Identification And Classification Of Plant Leaf Diseases Using Neural Networks

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Abstract - Plants are really important for the planet and for all living organisms. Plants maintain the atmosphere. Plant disease, an impairment of the normal state of a plant that interrupts or modifies its vital functions. All species of plants, wild and cultivated alike, are subject to disease. These diseases occur primarily on leaves, but some may also occur on stems and fruits. Leaf diseases are the most common diseases of most plants. Plant pathology is the scientific study of diseases in plants caused by pathogens and environmental conditions. Organisms that cause infectious disease include fungi, oomycetes, bacteria, viruses, viroids.etc The existing method encompasses automatic segmentation of diseases from plant leaf images using soft computing approach named as Bacterial Foraging Optimization Based Radial Basis Function Neural Nework. In this paper, In order to increase the speed and accuracy of the network to identify and classify the regions infected of different diseases on the plant leaves classic neural networks algorithms are used. The region growing algorithm increases the efficiency of the network by searching and grouping of seed points having common attributes for feature extraction process. The proposed method attains higher accuracy in identification and classification of diseases.

1. INTRODUCTION

Soft computing became a formal area of study in computer science in the early 1990s. Earlier computational approaches could model and precisely analyze only relatively simple systems. More complex systems arising in biology, medicine, the humanities, management sciences, and similar fields often remained intractable to conventional mathematical and analytical methods. However, it should be pointed out that complexity of systems is relative and that many conventional mathematical models have been very productive in spite of their complexity.

Soft computing deals with imprecision, uncertainty, partial truth and approximation to achieve computability, robustness and low solution cost. As such it forms the basis of a considerable amount of machine learning techniques. Recent trends tend to involve evolutionary and swarm intelligence based algorithms and bio-inspired computation. Soft computing have the ability to deal with uncertainty has been most widely used for image segmentation nowadays. In effect, the role model for soft computing is the human mind. Soft computing is based on techniques such as fuzzy logic, genetic algorithms, artificial neural networks, machine learning and expert systems. Machine learning is a field of artificial intelligence that uses statistical techniques to give computer systems the ability to" learn" from data, without being explicitly programmed. Machine learning explores the study and construction of algorithms that can learn from and make predictions on data. Neural networks are one of the learning algorithms used within machine learning. They consist of different layers for analyzing and learning data. A probabilistic neural network is a class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery. Neural networks use relatively little pre-processing compared to other image classification algorithms. Directional Neural networks connects two hidden layers of opposite directions to the same output. With this form of generative deep learning, the output layer can get information from past and future states simultaneously. Soft computing methods generally do not require human intervention they perform the segmentation task automatically.

Plants play an important role in all the aspects of life. They serve as a backbone to sustain the environment. Plants do suffer from diseases, which affects the normal growth of the plants. Leaf diseases are the most common diseases of most plants. Detection of such plant leaf disease is an important task to perform. Soft computing techniques have the ability to simulate human thinking having the capability to perform the task of identification and classification of such plant leaf diseases automatically in less time and cost.

2. RELATED WORK

Many researchers have worked on both traditional and soft computing approached for the segmentation of infected area of leaves from the disease. In this part, we try to encapsulate some of the soft computing approaches that have been utilized to perform this task. Support vector machine with radial basis function being its kernel has been used most often to identify and classify the disease present with an image of leaf with the disease. The neural network with its learning and training capabilities has also been deployed for this task. Table I shows the number of soft computing methods that have been used to identify the disease of the plant.

