Image Process Based Plant Diagnostic System

Naga Raju Jangam, Archish Amar Ringangonkar, Battula Mohan Kumar, Linga Vishal, and Kalal Hanush Goud

Abstract Plant disease diagnosis is critical for reducing crop losses, and increasing agricultural growth. This research paper discussed methods used to diagnose plant diseases using leaf pictures and discussed specific classifications and the algorithms to extract a factor used in the diagnosis of plant disease. Then, plant specific diseases plays an essential role in the agricultural sectors, because plant-borne diseases are quite nature. If proper care is not taken in plant disease, it causes adverse effects on the plants and consequently affects the quality of product, quantity or product. Plant diseases cause's outbreaks that results in production loss, and this problem need to be addressed in the first phase, saving lives and money. Detection of diseases in plants is critical research area, which shows benefits in monitoring large plant fields. Farm owners, and caregivers of plants (say, kindergarten) can benefits greatly from early detection of diseases, to prevent the bad from reaching their plants and to inform the person what needs to be done in advance for the similar to work properly, to prevent the worse.

Keywords Classification · Feature extraction process · Image processing application · Plant disease · Symptom

1 Introduction

India is a cultivated country, with agriculture employing over 70% of the people directly or indirectly. Farmers have a wide variety of options to choose from and find the right pesticides [1, 2]. Therefore, crop damage will lead to significant losses in productivity and ultimately affect the economy. The leaves are a very sensitive part of plants that show signs of disease at an early age. Plants must be checked for disease from the start of their life cycle until they are ready to be harvested [3–5]; formerly, disease monitoring was done in a different method, with traditional naked eye tracking being a time-consuming process that required experts to watch crop

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fields [6–8]. In recent years, a number of techniques have been developed to improve the diagnosis of spontaneous and autoimmune diseases by simply recognizing the symptoms on the leaves of plants and making them easier and cheaper [9, 10]. These programs have so far led to them being faster, less expensive and more accurate than the traditional way of looking at farmers [11].

This paper is organized into the following sections. The first section provides a brief introduction to the importance of diagnosing plant diseases. The second section discusses the work that has been done recently in this area and reviews the methods used. The third part lists the methods used in this research paper. Lastly, section four concludes this paper with future indicators. The identification of plant disease is most important aspect in modern agriculture system. Determining the health of a plant or a particular leaf in this plant is very important and plays a big role because a bad plant can damage the plants and plants around it and as a result, it can give a bad harvest.

2 Related Works

Kaur and Devendran [13] introduced a new optimization based segmentation and law mask system for leaf disease detection and classification. In this literature study, Support Vector Machine (SVM) classifier was applied for classifying the plant leaves. In addition, Verma and Dubey [14] developed a novel model; Long Short Term Memory (LSTM) and Simple Recurrent Neural Network (SRNN) for detecting the disinfected or disease plants with dynamic learning capability. Peker [15] has introduced new deep learning model on the basis of ensemble learning and capsule networks for plant disease detection. Further Vasumathi and Kamarasan [16] implemented convolutional neural network based LSTM model for classifying 6519 fruits into abnormal or normal classes. In this literature study, the CNN model was used for feature extraction and then the LSTM model was applied for classifying the fruits classes.

3 Description and Methodology

Plant diseases are usually caused by infectious substances such as fungi, bacteria and viruses [12]. Symptoms of plant diseases are visible evidence of infection and symptoms are a visible consequence of these types of diseases. Fungal infections cause symptoms such as blisters, mildew, or mildew and the basic symptoms are leaf spot and yellowing [13]. Fungal infections are fungal infections caused by mold. The fungus can be solitary or multi-cellular, but in any case, infects plants by stealing nutrients and breaking down tissues. Fungal infections are the most common plant disease. There are some symptoms of the condition, or visible effects of the disease, on the plants. Fungal infections can be identified by symptoms such as spots on plant leaves, yellow leaves, and bird spots on the berries. With some fungal diseases, the body itself can be viewed on the leaves and appear as a growth and as a fungus. The leaf affected by fungal infection is represented in Fig. 1.

This may be irregular with the stems or under the leaves. This specific target of a pathogen is called symptoms of a single-cell, prokaryotic virus. Bacteria are everywhere and many can be beneficial, but some can cause disease in humans and plants. Symptoms of bacteria are often harder to spot than mold, because they are smaller bacteria. When you cut an infected stem, a white milk-colored substance, called bacterial ooze, may appear. Other symptoms include water-soaked sores, which are wet areas on the leaves that bloom. Eventually, as the disease progresses, the lesions grow and develop reddish-brown spots on the leaves. The most common sign of infection is leaf spot or fruit spots. Unlike fungi, these are usually composed of arteries. The leaf affected by bacterial is indicated in Fig. 2.

The process of the plant disease process consists of four stages. The first stage involves obtaining photos with a digital camera and mobile phone or on the web. The second stage divides the image into different number groups for groups where different strategies can be used. The next section contains methods of removal of the feature and the final section is about the classification of diseases, and the work follow of the proposed model is given in Fig. 3.

