.5
[12]	Wheat, Grape	Neural networks for classification	94.2
[15]	Monocot and Dicot Plant	Threshold selection for segmentation	Not given
[23]	Cotton	Edge detection analysis for segmentation	Not given
[24]	Maple leaves	K means clustering for segmentation	Not given
[19]	Apple	For segmentation K-means technique and and SVM for Classification	85
[25]	Rice	Bi-level Thresholding for segmentation and neural networks for classification	80
[26]	Cotton	K-means clustering for segmentation Feed-Forward BP for classification	85
[27]	Sugar	SVM for classification	Not given
[28]	Cotton	Neural networks for classification	92.65
[29]	Watermelon	Median Filtering for segmentation and neural networks for classification	75.9

3. Discussion

Table1 shows the summarization of different techniques for sleuthing and classifying the diseased plants. The plant type and the specific tool used by the author respectively is also shown.

4. Conclusion

With the study of different detection and classification techniques we conclude the following. A number of methods have been proposed by researchers for sleuthing and classifying the diseased plant. For detection and segmentation of diseased plant, the simplest and accurate algorithm among all of the other algorithms is k-means clustering. Support vector machine (SVM) and neural networks was found competitive with each other for classifying the plant diseases. During the comparison of both the techniques, SVM was found to be more accurate than ANN. This paper presented an investigation on different digital image processing proficiencies for segmenting and classifying the diseased plants.

References

[1] T. Youwen, L. Tianlai and N. Yan, "The Recognition of Cucumber Disease Based on Image Processing and Support Vector Machine" Congress on Image and Signal Processing, IEEE, **(2008)**, pp, 262–267.
[2] M. Schikora and A. Schikora, "Image-based Analysis to Study Plant Infection with Human Pathogens", ELSEVIER, Computational and Structural Biotechnology Journal 12, **(2014)**, pp. 1-5.
[3] S. Kai, "A research of maize disease image recognition of corn based on BP networks", IEEE, Third international conference on measuring technology and mechatronics automation. IEEE, Shangshai, **(2011)**, pp 246–249.
[4] A. Bashish, "A framework for detection and classification of plant leaf and stem diseases",IEEE, International conference on signal and image processing. IEEE, Chennai, **(2010)**, pp. 113–118.
[5] H. Wang, "Application of neural networks to image recognition of plant diseases", IEEE, International Conference on Systems and Informatics (ICSAI). IEEE, Yantai, **(2012)**, pp, 2159–2164.
[6] D. A. Bashish, M. Braik and S. B. Ahmad, "A Framework for Detection and Classification of Plant Leaf and Stem Diseases", IEEE, International Conference on Signal and Image Processing, **(2010)**.
[7] N. Valliammal, Dr. S. N. Geethalakshmi, "Performance analysis of various leaf boundary edge detection algorithm", IEEE, ICPC, **(2010)**.
[8] Z. Jian and Z. Wei, "Support Vector Machine for recognition of Cucumber Leaf Diseases", IEEE, Symposium on computing and networking, **(2010)**.
[9] D. S. Guru, P. B. Mallikarjuna and S. Manjunath (2011) "Segmentation and Classification of Tobacco Seedling Disease", IEEE, COMPUTE'11, **(2010)**.
[10] S. Kai, L. Zhikun, S. Hang and G. Chunhong, "A Research of maize disease image recognition of corn based on BP networks", IEEE, Third international conference on measuring technology and Mechatronics automation, **(2011)**, pp. 246-249.
[11] C. Arunpriya and T. Balasaravanan, "An efficient leaf recognition algorithm for plant classification using support vector machine", IEEE, Proceedings of international conference on pattern recognition, informatics and medical engineering, **(2012)**.
[12] H. Wang, G. Li, Z. Ma and X. Li, "Image recognition of plant disease based on Principal component analysis and neural network", IEEE,8th International conference on natural computation, **(2012)**, pp. 246-251.
[13] Z. B. Husin and A. H. B. A. Aziz, "Feasibility study of plant chilli disease detection using image processing techniques", IEEE,Third international conference on intelligent systems modelling and simulations, **(2012)**, pp. 291-296.
[14] Y. Song, Z. Diao, Y. Wang and H. Wang, "Image feature Extraction of crop Disease",IEEE, Ssymposium on electrical and electronics engineering, **(2012)**, pp. 448-451.
[15] P. Chaudhary, A. Chaudhari, A. N. Cheeran and S. Godara, "Color transform based approach for spot detection on plant leaf", International journal of computer science and telecommunications, vol. 3, iss. 6, **(2012)**, pp. 65-70.
[16] Y. X. Zhao, "Research of maize leaf disease identifying system based image recognition", Scientia Agricultura Sinica, vol. 40, **(2007)**, pp. 698–703.
[17] Z. Y. Liu, "Estimating rice brown spot disease severity based on principal component analysis and radial basis function neural network",Spectroscopy and Spectral Analysis, vol. 28, **(2007)**, pp. 2156–2160.