Generally, it has been seen from the literature that SVM has been applied for the identification of plant diseases. Whereas the learning ability of NN also contributes for the same purpose. As it is seen from the survey authors have majorly focused on the identification of a disease from the specific plant because it is a hard task to identify and categorize the disease among different categories. As deep learning algorithms are appearing in the number of applications a novel work introduced by Yang

Lu et al. have applied convolutional neural network for the identification of rice diseases. Shanwen Zhang et al. uses K-means clustering for the identification of cucumber leaf diseases. There are number of applications using SVM have been presented like Pranjali B. Padol et al. uses it for identification of grapes leaf disease, Jagadeesh D. Pujari et al. for identification of plant leaf disease of crops such as wheat, maize, grape and sunflower etc., Sushma S. Patil et al. for identification of tomato leaf disease, Marion Neumann et al. for beet leaf disease, Rong Zhou et al. for identification of Cercospora leaf Spot form sugar beet and so on. Though the researchers have worked with SVM, the problem of identifying multiple diseases by using SVM will be a complicated task, because of this the efficiency of the system will decrease both in the terms of cost and time.

TABLE I[

REVIEW FOR SEGMENTATION OF PLANT LEAF DISEASE USING SOFT COMPUTING METHODS

Year	Author	Method	Application area
2017	Shanwen Zhang et al.	K-means clustering	Identification of cucumber leaf diseases
2017	Yang Lu et al.	Convolutional neural network	Identification of rice diseases
2017	Lin Yuan et al.	Fisher's linear discriminant analysis (FLDA)	Identification of plant diseases and pests from SAR images
2016	Pranjali B. Padol et	Support vector	Identification of
2014	Sushma S. Patil et al.	Support vector machine	Identification of tomato leaf disease
2014	Marion Neumann et al.	Support vector machine	Identification of beet leaf disease
2014	K. P. Waidyarathne et al.	Self-organizing map and multilayer perceptron	Identification of Weligama coconut leaf wilt disease (WCLWD)
2014	Lin Yuan et al.	Fisher linear discrimination analysis (FLDA) and Partial least square regression (PLSR)	Identification of wheat leaf diseases
2014	Rong Zhou et al.	Support vector machine	Identification of Cercospora Leaf Spot form Sugar beet
2017	Talha Akram et al.	Based on an Image processing technique	Real time classification of plant diseases
2017	Trimi Neha Tete et	Neural network, K-	Identification of
2016	Jayme Garcia Arnal Barbedo et al.	Based on an Image processing technique	Identification of leaf disease from 12 different species of plants
2016	Jayamala Kumar Patil et al.	Content based image retrieval	Identification of soybean leaf diseases
2016	Jagadeesh D. Pujari et al.	Support vector machine and artificial neural network	Identification of plant leaf disease of crops such as wheat, maize, grape, sunflower etc
2016	Iqbaldeep Kaur et al.	Support vector machine and Ant colony algorithm	Identification of plant leaf
2015	Ramakrishnan. M et al.	Backpropagation algorithm	Identification of groundnut leaf disease
2016	Malvika Ranjan et al.	Artificial neural network	Identification of cotton leaf disease
2015	Santanu Phadikar et al.	Genetic algorithm and rough set theory	Identification of rice leaf disease
2015	Prakash M. Mainkar et al.	K-means clustering, Gray level Co-occurrence matrix and Backpropagation neural network	Identification of disease from potato, tomato and cotton leaves
2014	Sushma S. Patil et al.	Support vector machine	Identification of tomato leaf disease
2014	Marion Neumann et al.	Support vector machine	Identification of beet leaf disease
	al.	means and thresholding	disease from potato, apple and mango leaves
2017	Vijai Singh et al.	Genetic algorithm	Identification of diseases from rose, beans, lemon, and banana plant leaves
2017	Megha. S et al.	Fuzzy c means and Support vector machine	Identification of plant leaf disease

3. LIMITATIONS OF EXISTING WORK

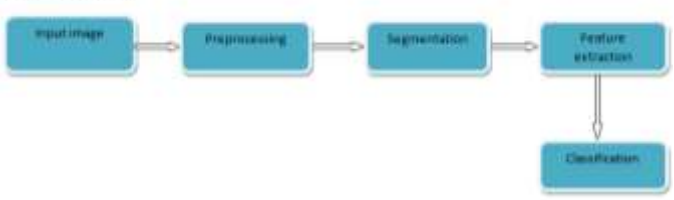
• The implementation still lacks in accuracy of result in some cases. More optimization is needed.

