

Automatic recognition and classification of agricultural diseases by Digital Image Processing- A literature survey

¹Dr. Virendra Singh Chaudhary, ²Ms. Yashmeet Kaur Reel

Department of ECE, RKDF University CTR, Bhopal (M.P.) India

ABSTRACT:

This paper provides a survey on different classification techniques that are used for the recognition of plant leaf diseases. As it is impossible to identify the symptoms of plant disease with a naked eye. Food is the basic need of all human beings and as population is growing day by day, it becomes significant to grow a sufficient number of crops to feed such a vast population. The constant monitoring of the field is difficult, so there is a need to suggest some automatic technique for continuous monitoring of the field and an image processing technique has a vast algorithm and can be used for the detection of plant diseases. Different types of image processing techniques are implied that can detect diseased leaves using color information of leaves. There are some other classification techniques which include, Probabilistic Neural Network, Genetic Algorithm, k-Nearest Neighbour Classifier, Support Vector Machine, Artificial neural network, Fuzzy logic etc. Now choosing a classification method has always been a difficult task because the quality of result can vary for different input data.

Keywords- Artificial neural network, fuzzy logic, Image processing, k- nearest neighbour, probabilistic neural network,

I. INTRODUCTION

Plants diseases have turned into a dilemma as it can cause significant reduction both in quantity and quality of agricultural products. Plants get distorted for a variety of reasons sometimes due to some nutrient deficiency, toxicities and sometimes because of environment changes etc. that can cause plants to become distorted. However, the cultivation of these crops for optimum yield and quality production is highly technical. Hence by using digital image processing histogram equalization method we have observed change in an image of leaf or stem as most of the diseases are observed in these parts of the plants. Digital Image Processing includes changing the nature of an image in order to improve its pictorial information for human interpretation and is a software used to manipulate the images with the help of a computer system. Digital image processing can also be applied and is useful in many fields for example in image sharpening and restoration, in medical field, in transmission and encoding, agriculture etc. digital image processing has vast applications in agricultural field also as agriculture is the primary source of livelihood for about 58% of India's population.

II. LITERATURE REVIEW

This section will provide various techniques and approaches implemented for the detection of various diseases in plant leaf using digital image processing-

Guan Wang , Yu Sun ,and Jianxin Wang [1] In this proposed methodology plant disease severity can be estimated by the help of deep learning method which include deep convolution of neural network. For the classification of disease severity few training data samples were taken and then comparison has been made between the two architectures, namely, building a shallow network and transmission knowledge by fine-tuning the top layers of a pretrained deep network. Transfer learning is a useful approach to build powerful classification network using few data sets, by fine-tuning the parameters of a network pretrained on a large dataset. The training and testing accuracies of shallow networks trained from scratch in which both the training and the test accuracies improve slightly with the depth of the model at first and the best performance, a test accuracy of 79.3%, was achieved by the network with 8 convolutional layers.

Ashwin Dhakal, Prof. Dr.Subarna Shakya [2] In this proposed work is based on deep learning with includes convolution of neural network for the detection of plant disease. Leaves of Infected crops were collected and labelled according to the disease. Processing of image is performed along pixel-wise operations to enhance the image information which is followed with feature extraction, segmentation and the classification of patterns of captured leaves in order to identify plant leaf diseases. Four classifier tags are used as Bacterial Spot, Yellow Leaf Curl Virus, Late Blight and Vigorous Leaf. The structures take out were fit into the neural network with 20 epochs. Numerous artificial neural network manners were executed with the best performance of 98.59% accurateness. This method was a great success in demonstrating the feasibility in the field of Plant Disease Diagnosis and high crop yielding.

Trimi Neha, Mesra Ranchi, Jharkhand [3] In this paper an image-based approach is used for identification of the disease of potato leaf with the help of k – clustering algorithm and artificial neural network in which different segmentation technique has been used for identification of plant leaf disease. Clustering and sorting of plant leaf diseases had been framed by the applications of image thresholding, clustering and Neural Networks . The diverse procedure was tried on diverse diseases influence on the plants. The image segmentation based on ANN algorithms with the experimental results which significantly support an accurate result in less computing time is neural network which give best accurate result compared to others.

