IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Vol.-7, Issue-7, July 2019 E-ISSN: 2347-2693

Plant Disease Detection Methods using Image Processing

Pankaj Gumber[1*], Lal Chand[2]

Punjabi University, Patiala, Punjab, India

DOI: https://doi.org/10.26438/ijcse/v7i7.391395 | Available online at: www.ijcseonline.org

Accepted: 15/Jul/2019, Published: 31/Jul/2019

***Abstract* -**The image processing is the technique which can process the information stored in the form of pixels. The disease of the plants can be detected using the methods of image processing. The plant image has various types of noises which can affect accuracy of plant disease detection. In this work, various image de noising methods are reviewed and analyzed in terms of certain parameters

***Keywords*-** Plant disease detection, De noising, feature extraction

I. INTRODUCTION

An arrangement of elements in the form of a square or a matrix can be defined as an image. The process of the extraction of useful information from an image by its conversion in digital form is known as Image Processing. An algorithm in which both inputs and outputs are in the forms of images is considered under image processing. In this process, a computer is used for processing of 2D images. It can be defined as a form of signal in which the input is an image and the output is in the form of various characteristics of the image [1]. The images are treated as two dimensional by the image processing system and the application of sets of signal processing methods is done. It is one of the latest technologies and it is widely used in vast number of applications. The sub images contained in an image are known as regions-of-interest. This concept denotes that the basis of a region is the collection of objects contained in the images. The image processing techniques can be easily applied to the shortlisted areas in a system which is sophisticated in nature. Therefore there is a freedom of application of color rendition on one part and motion blur on any other part of the image. The primary requirement of image processing is the availability of images in digital form [2]. For the process of digitization a discrete grid is used for sampling the image and a finite number of bits are used for quantization of pixels. A computer is used for the process of digitization. The image is converted into an analog signal first and then it is scanned to a display. In today's modern era, agriculture has become one of the most important parts of the population. Energy is the fundament part of the global warming and major source of plants also. Number of diseases is there which badly affected ecological, economical and society losses. There are many methods for detection of the pathologies in plants. A quantity of diseases does not have any detectable symptoms associated and display very late. To conduct a precise analysis, there is a requirement of a powerful microscope in such cases. In other cases, the detections of signs can be done through electromagnetic spectrum which can easily detect the things which cannot be seen by human eyes [3]. The utilization of the techniques of remote sensing for capturing of multi and hyper spectral images is the most common approach. To achieve such goals, the techniques of image processing are applied. To make a decision about the severity of any disease, it can be analyzed by a naked human eye, but the results are usually not very precise and reliable. There has been a significant development of the use of image processing in agricultural field. The algorithms named as back propagation, PCA and SVD techniques are used for the implementation of automated systems for the recognition of fungi diseases in plants. If there is a presence of a disease which is not visible to a naked eye then it becomes really difficult to detect that disease. And when it becomes visible to the naked eye, it is too late for the treatment of the disease. In earlier days, microscope was used for the detection of diseases in plants but the observation of each and every leaf becomes practically impossible [4]. SO sensing the disease through remote sensing can be considered as a fast and reliable technique. For an earlier recognition of diseases through their symptoms, the technique of machine learning has proved itself to be very helpful. The digital images can be analyzed by the use of digital image processing for the detection of diseases by plant pathologists. The detection of leaf and fruit diseases in agriculture are being done by the use of processing's done by computers. In all these methods, a digital camera is used for the collection of digital images and then there is an application of the techniques of image processing on these images to get the desired results. There is a huge role of these techniques in assisting farmers for better crops in their agricultural lands. In visible spectrum, there is a generation of some or other kind of manifestation by most of the diseases. The naked eye of humans does at least the first guess about the disease in most of the cases. Recognition of

diseases is easier by trained raters. There are several classifiers used in this research study [5].

a. SVM: It can be defined as a classifier which is discriminative in nature in which was formally defined by a separating hyperplane. The full form of SVM is Support Vector Machine. Below mentioned are few important steps:

- Set up the training data: A set of 2D-points are used for the formation of the data set used for training. These sets may belong to one class or other. One point is consisted by one class and other three points are consisted by the other class.
- Set up SVM's parameters: A very simple case has been used for the introduction of the theory of SVMs, when there is a spreading of training sets in two linearly separable classes. There is a wide range of issues in which there can be a use of SVM for example problems with non-linearly separable data, a SVM using a kernel function to raise the dimensionality of the examples, etc. There is a requirement of defining of some very important parameters before the training of SVM is done. An object of class named as CvSVMParams is used for the storage of these parameters.
- Train the SVM: For building the SVM model the CvSVM::train method is called.
- Regions classified by the SVM: For the classification of an input sample which is using a trained SVM, CvSVM method is widely used. In this particular example, for the purpose of coloring the space according to the prediction of a SVM classifier, this method is being used. We can also say that there has been a traversing of an image as per the interpretation of its pixels by Cartesian plane. The coloring of each point is done as per its class predicted by SVM.
- Support vectors: Several methods have been used for attaining knowledge about support vectors. The total number of support vectors which were used in a problem can be calculated by the use of CvSVM::get vector. Training examples have been classified by using the above mentioned technique.

