International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

A REVIEW ON IDENTIFICATION AND DISEASE DETECTION IN PLANTS USING MACHINE LEARNING TECHNIQUES

Anjali Devi A J[1], Janisha A[2]

[1]*M.TECH Scholar, Department of CSE, LBS Institute of Technology for Women, TVM, Kerala, India*
[2]*Assistant Professor, Department of CSE, LBS Institute of Technology for Women, TVM, Kerala, India*

Abstract - *In India, Agriculture plays an essential role because of the fast growth of population and increased demand for food. It has also an important role in the Indian economy. More than 70 percent of the rural people depends on agriculture for their income and food. Plant had a vital role in human life. For food, medicinal uses etc., plants are very important. A healthy plant perform photosynthesis which help human beings in different ways such as reducing the amount of carbon dioxide in the atmosphere, preparing and storing food for living organisms, reduce global warming which indirectly reduce the melting of ice caps in polar regions and so. Saving the plants from deforestation should not be our only objective. They also have to prevent the diseases occurring in plant by identifying and detecting the diseases in plants. There are so many diseases in plants which affects plants adversely. If these diseases are identified at correct time the plants can be saved with proper care and precautions.*

***Key Words*: Artificial Neural Network, Support Vector Machine, Machine learning.**

1. INTRODUCTION

Detecting and identifying the diseases in plants by visual way is more tedious task. Also, this method is less accurate and have many limitations. Instead of this if disease is detected by automatic techniques it will take less time, effort and also more accuracy can be achieved. Identification and disease detection are very necessary and there are many techniques available for the same. Diseases in rice, apple, potato, cucumber, grape, etc. are already identified and detected using machine learning techniques. Rice bacterial late blight disease, rice sheath blight and rice blast are some of the diseases in rice plant leaves. Potato late blight disease from crop images also been identified. FCM clustering, KNN Classifier, Minimum distance classifier, Back propagation, Artificial Neural network, Multi Vector Support Machine, FRVM- Accuracy, FRVM- Sensitivity, FRVM- Specificity, Faster- RCNN etc are the techniques already employed in the identification and disease detection of plant leaves. There are different types of diseases in plants. They are mainly classified into three:- Fungal Diseases, Bacterial diseases and Viral Diseases. Mottle is a viral plant disease. Spot, Bacterial Blight, Wilt, Rot etc are the main bacterial diseases whereas blight, rust, rot, mold, spot, wilt, mildew, cankers etc are some of the fungal diseases. The different stages of identification and disease detection in plant leaves is given in figure 1. The various stages are input of images, processing of the images, segmentation, and extraction of features from the images, classification of the images and finally the identification of diseases. The input images consist of both healthy and unhealthy images of plant leaves. Pre-processing techniques are applied on it. Then it is segmented and the features like shape, texture, colour variation, affected regions etc are extracted. These images are classified whether disease affected or not and then the disease is identified.

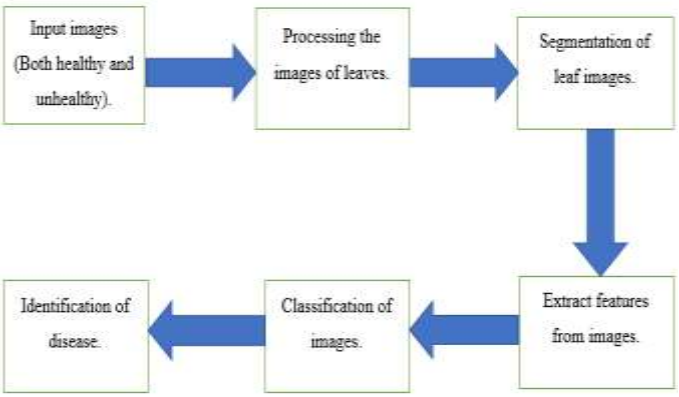

Figure 1: Stages of identification and disease detection.

2. LITERATURE SURVEY

Sandhika Biswa et al [1], uses FCM clustering and neural network which identifies the late blight disease in potato. The images of potato leaf is captured under uncontrolled environment. It's is a very robust technique to identify blight disease in potato. But here the segmentation is found to be difficult. Fuzzy C-means(FCM) is an iterative algorithm which find the cluster centers. These centre's minimise a dissimilarity functions and handle the overlapped data precision. It provide more accurate result in cases where data is incomplete or uncertain. In this method computation time is longer and it is sensitivity to noise. Fuzzy C-means clustering Neural Network consists of unsupervised fuzzy clustering and supervised artificial neural networks which help in achieving more optimal results with relatively few data sets. The algorithm consists of mainly two steps: (a) Fuzzy c-mean clustering to separate the disease affected area along with background (b) to extract affected leaf area from background using neural network. This model has a very good accuracy.