[18] B. Li, "Hyperspectral identification of rice diseases and pests based on principal component analysis and probabilistic neural network", Transactions of the CSAE, vol. 25, **(2009)**, pp. 143–147.
[19] E. Omrani, "Potential of radial basis function-based support vector regression for apple disease detection" Elsevier, Measurement 55, **(2014)**, pp. 512-519.
[20] G. L. Li, "Preliminary study on automatic diagnosis and classification method of plant diseases based on image recognition technology", Beijing: China Agricultural University, **(2011)**, pp. 1–64.
[21] H. Wang, G. Li, Z. Ma and X. Li, "Application of neural; networks of image recognition of plant disease",IEEE, International conference on systems and informatics, **(2012)**, pp. 2159-2164.
[22] N. H. Tuhid, N. E. Abdullah and N. M. Khairi, M. F. Saaid, M.S.B Shahrizam and H. Hashim, "A statistical approach for orchid disease identification using RGB color", IEEE,Control and system graduate research, **(2012)**, pp. 382-385.
[23] P. Revathi and M. Hemalatha, "Advance computing enrichment evaluation of cotton leaf spot disease detection using image edge detection", IEEE, **(2012)**.
[24] A. Rastogi, R. Arora and S. Sharma, "Leaf disease detection and grading computer vision technology and fuzzy logic", IEEE, Second international conference on signal processing and integrated networks(SPIN), **(2015)**, pp. 500-505.
[25] S. Phadikar and J. Sil, "Rice disease identification using pattern recognition Techniques", IEEE, Proceedings of 11th international conference on computer and information technology, **(2008)**, pp. 420-423.
[26] P. R. Roth and R.V. Kshirsagar, "Cotton leaf disease identification using Pattern recognition Techniques", IEEE, International Conference on Pervasive Computing, **(2015)**.
[27] R. Zhou, S. K. F. Tanaka, M. Kayamori and M. Shimizu, "Early Detection and Continuous Quantization of Plant Diseases Using Template Matchine Support Vector Machine Algorithms", IEEE, First international symposium on computing and networking, **(2013)**, pp. 300-304.
[28] P.R. Rothe and R. V. Kshirsagar, "Adaptive Neuro-fuzzy Inference System for Recognition of Cotton Leaf Diseases" International Conference on Innovative Applications of Computational Intelligence on Power, Energy and Controls with their Impact on Humanity (CIPECH14), **(2014)**, pp. 12-17.
[29] S. B. Kutty, "Classification of Watermelon Leaf Diseases Using Neural Network Analysis", IEEE, BEIAC, **(2013)**, pp. 459-464.
[30] G. P. Prathibha, "Early Pest Detection in Tomato plantation using Image Processing", International Journal of Computer Applications (0975 – 8887), vol. 96, no. 12, **(2014)**, pp. 22-24.