b. Bayesian classifier: Possibility of the prediction of the values by a part of natural class is the factor on which A Bayesian classifier highly depends. As the classes have normal values therefore an assembling of illustrations are done in classes. "Natural Sorts" is the term which is used for such kind of classes. A discrete class which is does not matter to binary course is compared with the target feature [6]. The thought which exists behind Bayesian classifier is that the prediction of the values of alternate features can be done by an agent if it knows the type of class. In the condition of the agent not knowing the class, the utilization of Baye's rule can be done for the prediction of given class. The manufacturing of a probabilistic model is done by the agent in Bayesian classifier. In other cases this model is used for the prediction of classification. Probabilistic model is used for the deduction of classification in this sort of classifier.

c. Decision Tree: It is a kind of classifier which is very simple in nature and its implementation is also very simple. It is a very general method used in the process of data mining. The motive is the creation of a model which can do the prediction of the target values on the basis of the values which are used as an input. There is a relation between each node and the input variable, every input value has some sort of conceivable values. Each leaf does the representation of the value of any particular target by speaking to the route from root to the leaf. The classifying cases are represented in a simple format by the use of a decision tree. There is a presence of finite domains of discrete nature in the larger parts of the segment. Class is the term which is used to represent each element of the domain. An input feature is used for the marking of each and every node in a decision tree. The conceivable values of various features are used to mark the circular segments which start from a node. Class is used to make a mark of each leaf of the tree. In a decision tree, domain knowledge or settings of parameter are not at all required. The results generated by it are simple and their interpretation can be done in an easy manner. Decision trees also provide an access to the features like nitty gritty patients.

d. Naïve Bayes: A classifier in which there is no acceptance of any kind of dependency between attributes is considered as Naïve Bayes. Conditional independence is the factor which is utilized during the calculations of this classifier. It simply means that there is no dependency of the attribute value of a given class on the values of attributes of other classes. There is no need of the utilization of Bayesian method while Naïve Bayes classification method is being used [7].

e. k-Nearest Neighbor: It is a very simple kind of classifier which is based on the concept of the identification of the nearest neighbor by query examples and then by using those neighbors the class of the query is determined. In this type of classification, minimum distance between the given point and other points is used as the basis to determine that a given point belongs to which class. Because of its non-robustness to noisy data, this classifier cannot be used for the classification of data which is large in numbers [8]. The calculation of Euclidean distance is done between test and training samples in case of classification of leaves in plants. There is a sample which has been produced on the basis of the highest number of votes from K neighbors. K can be considered as a positive integer which is small in value. In the case of the value of K=1. Then the assignment of the sample is done to its nearest neighbor. To avoid tied nodes, K can be chosen as an odd number.

II. LITERATURE REVIEW

K. Seeliger, et.al (2017) presented a study in which a deep CNN is applied for predicting the MEG source activity across visual system through stimulus representations in time as well as space [8]. It is seen through the performance of encoding in which a function is taken as the number of repetitions that for most of the participants, the 10 repetitions are nearer to the performance plateau. It is seen that for highly advanced decoding approaches, the source-space encoding approach applied on MEG data provides better results.

Edna Chebet Too, et.al (2018) performed evaluations and fine-tuning to propose a deep CNN through which the classification of image-based plant diseases can be done [9]. Thus, to identify the plants image-based disease, a good architecture proposed here is named as DenseNets. However, there is a need to enhance computational time in future research even though it provides better performance results.

Ye Xu, et.al (2018) proposed a novel CNN through which the complex network topology adjacent matrix can be reformatted within an image [10]. In order to extract the relevant features and classify them, a CNN of around 10 years that include several components is designed here. The target features can be extracted and around 95% of accuracy can be achieved in feature classification as per the experimental results achieved by applying the proposed CNN model.

Konstantinos P. Ferentinos, (2018) proposed novel CNN approach that included deep learning methodologies through which the plant diseases can be identified and diagnosed using images of leaves which are healthy and diseased [11]. With around 99% of success ratio in recognizing the relevant combinations, the various model architectures were trained using the proposed approach. Thus, a very useful advisory is created by applying the significant high success rate of model.

