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A Survey on Plant Leaf Disease Identification Techniques

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Abstract:

Agricultural productivity is the prime factor on which Indian Economy highly depends. As India is a developing nation, the increasing population majorly depends on the agricultural yield and its harvest. One of the main reasons for the reduction in plant growth is due to the various infectious plant leaf diseases. If proper attention is not given, it creates serious effects on the grade and quantity of the agricultural crops and also drastically declines the production rate. Most of the farmers still follow the manual methods for disease identification. This process is more time consuming and leads to earlier destruction of plants. Hence, image processing techniques can be deployed to eradicate these effects at the earlier stage itself. By using real time computer vision based systems, the various plant leaf diseases can be identified accurately. In this survey paper, several types of plant leaf diseases and its detection mechanisms are discussed briefly.

Keywords: Image segmentation, K-means clustering, Logistic regression, CNN, LVQ, Pre-processing

I. INTRODUCTION

Our country India is a powerhouse for global agriculture. About 70% of country's population depends on the agricultural production for their food. In the developing country like India, the agricultural sector provides a diverse amount of employment opportunities to the village people on a large scale. The plant leaves are the vital factors to increase the growth and production of the crops. However the plant leaves gets affected by various types of infections which leads to the infectious bacterial, fungal and viral diseases in plants. To identify these malicious diseases on the plant leaves, the farmers follow the traditional manual methods which includes identifying and removing the diseased plants manually. But comparing to this manual method, consultation of agricultural expert served better. But the main disadvantage in consulting the agricultural expert is that the process is more time consuming and it is much more expensive for the farmers to carry out the whole process. The next beneficial method followed by the farmers is spraying of pesticides on the infected crops and in Fig.1. the various plant diseases which affects the plant health and depicted clearly.

In order to identify and classify the plant leaf diseases at the initial stage, numerous machine learning and deep learning methodologies are applied. The paper we presented here is a survey of various types of plant leaf diseases and its detection mechanisms proposed by different researchers.

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Fig.1. Plant leaves affected by bacterial, fungal and viral diseases

II. LITERATURE SURVEY

Many research scholars have performed various researches on this field to detect the diseases in the plant leaves by exploring various algorithms and methodologies. We carried out a study on different plant leaf diseases. The literature survey is done in chronological order from 2015-2021. Vijai Singh in 2015, [1] has stated the beneficial genetic algorithm to identify and detect the plant leaf diseases. The genetic algorithm is one of the evolutionary algorithms. It is used to generate solutions for optimization problems. This algorithm has a set called population set. The solutions from one population has been chosen and used to train the new populations. This algorithm plays an important role in image segmentation process. By using this method, the plant leaf diseases are detected efficiently.

Jadhav Sanjivani in 2016, [2] has proposed a system which is a software solution through which automatic detection of plant leaf disease can be done. The developed processing scheme consists of four main steps using colour coherence matrix. Creating colour transformation structure for input RGB image and using specific threshold value, the green pixels are masked and removed. Then image segmentation is done and the segments which are useful are extracted. The texture statistics is computed from which the disease will be evaluated. Chaitali G. Dhaware in 2017 [3] used the method called Decision Support Systems (DSS) to perform the image processing technique to detect the plant leaf images. By using the SVM (Support Vector Machine) classifier, the various plant leaf images are classified into groups. In Fig.2. the control flow of image processing techniques are listed sequentially.

The output of the classification is used for the decision support system to give the decision related to health of plant leaves.Chaowalit Khitthuk in 2018, [4] describes the plant leaf disease diagnosis using Unsupervised Neural Network algorithm. The Table.1. shows the changes in the parameters with respect to true and false positive rate. This system performs efficiently with the prediction accuracy of about 90%.