Fig.1 Leaf affected by fungal infection

Fig. 2 Leaf affected by bacteria

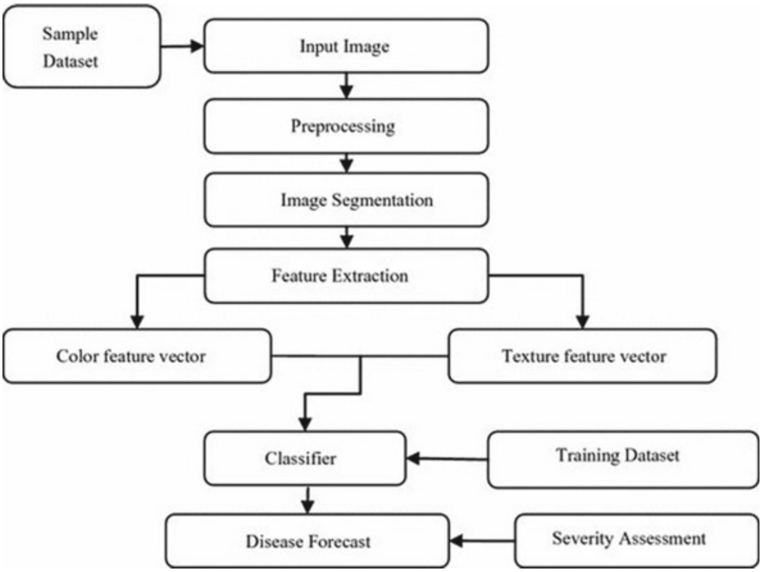

Fig. 3 Workflow of the proposed model

3.1 Image Acquisition

In this section, photos of the leaves of the plants are collected using digital media such as camera, mobile phones etc. with the adjustment and size you want. Photos can also be taken from the web. Image data formatting depends entirely on the application development tool. To get best functioning of the partition in the final phase of the acquisition process the data base is playing crucial role.

3.2 Image Segmentation

It primarily focuses on simplifying the image's representation so that it sounds better and is easier to process. As a basis for element rendering, this section is also a basic method of image processing. There are a variety of methods for categorizing photos, including k-means clustering, Otsu's algorithm, and adhesion, among others. Clustering based on a set of elements in the K number of classes divides objects or pixels. The division is performed by lowering the total number of distances between items and the groups to which they belong.

3.3 Feature Extraction and Classification

Therefore, at this stage we only focus on extraction of image and its related parameters. The parameters are required to obtain a description of the sample image. Features can be based on color, shape, and texture. Recently, most researchers intend to use texture features to diagnose plant diseases. There are a variety of feature extraction methods that can be used to create a system such as the gray-level co-occurrence matrix (GLCM), color occurrence method, spatial gray-level dependence matrix, and histogram-based feature extraction. The GLCM features includes cluster shade, contrast, maximum probability, difference variance and sum entropy, which are stated in the Eqs. (1) to (5). These methods are mathematical methodology of texture separation, and classification is performed by artificial neural network.

$$Clustershade = \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} (i + j - \mu_i - \mu_j)^3 P_{ij} \tag{1}$$

$$Contrast = \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_{ij} (i - j)^2 \tag{2}$$

$$Maximum\ probability = max(p_{ij}) \tag{3}$$

$$Difference\ variance = variance\ of\ p_{i-j} \tag{4}$$

$$Sum\ entropy = \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_{ij} \log P_{ij} \tag{5}$$

where, μ denotes mean and P_{ij} indicates normalized co-occurrence matrix.

4 Experimental Results

In the research paper, we are trying to design a way in which we can detect and test whether the affected plant is infected. We do this experiment by using MATLAB and image processing algorithms.

4.1 Discussion

In the existing systems, the deep learning algorithm training is not very efficient and it results in many false disease detections. Hence, the removal of good crops with an impression of being bad [14, 15]. In the performance analysis section, the proposed model obtained 97.8% of classification, and the existing models SVM [14]

Table 1 Comparative analysis between the proposed and existing method

Method	Accuracy (%)	Sensitivity (%)	Specificity (%)
SVM [14]	89	76	89
LSTM [15]	90.27	85	89.83
Proposed	**97.80**	**96.05**	**97**

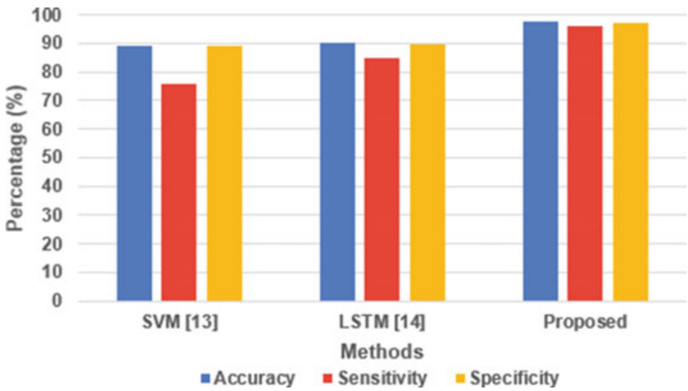

Fig. 4 Graphical analysis between the proposed and existing method

and LSTM [15] obtained limited performance of 89 and 90.27% of classification accuracy, and also showed better performance in terms of sensitivity and specificity. Comparative analysis is given in Table 1, and Fig. 4.

