ISSN (online) : 2277-5390
ISSN (Print): 2277-5382

A survey on leaf disease prediction algorithms using digital image processing

R. Shripriya[1], N. Yuvaraj[2]

[1]PG Scholar, [2]Assitant Professor, Department of Computer Science, KPR Institute of Engineering and Technology, Coimbatore-641407, Tamil Nadu, India
[1]shripriyaravi@gmail.com, [2]yuvaraj.n@kpriet.ac.in

Abstract

Objective: To investigate the plant leaf disease prediction algorithms that utilizes the digital image processing techniques in agricultural environments.
Findings: In digital image processing, the segmentation process of healthy and diseased tissue was mainly focused in order to detect and diagnose the plant leaf diseases accurately.Semi-automatic segmentation technique was mostly utilized among various segmentation methods, which was developed based on the grayscale histogram. However, the issue of accuracy in segmentation process was still not improved. In this paper, the leaf disease prediction algorithms are investigated briefly according to the digital image processing techniques and evaluated the performance effectiveness of different algorithms.
Results: In this paper, various segmentation algorithms are studied which are used to predict the leaf diseases through digital image processing techniques in terms of their merits and demerits to prove segmentation based on grayscale histogram is better than other segmentation techniques to predict the leaf diseases.
Application/Improvements: The finding of this study shows that the segmentation technique based on grayscale histogram is better than the other digital image processing techniques.

Keywords: Digital image processing, Plant disease, Segmentation, Grayscale histogram, Leaf symptoms

1. Introduction

In digital image processing, various algorithms are utilized to perform the different image processing steps on digital images. In agricultural area, digital image processing methods [1], [2]are mostly used for the purpose of plant growth monitoring, plant disease prediction, and so on.

Generally, the plant diseases are caused by the abnormal physiological functionalities of plants. Therefore, the characteristic symptoms are generated based on the differentiation between normal physiological functionalities and abnormal physiological functionalities of the plants [3]. Mostly, the plant leaf diseases are caused by Pathogens which are positioned on the stems of the plants. These different symptoms and diseases of leaves are predicted by different methods in image processing. These different methods include different fundamental processes like segmentation, feature extraction and classification and so on [4], [5].

Mostly, the prediction and diagnosis of leaf diseases [6] are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves using digital image processing algorithms. Consequently, various segmentation algorithms are provided in order to segment the leaf tissues accurately. However, the major issue in segmentation is prediction accuracy and the distortion in images will degrade the classification accuracy.

In [7] investigated about the automatic detection of leaf disease symptoms using digital image processing. The major objective of this automatic detection method was to remove the human errors entirely. Here, unnecessary narrow parts were removed by using masking. Then the image without mask was separated and also from the original image, the objects were separated. Every object regionand locations of petioles were determined. In addition, the objects were removed which are less than the region of the largest object. The final determination of symptoms was analyzed based on threshold value.

In [8] presented the various segmentation methods for tree leaves extraction. The segmentation methods include automatic and semi-automatic methods. These various segmentation methods were briefly discussed. The various observation criteria were used for analysis of segmentation methods for tree leaves such as Dice index, Hamming measure or SSIM and various conventional approaches compared with guided active contour method which was developed in the application Folia, which allows classification of tree leaves.

In [9] investigated segmentation method based on the fuzzy set theory. The input image was transformed into fuzzy domain and maximum fuzzy correlation criterion was calculated among fuzzy domain. The major objective was to optimize image maximum fuzzy membership function and finally target objects were detected from bright or dark parts of the images. The differential evolution algorithm was combined with the fuzzy set based segmentation for achieving the optimal threshold value.

In [10] presented discrete wavelet transform to improve the segmentation for agricultural images. This approach initially greenness was extracted according to the vegetation indices. Then the extracted image was utilized in wavelet application for extracting the spatial structures in three bands likevertical, horizontal, and diagonal which provides more detailed information and collected from the texture descriptors. After that, the greenness and texture information were combined to enhance the plants identification. Finally segmentation was occurred based on image thresholding technique.

In [11] investigated segmentation using adaptive thresholding method for leaf image. By analyzing the foreground and background images of jujube leaf, the leaf image was segmented. By utilizing the functions which are provided for mapping, the threshold value was selected. In addition, the segmentation of targeted leaf area was achieved by the Shape Identification algorithm and pattern recognition in OTSU and CANNY operators. Thus, the optimization process of the algorithm is designed to get an entire leaf edge.