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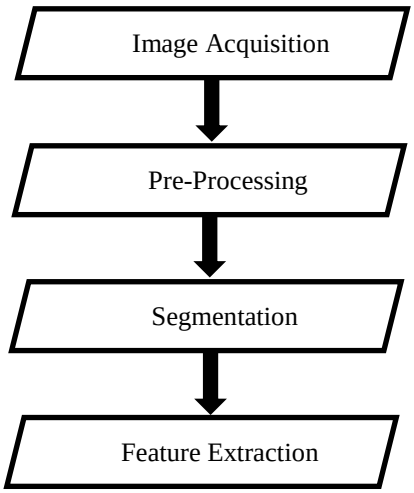

Fig.2. Process flow for Imageprocessing technique

Table 1. showing the result of plant leaf Diseases diagnosis for different number of gray levels

Levels	FALSE POSITIVE RATE	TRUE POSITIVE RATE
Ng8	0	0.93
Ng32	0	0.98
Ng64	0	0.90
Ng128	0	0.96
Ng256	0	0.95

Melike Sardogan in 2018, [5] designed a system which detected various plant diseases like bacterial spot, late blight, septoria leaf spot, yellow leaf curl and classified these at an initial stage by deploying the popular deep learning model Convolutional Neural Network(CNN) and Learning Vector Quantization(LVQ) algorithmNearly it achieved around 86% of prediction accuracy.Siddharth Singh Chouhan in 2018, [6] introduced a method named as Bacterial Foraging Optimization Based Radial Basis Function Neural Network (BRBFNN) for identification and classification of plant leaf diseases automatically. For training the network they are using Bacterial Foraging Optimization (BFO) which includes various steps like chemotaxis, swarming, reproduction, dispersal and elimination. The proposed method achieves higher performance both in terms of identification and classification of plant leaf diseases.

Jaskaran Singh in 2018, [7] has stated the method called k-closest neighbours. In this technique, input is taken as a 2D image of leaf for feature analysis having shape, texture, colour etc. The k- mean clustering is preferred for image segmentation. GLCM algorithm is used for image retrieval.Sammy V. Militante in 2019, [8] discussed about Convolutional Neural Network (CNN) a deep learning model which effectively comprises of four layers. Those input images are resized to 96*96 resolution and converted to the required colour

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scale. The trained model is then tested using 1000 real time plant images taken from the field. The model achieved an accuracy rate of about 96.5% as a result.

J.Nithiswara Reddy in 2019, [9] have considered one of the widely used technique used in the field of image processing called Otsu's classifier. This classifier automatically performs clustering by diminishing the greyscale image to binary image. The change in the colour of leaves shows the infected region. This is the threshold used in Otsu's strategy.Pushkara Sharma in 2020, [10] discussed he logistic regression. It is a machine learning algorithm which is used for classification and it is a predictive analysis algorithm based on concept of probability. The hypothesis tends to limit the function between 0 and 1 . Some of the examples are email spam or not spam . It's accuracy is up to 66.4 % only.

J. Manjarrez-Sanchez in 2020, [11] describes the fundamental process in analysis of images for content based retrieval and classification is the feature description. MPEG-7 visual descriptors – Suitably solves the tasks efficiently by describing plagues and diseases. Most efficient and provides 68% precision. Aamir Yousuf in 2021, [12] has stated that image segmentation method is used to split the digital images to number of segments by using Boundary and spot detection Algorithm. This boundary and spot detection algorithm is used to identify the diseased portion in leaf by detecting its boundary. The Fig.3. shows the conversion of image into a freehand crop picture. It is the method of combining several techniques into one predictive model.

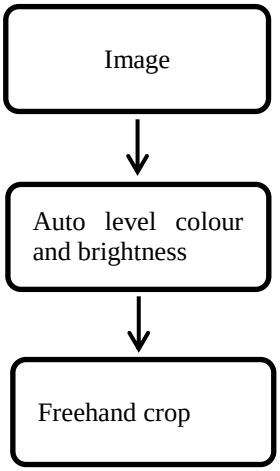

Fig.3. Process of Plant leaf segmentation

III. VARIOUS METHODOLOGIES

A. Convolutional Neural Network and K-Nearest Neighbour

CNN is a popular deep learning model used to identify and classify objects effectively. Convolutional Neural Network involves four active layers. The 4 layers are convolutional layer, pooling layer, activation layer and fully connected layer. In Fig.4. the various layers in CNN is explained clearly by obtaining the final output. The K-Nearest Neighbour is the simplest and easiest algorithm used on classification problems and its architecture is given in Fig.5. It is the best suitable algorithm for both the classification

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and regression problems.The neural network technique is also applied in various imaging techniques (14) for medical applications.