• Priori information is needed for segmentation
• Database extension is needed in order to reach the more accuracy.
• The possible reasons that can lead to misclassifications can be as follows: disease symptoms varies from one plant to another, features optimization is needed , more training samples are needed in order to cover more cases and to predict the disease more accurately.

4.PROPOSED METHODOLOGY

In this work identification and classification of plant leaf disease is performed by using PNN. Digital image processing techniques like Preprocessing, Segmentation, Feature extraction and classification are performed in this proposed method. The proposed algorithm achieves higher convergence ratio and accuracy. The methodology of the proposed work is illustrated in the following block diagram.

BLOCK DIAGRAM



5.Step by step approach for the proposed identification and classification of plant leaf diseases

5.1 Input image:

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output maybe image or characteristics/features associated with that image.

5.2 Preprocessing:

Preprocessing is a common name for operations with the images at the lowest level of abstraction both input and outputs are intensity images. The aim of the preprocessing is an improvement of the image data that suppresses unwanted distortions and errors or enhance some image features such as resizing, changing the pixel brightness values to improve its visual impact. The kernel of the filter will have zero values for alternate pixels in the window in either row or column or both, with reference to the pixel of interest.

5.3 Segmentation :

Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and /or change the representation of an image into something that is more meaningful and easier to analyze. In color image processing, there are various models one of which we are using is Hue Saturation Value (HSV) model. Using this model, an object with a certain color can be detected and to reduce the influence of light intensity from the outside. Hue will give you information regarding color (wavelength), Saturation always shows how much percentage of white is mixed with that color and Value is nothing but magnitude of that colour(intensity). A fast and efficient approach for color image segmentation is proposed. In this work, a new quantization technique for HSV color space is implemented to generate a color histogram and a gray histogram for K-Means clustering, which operates across different dimensions in HSV color space. K-Means clustering is a traditional,simple machine learning algorithm that is trained on a test data set an then able to classify a new data set using a prime, K number of clusters.

5.4 Algorithmic steps for k-means clustering

Let $X = \{x_1, x_2, x_3, \ldots\ldots, x_n\}$ be the set of data points and $V = \{v_1, v_2, \ldots\ldots, v_c\}$ be the set of centers.

1) Randomly select *'c'* cluster centers.

2) Calculate the distance between each data point and cluster centers.

3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers..

4) Recalculate the new cluster center using:

$$v_i = (1/c_i) \sum_{j=1}^{c_i} x_i$$

where, *'c_i'* represents the number of data points in *i^{th}* cluster.

5) Recalculate the distance between each data point and new obtained cluster centers.

6) If no data point was reassigned then stop, otherwise repeat from step 3).

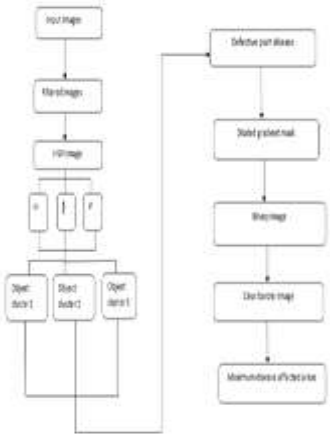
5.5 Feature extraction:

One very important area of application in image processing, in which algorithms are use to detect and isolate various desired portions or features of a digitized image. The sobel operator is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. Image thresholding is a simple, yet effective way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. A statistical method of examining texture that considers the spatial relationship of pixels is the Gray Level Co-occurrence Matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix.in this proposed method we find 13 features .

5.6 Classification :

Digital image classification uses the quantitative spectral information contained in an image,which is related to the composition or condition of the target surface. Image analysis can be performed on multispectral as well as hyperspectral imagery. In this paper, two classic neural networks are employed because of its high accuracy and efficiency.

6.Flow Chart Representation Of Various Process In Classification And Identification Of Plant Leaf Diseases



7.RESULT

All the processes are performed in MATLAB. For input images plant leaf images with diseases like Anthracnose, Bacterial Blight, Cercospora leaf spot and Healthy leaves are considered. A figure below shows the various image in classification and identification of plant leaf with diseases during various image processing techniques in this proposed method. Here leaf image with Anthracnose is diagonised.