Emma Harte [4] This paper demonstrates the technical feasibility of convolution of neural network in classifying plant diseases and presents a path towards artificial intelligence solutions. The performance of a pre-trained ResNet34 model is used in detecting crop disease. This developed model is deployed as a web application and capable of recognizing 7 plant diseases out of healthy leaf tissue. A dataset containing a leaf image were captured in a controlled environment, is established for training and validating the model. Authentication outcomes display that the proposed technique can accomplish an accurateness of 97.2%.

Ke Lin, Liang Gong, Yixiang Huang, Chengliang Liu and Junsong Pan[5] In this proposed methodology a deep learning-based segmentation and convoluted neural network of cucumber powdery mildew has been considered. In this paper a new deep learning scheme is proposed which represents powdery mildew infection by masked regions generated from the segmentation model to exact severity of the disease. Compared to the hyperspectral image-based method, this proposed method is easier to implement and does not require expensive special imaging equipment. Further, compared to methods based on visible image classification, this method is able to obtain the location of the disease regions the proposed method can also provide the area and shape of the disease regions so further it can be used to indicate the severity of the disease, and can also help with the morphological analysis of the disease regions.

M. Akila Deepan [6] Plants are susceptible to several disorders and attacks caused by diseases and environmental conditions such as temperature, humidity, nutritional excess nutritional losses, light and the most mutual diseases that comprise of bacterial, virus, and fungal diseases. These diseases along with the plants shows a different physical characteristic on the leaves which may include changes in shapes, colours etc. This proposed methodology not only deals with the identification of disease but also the infection status of the disease in leaves and tries to give solution. In this paper, proposed work is based on recent detectors such as Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-based Fully Convolutional Networks (R-FCN) and Single Shot Multibox Detector (SSD) to identify and classification of plant leaf diseases that affect in various plants. The exciting part of this method is not only pact with disease detection, and also known the infection grade of the disease in leaves and tries to give explanation. The experimental results were compared between various deep-architectures with feature extractors and demonstrates how deep-learning-based detector is able to successfully recognize different categories of diseases in various plants and also give solution for concern diseases.

S. Arivazhagan, R. Newlin Shebiah , S. Ananthi, S. Vishnu Varthini [7] In this paper, detection and classification of leaf diseases has been proposed by the method which is based on masking and removing of green pixels and applying a specific threshold to extract the infected region and computing the texture such as Contrast, Energy, Local homogeneity, Cluster shade and cluster prominence are computed for the H image statistics to evaluate the diseases. For this method sample of the acquired leaf images are taken and converted into HSI format. The co-occurrence features like contrast, energy, local homogeneity, shade and prominence are derived from the co-occurrence matrix. By these established of co-occurrence features the plant diseases are detected.

P.Revathi and M.Hemalatha,[8] This paper proposed the methodology of classifying the disease on cotton leaf using Edge detection image processing technique .Production of agricultural products is difficult task as the plant comes to an occurrence from numerous micro-organisms, pests and bacterial diseases. The proposed paper discusses the image processing techniques used in performing early detection of plant diseases. The objective of the proposed work is to implement image analysis and classification techniques for extraction and classification of leaf diseases. The sample of Leaf image is captured and processed to determine the status of each plant.

Proposed framework is divided into four parts which includes image pre-processing image enhancement, image segmentation using K-mean clustering for statistical usage to determine the defect and severity areas of plant leaves, feature extraction and classification. texture feature extraction using statistical GLCM (grey level co-occurrence matrix) and colour feature by means of mean values. After finding the mean values endmost classification can be achieved by using SVM (Support vector mechanism). This proposed technique will ensure that chemicals only applied when plant leaves are identified to be affected with the disease.