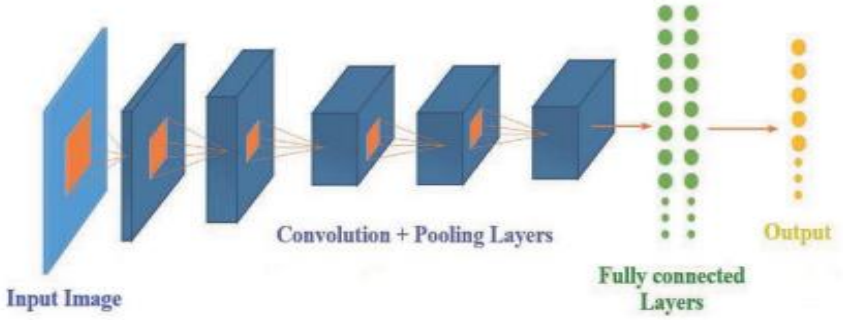

Fig.4. Convolutional Neural Network Architecture

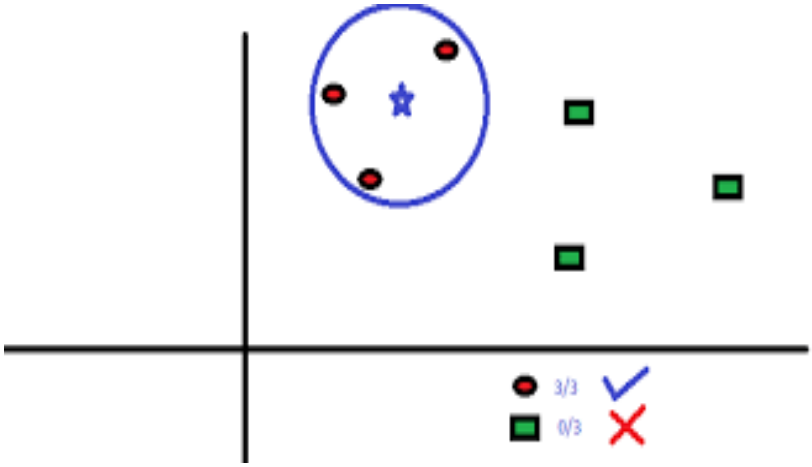

Fig.5. K-Nearest Neighbour

B. Logistic Regression and Unsupervised Neural Network

Logistic regression is used to model the binary independent variables. This algorithm is a predictive analysis algorithm based on the concept of probability. The algorithm has its function limited between 0 and 1 and it is shown in Fig.6. The Unsupervised Neural Network consists of two stages namely disease feature extraction and disease classification. The Agent to environment cycle is shown in Fig.7. In order to form clusters, the input vectors of similar types are combined during the training of artificial neural networks under unsupervised learning.The concept of neural network optimazation is discussed for other applications such as cancer detection in medical researches(13).

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Fig.6. Logistic Regression

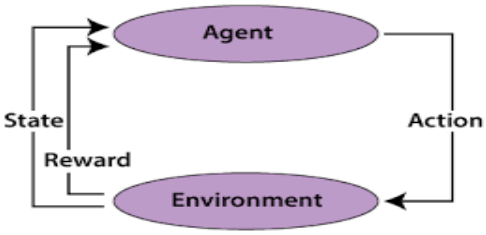

Fig.7. Unsupervised Neural Network

C. Learning Vector Quantization

Learning Vector Quantization uses supervised learning and generally it is a competitive network. It is a process of classification and clustering of the patterns. Inlearning vector quantization, each output units describes a particular class. LVQ will actively classify an vector by assigning it to the same class as similar to that of output unit after the training process

IV. CONCLUSION

This survey paper consists of different techniques used for the recognition and classification of different types of plant leaf diseases accurately. As we discussed, the various machine learning and deep learning algorithms like K-Nearest Neighbour, Convolutional Neural Network, Logistic Regression, Unsupervised Neural Network, K-means clustering, Decision Support Systems, Genetic algorithm, BRBFNN can be widely deployed to detect the plant leaf diseases which emerges as an automatic disease detection mechanism. As these technologies are very user friendly, the farmers can use these systems in an easier manner to protect their crops and to increase their productivity.

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