A.A. Joshi et al [2] uses KNN classifier and Minimum Distance Classifiers. Simple implementation is the advantage of this method. This method learns complex models easily. But it has high computational complexity. K Nearest Neighbour is used for statistical estimation and pattern recognition. It is an easy, simple and flexible classification method. KNN is robust to noisy training data but computation cost is higher. The colour, zone wise shape features etc are extracted in feature extraction process. This is used as the input for further classification. For each disease, a separate database has been used for training and testing. Proposed techniques have been tested for four mentioned rice diseases using two classifiers, k-NN and MDC and the accuracy achieved with two classifiers is 87.02%, 89.23% respectively. While comparing with the previous techniques, it is found that the proposed technique is 475 superiors in terms of time complexity, accuracy, number of diseases covered. Color and shape features are extracted in this work. In addition to this, texture feature can be included and can be checked for the impact of this extra feature on the performance of an algorithm. There are other rice diseases except four covered in this work. Future work can be to cover other rice diseases. The same techniques can be applied to other crops with little modifications.

John William Orillo et al[3], is using Back Propagation and Artificial Neural Network techniques their paper. In this paper color-based characterization of leaf can be extracted properly. Also, high computations also can be done by this technique. High computational cost is a drawback. Artificial Neural Network uses forward propagation which is the heart of a neural network. Probabilistic Neural Network is a feed forward algorithm which is very faster and more accurate. In this study, the images of rice leave using fundamental techniques in image pr MATLAB. The color characteristics of properly extracted and computed before it neural network. The field experiments w IRRI, Los Baños, Philippines supervised Buresh. The system was able to overcome perception, and provided an accuracy additional remark was given to the system analysis of 3.5 equivalent rate in LCC, which be a challenge in manual visual inspection program implemented specific enhancement will help for future application.

Pooja Pawar et al[4] uses Artificial Neural Network technique. It works well for more than one crop of different types. But feature selection is difficult. Study involves collecting leaf samples of cucumber crop diseases. Work is carried out to diagnose cucumber crop disease and to provide treatment for the detected crop disease. Downy mildew and powdery mildew are the two diseases in cucumber which are discussed in this work. The first order statistical moments and GLCM are used here to extract texture features from the dataset. Classification is carried out by using neural network toolbox of MATLAB 7.10.1. System provides classification accuracy of 80.45%. The proposed work can be applicable for more than one crop of different types. But in case of other crop type, system has to extract features only that can classify their crop diseases accurately. In future, classification accuracy can be increased by using additional texture features. In this model Gabor filter can also be used for the extraction of texture feature.

Harshal Waghmare. et al[5] uses Multi Vector Support Machine in the paper Detection and Classification of Diseases of Grape Plant Using Opposite Colour Local Binary Pattern Feature and Machine Learning for Automated Decision Support System. It performs accurate classification. But accuracy improves only when the testing and training ratio increases. The disease in grape plant is classified using Multiclass SVM in this paper. In this paper a single leaf is given as input for performing segmentation and analyses it. Analysis is done through high pass filter. By this the diseases part of leaf is detected. The segmented leaf texture is retrieved using fractal based texture feature which are locally invariant in nature and therefore provides a good texture module. The extracted texture pattern is then classified to train Multiclass SVM classifiers into healthy or diseased classes respectively. In this paper major disease commonly observed in Grapes plant such as Downy Mildew, Powdery Mildew, Black rot, etc. are taken into consideration to carry out the experiment. Experimental results shows that integration of image processing techniques with DSS using multiclass SVM gives accuracy up to 96.66% for grape plant disease classification. The accuracy of the system can be further improved by improving the training ratio. The purpose of this work is to provide an automated Decision Support System (DSS) to perform classification between healthy and diseased leaf efficiently as well easily available for Farmers.