In [12] presented automatic segmentation and classification method for leaf image features. The input image which is acquired from scanner was used for segmentation. For segmentation, unconstrained hit-or-miss transform and adaptive thresholding techniques were provided for legume leaves. The morphological features were computed by segmented images and classified by using support vector machine (SVM), penalized discriminant analysis and random forest classifier.

In [13] investigated computer vision based segmentation method for detecting crop diseases automatically. The combination of marker controlled watershed and super-pixel based segmentation algorithms were provided for extracting the features. The extracted features were selected based on textural, Gabor, gradient and biologically inspired features. Then the features were classified based on support vector machines (SVM) and also compared with ANN based classification.

In [14] presented automatic prediction of plant disease based on colour segmentation. This automatic detection system introduced an algorithm which automatically detects the plant diseases. In pre-processing, color segmentation was utilized to separate leaf from the background. In feature extraction, morphological features, Fourier descriptors (FDs) and proposed shape defining feature (SDFs) were included and those features were extracted from a plant leaf and these features are given as input vector to Artificial Neural Networks (ANN) to classify plant leaf based on the features.

In [15] investigated Gemini virus attack in chili by utilizing Bayesian segmentation method. The Gemini virus was analyzed for exposing the chili farms by capturing the aerial images with the location perpendicular to the earth surface. The image acquisition was made through an aerial photography through multi-copter. The virus attack levels on individual plant were determined based on Bayesian segmentation with a 3-dimensional input color component such as Red, Green, and Blue and 4 segmentation targets.

In [16] investigated about the leaf disease severity measurement based on image processing segmentation approach. The proposed technique was provided for the analyzing the severity of brown spot disease. Initially the sugarcane leaves which are affected by the brown spot disease were collected. Then the leaf region segmentation method and disease region segmentation were performed by using simple threshold and triangle thresholding techniques. Then the diseases were categorized by measuring the quotient of disease region and leaf region.

In [17] leaf segmentation and classification algorithm were presented in order to improve the both segmentation and classification accuracy. For leaf segmentation and classification, the group of sophisticated algorithms was incorporated. The input leaf images were initially recovered as 3D structure based on optical flow estimation algorithm and camera self-calibration algorithm. After recovering, the two-dimensional or three-dimensional joint segmentation method was performed based on the 3D information. Then the segmented leaves were classified based on centroid-contour distance measurement.

In [18] semi-automatic segmentation algorithm was developed for predicting the plant leaf disease symptoms using digital image processing. According to the grayscale histograms, the semi-automatic segmentation algorithm was introduced. The differentiation of normal and abnormal tissues was identified by different signs and symptoms

ISSN (online) : 2277-5390
ISSN (Print): 2277-5382

of leaves. In HSV and L*a*b color space, histograms of H and a* were segmented using the proposed technique. Moreover, in-depth analysis of different issues likes illumination, lesion delimitation and etc, were studied.

The comparison of different plant disease prediction techniques are shown in table 1.

Table 1. Comparison of Plant Disease Prediction Algorithms Using Digital Image Processing

Ref. No.	Merits	Demerits
[7]	For multiple leaves the proposed prediction algorithm was well suited.	Input image having background color nearer to white was not always possible.
[8]	The issues of shape and sub-segmentation was reduced	Manual initialization was needed for segmentation
[9]	The noisy information was effectively removed from an image	Time complexity for segmentation process was high
[10]	High classification accuracy	Computational cost was high and poor directionality due to considering only three orientations
[11]	Improved accuracy	Detection speed was less
[12]	The classification accuracy was improved	Not applicable for multiple species of plants
[13]	High accuracy and execution time was less	Robustness was less
[14]	High accuracy	This method was only applicable for leaf databases
[15]	Accuracy was 100%	Computational cost was high
[16]	High accuracy and convenient to measure disease severity	Only specific problems were tackled
[17]	Simple and acceptable accuracy	Leaf shape may be distorted due to exploit 3-D information
[18]	Better accuracy and high flexibility	An error due to few sources does not remove and limitations in color channels were raised.