Xiaolong Zhu, et.al (2018) proposed an enhanced deep convolutional neural network through which the benefits of Inception V2 were considered along with BN [12]. Thus, within the region proposal networks, multi-scale image features were provided by this approach. Thus, the leaf species within complex backgrounds are identified at a better accuracy level by the proposed approach in comparison to other traditional approaches.

Soniya, et.al (2015) presented an overview in which various deep learning techniques were studied. More realistic issues are handled by highlighting few limitations that restrict the performance of deep neural networks [13]. This research also provides an investigation of various hybrid deep neural network models. This research can be extended further for studying the integration of fuzzy logic within the deep neural network models which is also important.

Jayme Garcia, et.al (2016) analyzed every challenge being faced in plant disease detection technologies and focused on the issues being caused and the manner in which they will affect the approaches [14]. Further, the researchers presented few possible solutions through which few of the challenges could be overcome at minimal cost and the development of novel enhancements can be done. Therefore, image analysis tools will be designed here which will be more powerful and accurate as per the simulation results achieved.

Weibo Liu, et.al (2016) presented a study of four deep learning designs in this paper. A survey of various types of deep neural networks was presented here along with the summarizations of latest progresses [15]. The major focus here is to study the application of deep learning approach on few selected regions. There is huge attention given to the deep neural networks with huge growth in hardware resources and computation techniques. The future research will focus on providing broader applications related to this technology.

Federico Martinelli, et.al (2014) presented a study of modern techniques that are based on analysis of nucleic acid and protein [16]. Even through the disease diagnosis can be confirmed through serological and PCR-based techniques, very efficient results can be provided by volatile and biophotonic sensors and at asymptomatic stages, the infections can be identified here. The diagnostic results can be spatialized on large scale through the remote sensing techniques. For providing more sustainable and safe agriculture by eliminating the use of any pesticides, unprecedented tools are provided through these innovative techniques.

Jayme Garcia, et.al (2014) proposed a method that utilizes conventional color digital images through which the leaf symptoms are detected and quantified [17]. The automatic method was designed; the chances of human error were eliminated and time to calculate disease severity is minimized by the proposed method. Over various scenarios, accurate estimations were shown through the test results achieved after performing tests.

Table 1. Comparison

Authors Names	Year	Description	Outcomes
K. Seeliger, M. Fritsche, U. Guclu, S.	2017	A study was presented in which a deep CNN is applied for predicting the MEG source	It is seen that for highly advanced decoding approaches, the source-space

Schoenmakers, J.-M. Schoffelen, S. E. Bosch, M. A. J. van Gerven		activity across visual system through stimulus representations in time as well as space.	encoding approach applied on MEG data provides better results.
Edna Chebet Too, Li Yujian, Sam Njuki, Liu Yingchun	2018	Evaluations and fine-tuning to propose a deep CNN were done through which the classification of image-based plant diseases can be done.	To identify the plants image-based disease, a good architecture was proposed here is named as DenseNets.
Ye Xu, Yun Chi, Ye Tian	2018	A novel CNN was proposed through which the complex network topology adjacent matrix can be reformatted within an image.	The target features can be extracted and around 95% of accuracy can be achieved in feature classification as per the experimental results achieved by applying the proposed CNN model.
Konstantinos P. Ferentinos	2018	Novel CNN approach was proposed that included deep learning methodologies through which the plant diseases can be identified and diagnosed using images of leaves which are healthy and diseased.	With around 99% of success ratio in recognizing the relevant combinations, the various model architectures were trained using the proposed approach.
Xiaolong Zhu, Meng Zhu, Honge Ren	2018	An enhanced deep convolutional neural network was proposed through which the benefits of Inception V2 were considered along with BN.	The leaf species within complex backgrounds are identified at a better accuracy level by the proposed approach in comparison to other traditional approaches.
Soniya, Sandeep Paul, Lotika Singh	2015	An overview was presented in which various deep learning techniques were studied. More realistic issues are handled by highlighting few limitations that restrict the performance of deep neural networks.	This research also provided an investigation of various hybrid deep neural network models.
Jayme Garcia, Arnal Barbedo	2016	Every challenge being faced in plant disease detection technologies was discussed and focused on the issues being caused and the manner in which they will affect the approaches.	The researchers presented few possible solutions through which few of the challenges could be overcome at minimal cost and the development of novel enhancements can be done.
Weibo Liu, Zidong Wang, Xiaohui Liu, Nianyin Zeng, Yurong Liu, and Fuad E. Alsaadi	2016	A survey of various types of deep neural networks was presented here along with the summarizations of latest progresses.	There was huge attention given to the deep neural networks with huge growth in hardware resources and computation techniques.
Federico Martinelli, Riccardo Scalenghe, Salvatore Davino, Stefano Panno, Giuseppe Scuderi, Paolo Ruisi, Paolo Villa, Daniela Stroppiana, Mirco Boschetti, Luiz R. Goulart	2014	A study of modern techniques that are based on analysis of nucleic acid and protein was presented.	For providing more sustainable and safe agriculture by eliminating the use of any pesticides, unprecedented tools are provided through these innovative techniques.
Jayme Garcia, Arnal Barbedo	2014	A method was proposed that utilized conventional color digital images through which the leaf symptoms were detected and quantified.	Over various scenarios, accurate estimations were shown through the test results achieved after performing tests.