Balasubramanian Vijaya Lakshmi.et al [6] uses FRVM-Accuracy, FRVM- Sensitivity, FRVM- Specificity methods in Kernel based PSO and FRVM: An automatic plant leaf type detection using texture, shape and colour features. It produce better accuracy, not sensitive to noise. It reduces time complexity and there is no limitation in speed and size. But the segmentation is a challenging task. Leaves with like shape and size are tough to classify. Difficulty to classify leaves with complicated backgrounds.The main aim of the proposed classification technique is to classify the type of leaf. There are several issues during this research work, which is listed as below: (i) The leaves with the formal structure and similar shapes are difficult to classify. (ii) If the leaves are affected by shadow or any disease, which change the color of the leaf is difficult to classify the type of leaf. The leaf with complicated backgrounds is difficult to identify. The proposed system can extend to classify the disease of the plant leaf. It can be done by determining the effects of adding multiple leaf features and also extend the proposed work to classify the medicinal leaf images, which is used in the Ayurvedic medicines for curing the human diseases.

Dheeb Al Bashish. et al[7] worked in the Detection and Classification of Plant Leaf Diseases by using Deep Learning Algorithm. Protection of crop in organic compounds is a

complex matter. In this system specialized deep learning models were developed, based on specific convolutional neural networks architectures, for the detection of plant diseases through leaves images of healthy or diseased plants. Faster R-CNN is used here for object recognition and its Region Proposal Network. The Object detection system called Faster R-CNN has two modules in it. In this model the first module is a deep fully connected convolutional neural network. This CNN proposes regions. For training purpose, the system considers anchors containing an object or not, based on the Intersection-over-Union (IoU) between the object proposals and the ground-truth. Then the second module is the Fast R-CNN detector that uses the proposed regions. Box proposals method is used in this model to crop the features. Also, same intermediate feature map which are subsequently fed to the remainder of the feature extractor. This is done in order to predict a class and class-specific box refinement for each proposal. Using a single unified network, the entire process is taking place in this model. This model allows the system to share full-image convolutional features with the detection network, thus enabling nearly cost-free region proposals.

Kaur et al[8] developed a framework for the detection and classification of plant leaf and stem diseases. Neural network is used here. This method is very accurate and very effective in leaf disease recognition, also it reduce the computational complexity. But it eliminates the intensity texture features. For leaf and steam detection an image-processing based approach is done here. Here five diseases affected on plants are tested. They are: Early scorch, Cottony mold, ashen mold, late scorch, tiny whiteness. The proposed approach is image-processing-based. In this model initially, the images in dataset are segmented using the K-Means technique, in the second step the segmented images are passed through a pre-trained neural network. The set of leaf images taken from Al-Ghor area in Jordan is used in this model. This model significantly support accurate and automatic detection of leaf diseases.

Robert G. de Luna.et al[9] done identification of Philippine herbal medicine plant leaf using artificial neural network. It has better accuracy and simple implementation. But the computational time is too big. It mainly focus on the medicinal herbal plant in Philippine only. Diseases in herbal leaves like akapulko, amplaya etc. Artificial Neural Network technique is used in this paper.

Bin Liu et al [10] done identification of apple leaf diseases based on deep convolutional neural networks. Accuracy, robustness are the advantages of this paper along with the prevention of over fitting and high feature extraction capability. The difficulty in identifying structure of the model is a big issue. This paper has proposed a novel deep convolutional neural network model to accurately identify apple leaf diseases, which can automatically discover the discriminative features of leaf diseases and enable an end-to-end learning pipeline with high accuracy. A total of 13,689 images were generated by image processing technologies. The results are satisfactory, and this proposed model can obtain a recognition accuracy of 97.62%. This rate is higher than the recognition abilities of other models. The proposed model reduces the number of parameters greatly, has a faster convergence rate as compared to the standard AlexNet model. Accurate identification of the four common types of apple leaf diseases can be identified using this CNN model. This model has a high accuracy, and provides a feasible solution for identification and recognition of apple leaf diseases. In addition, due to the restriction of biological growth laws and the current season in which the apple leaves have fallen, other diseases of apple leaves are difficult to collect. In future work, for the sake of detecting apple leaf diseases in real time, other deep neural network models, such as Faster RCNN (Regions with Convolutional Neural Network), YOLO (You Only Look Once), and SSD (Single Shot MultiBox Detector), are planned to be applied. Furthermore, more types of apple leaf diseases and thousands of high-quality natural images of apple leaf diseases still need to be gathered in the plantation in order to identify more diseases in a timely and accurate manner.

Santanu Phadikar et al [11] identified rice diseases using pattern recognition techniques. Self- Organizing Map (SOM) technique is employed which has simple and computational efficiency. But the image transformation in frequency domain does not offer better classification . It mainly focuses on rice disease identification using pattern recognition . In the paper, train images are obtained by extracting features of the infected parts of the leave. Here four different types of images are applied for testing purposes. Using simple computationally efficient techniques this model extracts features.