ShoyebAhammadRafi ,Md. Washimul Bari ,Toukir Hasan Chowdhury ,Md. Jahidul Islam ,Dewan Md. AnisurRahaman[9] This research methodology is an autonomous robotic technology used to assist the farmer by detecting the leaf disease here the sample of the guava leaf has been taken. The initial goal was to implement a prototype and test its feasibility to find out the diseases. This prototype is designed with two features. One is motion and the second one is study with image processing along with real-time data processing. In motion part, the robot is taking the decision whether to take left turn, right turn or stop, based on three specific range of colours (on the field). In the second part the robot analyses that the leaf is normal or is affected by the disease. The temperature and humidity monitoring of the environment is an additional feature of this prototype. This prototype has been technologically advanced with the intent to support the farmer for redeemable their time and for the improvement of straight agricultural decisions.

Dr. Pankaj Mohindru¹, Gagandeep Kaur² ,Dr. Pooja³ [10] This paper explore the leaf disease prediction by using KNN (k-nearest neighbour) algorithm. A colour-based segmentation model is well-defined to segment the diseased area and placing it to its appropriate classes. Sample shave been taken and experimental analyses were done on the sample images in terms of time complexity and the area of infected region. Plant diseases can be detected by image processing technique like image acquisition, image pre-processing, image segmentation, feature extraction and classification. This paper gives a method which is used to distinguish the plant diseases and delivers an explanation to recover from the disease. It results in the inflated part of the leaf in percentage.

Mukesh Kumar Tripathi D. Y. Patil Dr. Dhananjay D. Maktedar [11] This paper compares the number of systems on the basis various criteria which includes the product and its disease. The main aim of the proposed work is to detect the diseases on all types of vegetables and increase yield of crops. samples has been taken which consist of input image of vegetables the input images are resized for faster computation. After that number of processes have been deployed which includes abstract image processing to improve the quality of image, image segmentation to extract the meaningful object by excluding the pointless background features are taking out to find out the meaning of testing sample and finally classification of given testing input query according to the disease. The dataset for evaluating this system is containing all kind of vegetable images which can be captured from camera .

Dr.sridhanthan C, Dr. M. Senthil kumar[12] In this proposed methodology plants disease infections are detected based on K-means clustering and GLCM (grey level co-occurrence matrix) techniques. It contains Image Acquisition in which images of leaves were captured. Then Image Pre-processing was done which improves the

quality of the image by removing undesired distortions. Image Segmentation is performed image is divided into sub images in this paper K-mean segmentation technique which uses hue estimation method for dividing and clustering the image. After that Feature Extraction part of an image is performed by (GLCM) Gray level co-occurrence matrix is one of the best methods for texture analysis.

Piyush Chaudhary, Anand K. Chaudhari ,Dr. A. N. Cheeran and Sharda Godara [13] In this research an algorithm is used to detect disease spot in plant leaf segmentation using image processing techniques . Automatic recognition and sorting of plant diseases is the first and significant phase. Disease spots are in different colour but not in intensity, in comparison with plant leaf colour. So, colour transform of RGB image can be used for better segmentation of disease spots. In this paper an assessment of the consequence of CIELAB, HSI and YCbCr colour space in the procedure of disease spot recognition is done. Median filters are used for image smoothing and threshold can be calculated by applying Otsu which is automatic image threshold method on colour component use to detect the disease spot.

J. G. A. Barbedo[14] A methodology presented in this paper is to distinguish and compute leaf symptoms by means of conventional colour digital images. The method was intended to be fully automatic which eliminates the possibility of human error and falling time taken to measure disease severity. The program is accomplished of dealing with images containing multiple leaves by further reducing the time taken. Accurate results are possible when the indications and leaf veins have alike colour and shade characteristics. The algorithm is subjected to one constraint that is the background must be as close to white or black as possible. Tests exhibited that the method providing accurate estimations over a wide variety of conditions.