III. CONCLUSION

In this work, it is concluded that plant disease detection is the approach which is applied to detect disease from the plants. The various feature extraction methods are applied to detect features of the plant images. In this paper, various denoising methods of plants are reviewed and analyzed in terms of certain parameters. In future hog transformation method will be designed for the plant disease detection.

REFERENCES

[1] Jayamala K. Patil and Raj Kumar, " Advance in image Processing for detection of plant disease", Journal of Advanced

Bioinformatics Applications and Research ISSN 0976-2604 Vol 2, Issue 2, June-2011, pp 135-141
[2] Laxman Poudal , Bhola Thapa, Bim "Application of Digital Image Processing for Shape Characterization of Sand Particles", 2011
[3] Jie Zhao, Xu Zhao and Yuncai Liu, "A Method for Detection and Classification of Glass Defects in Low Resolution Images," Sixth International Conference on Image and Graphics, 2011, pp.642-647.
[4] Luo Juan & Oubong Gwun," A Comparison of SIFT, PCA-SIFT and SURF, International Journal of Image Processing (IJIP) Volume(3), Issue(4),2009,pp. 143-152
[5] F. Adamo, F. Attivissimo, A. Di Nisio, M. Savino, An Automated visual inspection system for the glass industry,In: Proc. of 16th IMEKO TC4 Symposium, Florence, Italy, Sept. 22–24, 2008.
[6] Krystian Mikolajczyk and Cordelia Schmid," A performance evaluation of local descriptors", Pattern Analysis and Machine Intelligence, IEEE Transactions on Pattern Analysis and Machine Intelligence ,Volume 27 , Issue 10 ,2005, pp 1615 – 1630.
[7] Yan K, Rahul Sukthankar, "pca-sift: a more distinctive representation for local image descriptors" Computer Vision and Pattern Recognition, 2004, CVPR 2004.,Proceedings of the 2004, IEEE Computer Society Conference on ,2004 pp.506-513.
[8] K. Seeliger, M. Fritsche, U. Guclu, S. Schoenmakers, J.-M. Schoffelen, S. E. Bosch, M. A. J. van Gerven, "Convolutional Neural Network-based Encoding and Decoding of Visual Object Recognition in Space and Time", 2017, ScienceDirect
[9] Edna Chebet Too, Li Yujian, Sam Njuki, Liu Yingchun, "A comparative study of fine-tuning deep learning models for plant disease identification", 2018, Computers and Electronics in Agriculture
[10] Ye Xu, Yun Chi, Ye Tian, "Deep Convolutional Neural Networks for Feature Extraction of Images Generated from Complex Networks Topologies", Springer Science+Business Media, LLC, part of Springer Nature 2018
[11] Konstantinos P. Ferentinos, "Deep learning models for plant disease detection and diagnosis", Computers and Electronics in Agriculture 145 (2018) 311–318
[12] Xiaolong Zhu, Meng Zhu, Honge Ren, "Method of plant leaf recognition based on improved deep convolutional neural network", Cognitive Systems Research 52 (2018) 223–233
[13] Soniya, Sandeep Paul, Lotika Singh, "A Review on Advances in Deep Learning", 2015, IEEE
[14] Jayme Garcia, Arnal Barbedo, "A review on the main challenges in automatic plant disease identification based on visible range images", 2016, Biosystem Engineering 144, 52-60
[15] Weibo Liu, Zidong Wang, Xiaohui Liu, Nianyin Zeng, Yurong Liu, and Fuad E. Alsaadi, "A Survey of Deep Neural Network Architectures and Their Applications", 2016, Neurocomputing; ScienceDirect Publications
[16] Federico Martinelli, Riccardo Scalenghe, Salvatore Davino, Stefano Panno, Giuseppe Scuderi, Paolo Ruisi, Paolo Villa, Daniela Stroppiana, Mirco Boschetti, Luiz R. Goulart, "Advanced methods of plant disease detection. A review", Springer, 2014
[17] Jayme Garcia, Arnal Barbedo, "An Automatic Method to Detect and Measure Leaf Disease Symptoms Using Digital Image Processing", 2014 The American Phytopathological Society