K. Renugambal et.al [12] uses application of image processing technique in plant disease recognition. ANN, Linear SVM, Non-Linear SVM are the main techniques used in this model. There is a large difficulty in identifying the structure of the model. Also, the accuracy is comparatively low. This model supports the farmers during their daily struggles against disease outbreaks occurring in sugarcane plants. Digital images of sugarcane plants having symptoms of a particular disease are used in this model. Using K means algorithm these diseased regions were identified and segmented. The input to this model is the GLCM features extracted from each segmented region. Initially texture measurement is taken and used as the discriminator. Then to identify the visual symptoms of plant disease SVM machine learning techniques are used and this may have a particular application for crop produces in cultivation field. In future, this work will focus on developing fuzzy optimization algorithms in order to increase the recognition rate of the classification process.

H. Al-Hiary et al [13] has done fast and accurate detection and classification of plant diseases. Neural Network is the technology used here. This paper provides accuracy with Less computational effort. But dependent on certain features

of the leaf, which is a limitation. In this paper, respectively, the applications of K-means clustering and Neural Networks (NNs) have been formulated for clustering and classification of diseases that effect on plant leaves. Recognizing the disease is mainly the purpose of the proposed approach.

Sun Liu et al [14] done deep learning for plant identification in natural environment. Deep learning is the model used in this paper. It is a fast, robust, and simple to implement. But it has less scalability. This model uses dataset containing 10,000 images of 100 plant species. This model uses ResNet26 which results in 91.78% accuracy in test set. In future work, the database can be expanded by more plant species at different phases of life cycle and number of annotations also can be increased. The deep learning model will be extended from classification task to yield prediction, insect detection, disease segmentation, and so on.

Santanu Phadikar et al [15] has done morphological feature-based maturity level identification of Kalmegh and Tulsi leaves. Back Propagation Multi-Layer Perceptron Neural Network is the method employed in this paper. This model classifies medical plants like Kalmegh and Tulsi based on their morphological features. Dithering present at the edges makes the task tougher. In this work, the application of computer vision in classifying Kalmegh and Tulsi, two important and familiar medicinal plants on the basis of their morphological features is accomplished. The classification has been represented in the separate maturity clusters along with the respective distinct cluster centres. The class separability measure has been carried out to show the separation of classes among different maturity classes in explicit way. The classification was also performed later by using the BPMLP neural network classifier trained up with training features and tested with selected set of features. The work can be extended to other different types of medicinal plant leaves with more robust and good number of morphological features and classifiers, optimization of features in more improved classification and other interesting avenues.

Table -1: Comparison of performance, method and crops.

First Author, Year	Classification Algorithm	Crop	Accuracy
Sandhika Biswa, 2104	FCM Clustering and neural network	Potato	93%
A.A. Joshi, 2016	KNN classifier Minimum Distance Classifier	Rice	87.02%-89.23%
John William Orillo, 2013	Back Propagation ANN	Rice	93.33%
Pooja Pawar, 2016	ANN	Cucumber	80.45%
Harshal Waghmare	Multi class SVM	Grape	96.6%
Balasubramanian Vijaya Lakshmi, 2016	FRVM-Accuracy FRVM-Sensitivity FRVM-Specificity	Gingkgo, Paper Mulberry, Mono Maple	99.87%-99.9%
Dheeb Al Bashish, 2011	Neural Network	Cotton	93%
Kaur, 2016	SVM with Ant Colony Optimization	Cotton	96.77% to 98.42%
Robert D Luna, 2017	ANN	Akapulko, Amplaya	98.61%
Bin Liu, 2017	Deep CNN	Apple	97.62%
Santanu Phadikar, 2008	SOM	Rice	
K Renugambal, 2017	ANN, Linear SVM, Non-Linear SVM	Sugarcane	
H Al- Hiary, 2011		Cotton	83%-94%
Sun, 2015	Deep Learning Model	Apple	91.78%
Santanu Phadikar, 2008	Back Propagation Multi-Layer Perceptron Neural Network	Kalmega, Tulsi	92%

3. CONCLUSIONS

This paper deals with the survey of some of the disease identification and classification techniques used for plant disease detection. The above discussed papers focus on the identification and disease detection in plants such as rice, potato, apple, tulsi, grape, cucumber, etc. The main disease like late blight, bacterial blight, black rot, downey mildew, rice sheath rot, mosaic, rust, brown spot, Alternaria leaf spot etc are identified in theses analysis works.