3. Conclusion

The various digital image processing techniques were developed including with different segmentation and classification methods to effectively achieve high prediction or classification accuracy for leaf disease prediction in agriculture. The developed algorithms should have capability to improve the classification accuracy for plant disease prediction and diagnosis. Finally, the better semi-automatic segmentation technique using color histogram should be selected for further improvement in segmentation algorithm resulting in more accurate and comprehensive method.

4. References

1. A. Vibhute, S.K. Bodhe. Applications of image processing in agriculture: a survey. *International Journal of Computer Applications*.2012; 52(2), 34-40.
2. Iqbaldeep Kaur, Gifty Aggarwal, Amit Verma. Detection and classification of disease affected region of plant leaves using image processing technique. *Indian Journal of Science and Technology*.2016; 9(48), 1-13.
3. C.H. Bock, G.H. Poole, P.E. Parker, T.R. Gottwald. Plant disease severity estimated visually, by digital photography and image analysis, and by hyperspectral imaging. *Critical Reviews in Plant Sciences*. 2010;29(2), 59-107.
4. S. Kumar,R. Kaur. Plant disease detection using image processing-A review. *International Journal of Computer Applications*, 2015; 124(16), 6-9.
5. P. Karmuhil, L. Parthiban. An automatic road network extraction from satellite images using Modified SOFM approach. *Indian Journal of Innovations and Developments*.2016; 5(4), 1-6.
6. K. Khairnar, R. Dagade. Disease detection and diagnosis on plant using image processing- A Review. *International Journal of Computer Applications*.2014; 108(13), 36-38.
7. J.G.A.Barbedo. An automatic method to detect and measure leaf disease symptoms using digital image processing. *Plant Disease*.2014; 98(12), 1709-1716.
8. M. Grand-Brochier, A.Vacavant, G. Cerutti, K. Bianchi, L. Tougne. Comparative study of segmentation methods for tree leaves extraction. In: *Proceedings of the International Workshop on Video and Image Ground Truth in Computer Vision Applications.* ACM. 2013.
9. R. Gao, H. Wu. Agricultural image target segmentation based on fuzzy set. *Optik-International Journal for Light and Electron Optics*, 2015; 126(24), 5320-5324.

10. M. Guijarro, I. Riomoros, G. Pajares, P. Zitinski. Discrete wavelets transform for improving greenness image segmentation in agricultural images. *Computers and Electronics in Agriculture*.2015; 118, 396-407.
11. J. Wang, J.He, Y. Han, C. Ouyang, D. Li. An adaptive thresholding algorithm of field leaf image. *Computers and electronics in agriculture*, 2013; 96, 23-39.
12. M.G. Larese, R. Namías, R.M. Craviotto, M.R. Arango, C. Gallo, P.M. Granitto. Automatic classification of legumes using leaf vein image features. *Pattern Recognition*, 2014; 47(1), 158-168.
13. L. Han, M. S. Haleem, M. Taylor. A novel computer vision-based approach to automatic detection and severity assessment of crop diseases. In:*Science and Information Conference (SAI),* IEEE.2015; 638-644.
14. A. Aakif, M.F. Khan. Automatic classification of plants based on their leaves. *Biosystems Engineering*.2015; 139, 66-75.
15. M. Solahudin, B. Pramudya, R. Manaf. Gemini virus attack analysis in field of chili (*Capsicum annuum* L.) using aerial photography and Bayesian segmentation method. *Procedia Environmental Sciences*, 2015; 24, 254-257.
16. S.B. Patil, S. K. Bodhe. Leaf disease severity measurement using image processing. *International Journal of Engineering and Technology*, 2011; 3(5), 297-301.
17. C.H. Teng, Y.T. Kuo, Y.S. Chen. Leaf segmentation, classification, and three-dimensional recovery from a few images with close viewpoints. *Optical Engineering*. 2011; 50(3), 1-13.
18. J.G.A. Barbedo. A novel algorithm for semi-automatic segmentation of plant leaf disease symptoms using digital image processing. *Tropical Plant Pathology*. 2016; 41(4), 210-224.

The Publication fee is defrayed by Indian Society for Education and Environment (iSee). www.iseeadyar.org

Citation:

R. Shripriya, N. Yuvaraj. A survey on leaf disease prediction algorithms using digital image processing. *Indian Journal of Innovations and Developments.* 2016; 5(10), October.