H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. ALRahamnehWe [15] the suggested methodology is based on a software solution for automatic detection and classification of plant leaf diseases. The developed processing method consists of four main stages which includes as in the first step we recognize the mostly green coloured pixels. These pixels are disguised based on specific threshold values that are totaled using Otsu's method, then those typically green pixels are masked. The other add-on step is that the pixels with zeros red, green and blue values and the pixels on the borders of the disease-ridden cluster were completely removed. The tentative results validate that the proposed technique is a vigorous technique for the recognition of plant leaves diseases. The developed algorithm's usefulness can effectively distinguish and categorize the detected diseases with a correctness.

Below table -1 provides all the proposed methodology used in detection and recognition techniques used for the detection of plant diseases

S.No	Author	Proposed Work	Year
1.	Guan Wang, Yu Sun and Jianxin Wang	Automatic Image Based- Plant Disease Severity Estimation Using Deep Learning	2017
2.	Ashwin Dhakal, Prof. Dr.Subarna Shakya	“Image-Based Plant Disease Detection with Deep Learning”	2018
3.	TrimiNeha Tete, Sushma Kamlu	“Plant Disease Detection Using Different Algorithms”	2017
4.	Emma Harte	Plant Disease Detection Using CNN	2020
5.	Ke Lin, Liang Gong, Yixiang Huang, Chengliang Liuand Junsong Pan,	“Deep Learning-Based Segmentation and Quantification of Cucumber Powdery Mildew Using Convolutional Neural Network”	2019
6.	M. Akila, P. Deepan ,	“Detection And Classification of Plant Leaf Diseases by Using Deep Learning Algorithm”	2018
7.	S. Arivazhagan, R. Newlin Shebiah, S. Ananthi, S. Vishnu Varthini	“Detection Of Unhealthy Region of Plant Leaves and Classification of Plant Leaf Diseases Using Texture Features”	2013
8.	P. Revathi; M. Hemalatha,	“Classification Of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques”	2012
9.	ShoyebAhammadRafi,Toukir Hasan Chowdhury,Dewan Md. AnisurRahaman,Md. Washimul Bari, Meer ShadmanShafkatTanjim	“ Crop Condition Analyzer Robot With Image Processing Feedback To Assist Farmer”	2021
10.	Dr. Pankaj Mohindru, Gagandeep Kaur ,Dr. Pooja	“Stimulated Investigation for Plant Disease Using KNN Algorithm”	2019
11.	Mukesh Kumar Tripathi, Dhananjay D. Maktedar, “Recent machine learning based approaches for disease detection and classification of agricultural products	“Recent Machine Learning Based Approaches for Disease Detection And Classification Of Agricultural Products”	2016
12.	V Suresh , Mohana Krishnan , M Hemavarthini , K Jayanthan, D Gopinath	“Plant Disease Detection Using Image Processing”	2020

13	Piyush Chaudhary ,Anand K. Chaudhari, Dr. A. N. Cheeran ,Sharda Godara	Color Transform Based Approach for Disease Spot Detection on Plant Leaf	2012
14	J. G. A. Barbedo	“An Automatic Method to Detect and Measure Leaf Disease Symptoms Using Digital Image Processing <i>Plant Disease</i> ”	2014
15	H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. ALRahamneh,	“Fast And Accurate Detection and Classification of Plant Diseases”	2011

Table -1

III. CONCLUSION

Recognition and analysis of disease is the most significant tasks in image processing. So, this paper presents a survey on diverse method for plant leaf disease detection using image processing technique and also signifies an approach taken by researchers for recognition of plant leaf diseases which is shown above in Table 1. In this survey paper has briefly explained the numerous techniques used for the purpose of recognition and analysis. Among all these diverse techniques best techniques will be analysed who have the maximum benefits. But in spite of the maximum benefits every technique has certain limitations like variety of methods have been developed but there is still no general method or common system which is appropriate for recognition and analysis of any type of disease. To overcome the drawback of diverse techniques fusion of diverse techniques is a good idea. The study analyses and summarizes some methods have been used for plant disease detection.