Fig.5 S image

Fig.6 V image

Fig.7 Objects in cluster1

Fig.8 cluster2

Fig.9 cluster3

Fig.10 Defective plant detectio

Fig.11 Gray scale images

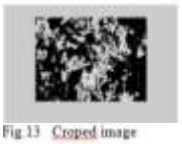


Fig.12 Edge detection

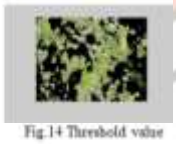


Fig.13 Croped image

Fig.14 Threshold value

Fig.15 Dilated gradient mask

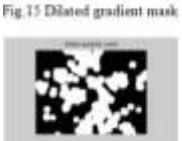


Fig.16 Binary images

Fig.17 Cleared border image

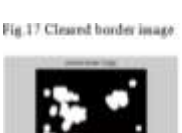


Fig.18 Disease affected area

Comparative analysis of proposed method has been done with GA, SVM, BRBFNN. Proposed method achieved higher classification accuracy of 1.0000 respectively when compared with GA having 0.1933, SVM having 0.1665 and BRBFNN having 0.8621. The sobel features for the leaves are extracted and the threshold value of the image is found out using Gray level co-Occurrence matrix.

8.CONCLUSION

The plant serves as the basic need for any living organisms. They are the most important and integral part of our surroundings. Just like a human or other living organism does plant do suffer from different kind of diseases. Such diseases are harmful to plant in a number of ways like can affect the growth of the plant, flowers, fruits, and leaves etc. due to which a plant may even die. So in this work, we have proposed classic neural networks for identification and classification of plant leaf diseases. The results, when compared with other methods, show that the proposed method achieves higher performance both interms of identification and classification of plant leaf diseases. The proposed method is also superior in terms of computational efficiency and accuracy for identification and classification of diseases. For this work, we have worked with only MATLAB (software), in future, this work can be extended working on with hardware such as various controllers for performing embedded system technology applications.

REFERENCES

[1] Shanwen Zhang et al., "Leaf image based cucumber disease recognition using sparse representation classification," *Computers and Electronics in Agriculture*, pp. 135–141, 2017, doi: 10.1016/j.compag. 2017.01.014.

[2] Yang Lu et al., "Identification of rice diseases using deep convolutional neural networks," *Neurocomputing*, pp. 378-384, 2017, doi:10.1016/j.neucom.2017.06.023.

[3] Tallha Akram et al., "Towards real-time crops surveillance for disease classification: exploiting parallelism in computer vision," *Computers and Electrical Engineering*, pp. 15–26, 2017, doi:10.1016/ j.compeleceng.2017.02.020.

[4] Trimi Neha Tete and Sushma Kamlu, "Plant Disease Detection Using Different Algorithms," *International Conference on Research in Intelligent and Computing in Engineering*, vol. 10, pp. 103–106, 2017, doi: 10.15439/2017R24.

[5] Vijai Singh and A.K. Misra, "Detection of plant leaf diseases using image segmentation and soft computing techniques," *Information Processing in Agriculture*, pp. 41–49, 2017, doi:10.1016/ j.inpa.2016.10.005.

[6] Megha S. et al., "Image processing system for plant disease identification by using FCM clustering technique," *International Journal of Advance Research, Ideas and Innovations in Technology*, vol. 3 (2), pp. 445-449, 2017.

[7] Lin Yuan et al., "Habitat monitoring to evaluate crop disease and pest distributions based on multi-source satellite remote sensing imagery," *Optik*, pp. 66–73, 2017, doi: 10.1016/j.ijleo.2017.06.071.

[8] Pranjali B. Padol et al., "SVM Classifier Based Grape Leaf Disease Detection," *2016 Conference on Advances in Signal Processing (CASP) Cummins College of Engineering for Women, IEEE 2016*, pp. 175-179, doi: 978-1-5090-0849-0/16.