4.2 *Outcome of Proposed System*

In the proposed system, we try to design and implement a system with proper amounts of training required by the system in less time before deploying it, and the output of the proposed model is represented in the Figs. 5 and 6.

Fig. 5 Classification of leaf diseases

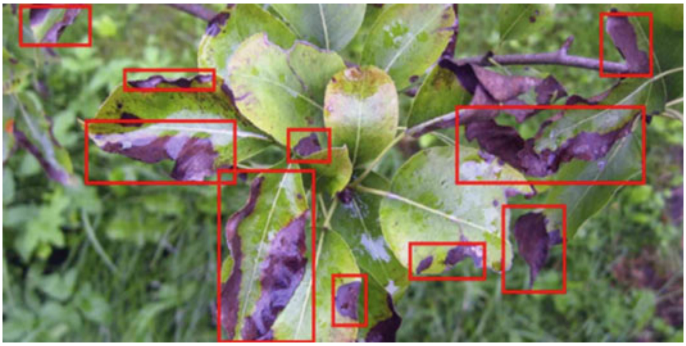

Fig. 6 Identification of leaf disease

5 Conclusion

This paper descries a research of various disease classification methods used for plant disease detection, as well as a classification technique algorithm that may be utilized for later automatic detection and classification of plant leaf diseases. The 10 most extensively tested algorithms are bananas, beans, jackfruit, lemons, mangoes, potatoes, tomatoes, and sapota. As a result, diseases connected with these plants were collected for analysis. The findings were produced with relatively little effort, demonstrating the efficiency of the suggested algorithm in the acceptance and classification of leaf diseases. Another advantage of this technology is that it can detect plant diseases early or in their early stages. Bayes division, Fuzzy Logic, and hybrid algorithms can be utilized to improve the recognition rate of the Artificial Neural Network separation process.

References

1. Ghaiwat SN, Arora P (2014) Diagnosis and classification of plant leaf diseases using imaging techniques: a review. Int J Recent Adv Eng Technol 2(3):2347–2812. ISSN (online) is Google Scholar
2. Dhaygude SB, Nitin PK (2013) Agricultural plant leaf disease detection using image processing. Int J Adv Res Electr Electron Instrum Eng 2(1)
3. Badnakhe Mrunalini R, Prashant RD (2011) An application of K-means clustering and artificial intelligence in pattern recognition for crop diseases. Int Conf Adv Inf Technol 20. 2011 IPCSIT
4. Arivazhagan S, Newlin Shebiah R, Ananthi S, Vishnu Varthini S (2013) Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features. Agric Eng Int CIGR 15(1):211–217
5. Kulkarni AH, Ashwin Patil RK (2012) Applying image processing technique to detect plant diseases. Int J Mod Eng Res 2(5):3661–3664
6. Bashir S, Sharma N (2012) Remote area plant disease detection using image processing. IOSR J Electron Commun Eng 2(6):31–34. ISSN 2278–2834

7. Naikwadi S, Amoda N (2013) Advances in image processing for detection of plant diseases. Int J Appl Innov Eng Manage 2(11)
8. Patil SB et al (2011) Leaf disease severity measurement using image processing. Int J Eng Technol 3(5):297–301
9. Chaudhary P et al (2012) Color transform based approach for disease spot detection on plant leaf Int Comput Sci Telecommun 3(6)
10. Rathod AN, Tanawal B, Shah V (2013) Image processing techniques for detection of leaf disease. Int J Adv Res Comput Sci Softw Eng 3(11)
11. Vijayaraghavan V, Garg A, Wong CH, Tail K, Bhalerao Y (2013) Predicting the mechanical characteristics of hydrogen functionalized graphene sheets using artificial neural network approach. J Nanostruct Chem 3:83
12. Garg A, Garg A, Tai K (2014) A multi-gene genetic programming model for estimating stress-dependent soil water retention curves. Comput Geosci 1–12
13. Kaur N, Devendran V (2020) Novel plant leaf disease detection based on optimize segmentation and law mask feature extraction with SVM classifier. Mater Today Proc
14. Verma T, Dubey S (2021) Prediction of diseased rice plant using video processing and LSTM-simple recurrent neural network with comparative study. Multimedia Tools Appl 1–32
15. Peker M (2021) Multi-channel capsule network ensemble for plant disease detection. SN Appl Sci 3(7):1–10
16. Vasumathi MT, Kamarasan M (2021) An effective pomegranate fruit classification based on CNN-LSTM deep learning models. Indian J Sci Technol 14(16):1310–1319