IV. REFERENCES

1. Guan Wang, Yu Sun and Jianxin Wang, “Automatic image based- plant disease severity estimation using deep learning”, volume 2017 |Article ID 2917536 .
2. Ashwin Dhakal, Prof. Dr.Subarna Shakya “Image-Based Plant Disease Detection with Deep Learning”International Journal of Computer Trends and Technology (IJCTT)Volume 61 Number 1July 2018.
3. TrimiNeha Tete, Sushma Kamlu , “plant disease detection using different algorithms” Proceedings of the Second International Conference on Research in Intelligent and Computing in Engineering pp. 103–106 DOI: 10.15439/2017R24 ACSIS, Vol. 10 ISSN 2300-5963 RICE 2017.
4. Emma Harte, “Plant Disease Detection using CNN” Dublin, Ireland September 2020 DOI:10.13140/RG.2.2.36485.99048.



5. Ke Lin, Liang Gong, Yixiang Huang, Chengliang Liu and Junsong Pan, "Deep Learning-Based Segmentation and Quantification of Cucumber Powdery Mildew Using Convolutional Neural Network" *Front. Plant Sci.*, 15 February 2019 doi.org/10.3389/fpls.2019.00155.
6. M. Akila, P. Deepan, "Detection and Classification of Plant Leaf Diseases by using Deep Learning Algorithm" *IJERT Paper ID : IJERTCONV6IS07082 ISSN : 2278-0181. Volume & Issue: ICONNECT – 2018 (Volume 6 – Issue 07) .*
7. S. Arivazhagan, R. Newlin Shebiah, S. Ananthi, S. Vishnu Varthini "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features" *Vol. 15, No.1 211 Agric Eng Int: CIGR Journal March, 2013.*
8. P. Revathi; M. Hemalatha, "Classification of cotton leaf spot diseases using image processing edge detection techniques" *2012 International Conference on Emerging Trends in Science, Engineering and Technology (INCOSET). ISBN:978-1-4673-5141-6 ,IEEE Publication.*
9. Shoyeb Ahammad Rafi, Toukir Hasan Chowdhury, Dewan Md. Anisur Rahaman, Md. Washimul Bari, Meer Shadman Shafkat Tanjim "Crop Condition Analyzer Robot with Image Processing Feedback to Assist Farmer" *2021 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST) ISBN:978-1-6654-1577-4, IEEE Publication.*
10. Dr. Pankaj Mohindru, Gagandeep Kaur, Dr. Pooja "Stimulated investigation for plant disease using KNN Algorithm" *international journal of innovative research in electrical, electronics, instrumentation and control engineering IJIREICE, ISSN 2321-5526 Vol. 7, Issue 8, August 2019*
11. Mukesh Kumar Tripathi, Dhananjay D. Maktedar, "Recent machine learning based approaches for disease detection and classification of agricultural products" *2016 International Conference on Computing Communication Control and automation (ICCUBEA), ISBN:978-1-5090-3292-1.*
12. V Suresh, Mohana Krishnan, M Hemavarthini, K Jayanthan, D Gopinath "Plant Disease Detection using Image Processing" *IJERT Volume 09, Issue 03 (March 2020), ISSN : 2278-0181.*
13. Piyush Chaudhary, Anand K. Chaudhari, Dr. A. N. Cheeran, Sharda Godara "Color Transform Based Approach for Disease Spot Detection on Plant Leaf" *International Journal of Computer Science and Telecommunications [Volume 3, Issue 6, June 2012] .*
14. J. G. A. Barbedo, "An automatic method to detect and measure leaf disease symptoms using digital image processing" *Plant Disease* vol. 98, no. 12, pp. 1709–1716, 2014.
15. H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. ALRahamneh, "Fast and Accurate Detection and Classification of Plant Diseases", *International Journal of Computer Applications (0975 – 8887), Volume 17– No.1, March 2011*