[9] Jagadeesh D.Pujari et al., "SVM and ANN Based Classification of Plant Diseases Using Feature Reduction Technique," *International Journal of Interactive Multimedia and Artificial Intelligence*, vol. 3 (7), pp. 6-14, 2016, doi: 10.9781/ijimai.2016.371.

[10] Jayme Garcia Arnal Barbedo et al., "Identifying multiple plant diseases using digital image processing," *Biosystem engineering*, pp. 104-116, 2016, doi: 10.1016/j.biosystemseng.2016.03.012.

[11] Jayamala Kumar Patil and Raj Kumar, "Analysis of content based image retrieval for plant leaf diseases using color, shape and texture features," *Engineering in Agriculture, Environment and Food*, pp. 1-10, 2016, doi: org/10.1016/j.eaef.2016.11.004.

[12] Iqbaldeep Kaur et al., "Detection and Classification of Disease Affected Region of Plant Leaves using Image Processing Technique," *Indian Journal of Science and Technology*, vol. 9 (48), 2016, doi: 10.17485/ijst/ 2016/v9i48/104765.

[13] Ramakrishnan.M and Sahaya Anselin Nisha. A, "Groundnut Leaf Disease Detection and Classification by using Back Probagation Algorithm," *IEEE ICCSP 2015 Conference*, doi: 978-1-4 799-8081-9/15.

[14] Malvika Ranjan et al., "Detection and Classification of Leaf Disease using Artificial Neural Network," *International Journal of Technical Research and Applications*, vol. 3 (3), pp. 331-333, 2015.

[15] Santanu Phadikar et al., "Rice diseases classification using feature selection and rule generation techniques," *Computers and Electronics in Agriculture*, pp. 76–85, 2015, doi: 10.1016/j.compag.2012.11.001.

[16] Prakash M. Mainkar et al., "Plant Leaf Disease Detection and Classification Using Image Processing Techniques," *International Journal of Innovative and Emerging Research in Engineering*, vol 2 (4), pp. 139-144, 2015.

[17] Sushma S. Patil et al., "Identification and Classification of Cotton Leaf Spot Diseases using SVM Classifier," *International Journal of Engineering Research & Technology (IJERT)*, vol. 3 (4), pp. 1511-1544, 2014.

[18] Marion Neumann et al., "Erosion Band Features for Cell Phone Image Based Plant Disease Classification," *22nd International Conference on Pattern Recognition IEEE*, pp. 3315-3320, 2014, doi: 10.1109/ICPR.2014.571.

[19] K. P. Waidyarathne and S. Samarasinghe, "Artificial neural networks to identify naturally existing disease severity status," *Neural*
Computing & Applications, pp. 1031-1041, 2014, doi: 10.1007/s00521-014-1572-6.

[20] Lin Yuan et al., "Spectral analysis of winter wheat leaves for detection and differentiation of diseases and insects," *Field Crops Research*, pp. 199–207, 2014, doi: 10.1016/j.fcr.2013.11.012.

[21] Rong Zhou et al., "Disease detection of Cercospora Leaf Spot in sugar beet by robust template matching," *Computers and Electronics in Agriculture*, pp. 58–70, 2014, doi:10.1016/j.compag.2014.07.004.

[22] T. Rumpf et al., "Early detection and classification of plant diseases with Support Vector Machines based on hyperspectral reflectance," *Computers and Electronics in Agriculture*, pp. 91-99, 2010, doi: 10.1016 /j.compag. 2010.06.009.

[23] Zhan-Yu Liu et al., "Application of neural networks to discriminate fungal infection levels in rice panicles using hyperspectral reflectance and principal components analysis," *Computers and Electronics in Agriculture*, pp. 99–106, 2010, doi:10.1016/j.compag.2010.03.003.

[24] Camargo and J.S. Smith "Image pattern classification for the identification of disease causing agents in agents in plants," *Computers and Electronics in Agriculture*, pp. 121–125, 2009, doi: 10.1016/j.compag.2009.01.003.