FCM clustering and neural network, KNN Classifier Minimum Distance Classifier, Back Propagation ANN, Artificial Neural Network, Multi class Support Vector Machine, FRVM– Accuracy, FRVM– Sensitivity, FRVM– Specificity, Neural Network, Support Vector Machine with Ant Colony Optimization, Back Propagation Multi-Layer Perceptron Neural Network, Deep Convolution Neural Network, Linear SVM, Non Linear SVM, Self-Organizing Maps(SOM) are the methods employed in these papers.

REFERENCES

[1] Sandika Biswas, Bhushan Jagyasi, Bir Pal Singhy and Mehi Lal, "Severity Identification of Potato Late Blight Disease from Crop Images Captured under Uncontrolled Environment," IEEE Canada International Humanitarian Technology Conference - (IHTC), 2014.

[2] A. A. Joshi and B. D. Jadhav, "Monitoring and Controlling Rice Diseases Using Image Processing Techniques," 2016 International Conference on Computing, Analytics and Security Trends (CAST) College of Engineering Pune, Dec 2016.

[3] John William Orillo, Gideon Joseph Emperador, Mark Geocel Gasgonia, Marifel Parpan, and Jessica Yang, "Rice plant nitrogen level assessment through image processing using artificial neural network," IEEE International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), pp. 1-6. 2014.

[4] Pooja Pawar, Varsha Turkar, and Pravin Patil, "Cucumber disease detection using artificial neural network," IEEE International Conference on Inventive Computation Technologies (ICICT), vol. 3, pp. 1-5, 2016.

[5] Harshal Waghmare, Radha Kokare and Yogesh Dandawate, "Detection and Classification of Diseases of Grape Plant Using Opposite Colour Local Binary Pattern Feature and Machine Learning for Automated Decision Support System," 3rd International Conference on Signal Processing and Integrated Networks (SPIN), 2016.

[6] Balasubramanian Vijayalakshmi and Vasudev Mohan, "Kernel based PSO and FRVM: An automatic plant leaf type detection using texture, shape and colour features," Computer and Electronics in Agriculture, vol. 125, pp. 99-112, 2016.

[7] Kaur, Iqbaldeep, Gifty Aggarwal, and Amit Verma, "Detection and Classification of Disease Affected Region of Plant Leaves using Image Processing Technique," Indian Journal of Science and Technology, vol. 9, no. 48, 2016.

[8] Dheeb Al Bashish, Malik Braik, and Sulieman Bani-Ahmad, "A Framework for Detection and Classification of Plant Leaf and Stem Diseases, "International Conference on Signal and Image Processing", 2010.

[9] Robert G. de Luna, Renann G. Baldovino, E. A. Cotoco, Anton Louise P. de Ocampo, C. Ira,Valenzuela, A. B. Culaba, and E. P. Dadios Gokongwei, "Identification of philippine herbal medicine plant leaf using artificial neural network," 9th IEEE International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), pp. 1-8, 2017.

[10] Bin Liu, Yun Zhang, Dong Jian He and Yuxiang Li, "Identification of Apple Leaf Diseases Based on Deep Convolutional Neural Networks," Symmetry, vol. 10, no. 11, 2017.

[11] Santanu Phadikar and Jaya Sil, "Rice disease identification using pattern recognition techniques," 11th IEEE International Conference on Computer and Information Technology, pp. 420-423, 2008.

[12] K. Renugambal and B. Senthilraja, "Application of image processing technique in plant disease recognition," International journal of engineering research and technology, vol. 4, no. 03, Mar. 2015.

[13] H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik, and Z. ALRahamneh, "Fast and accurate detection and classification of plant diseases," Machine learning, vol. 14, no. 5, 2011.

[14] Sun, Yu, Yuan Liu, Guan Wang, and Haiyan Zhang, "Deep learning for plant identification in natural environment," Computational intelligence and neuroscience, vol. 2017, 2017.

[15] Mukherjee, Gunjan, Arpitam Chatterjee and Bipan Tudu, "Morphological feature based maturity level identification of Kalmegh and Tulsi leaves," Third IEEE International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), pp. 1-5, 2017.

BIOGRAPHIES

Anjali Devi A J
Doing M. Tech in Computer Science and Engineering at L.B.S Institute of Technology for Women Trivandrum, Kerala.

Janisha A,
Assistant Professor in the department of computer science and engineering, LBSITW Kerala.