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FRUIT LEAVES DISEASE DETECTION: A REVIEW

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ABSTRACT

Fruit farming plays a very important role in economy of India and it also fetches profit to farmers. Their livelihood depends on this occupation. If the diseases in the plants are left untreated, it gives rise to variety of problems such as soil pollution, air pollution, health problems to humans and animals as they consume the products of plants. So, there is a very urgent need to detect the diseases of plants at an early stage so as to prevent the damage caused to environment as well as humans and animals. This article has reviewed the methods by which the fruit diseases can be detected at an early stage. First a review of the previous methods used to detect fruit diseases has been done. Second, the study has highlighted the results obtained from the methodologies and lastly research gaps have been identified. The purpose of this survey is to pave a path for researchers to learn different methods in detecting plant diseases at an early stage.

Keywords: CNN, Image processing, k-means clustering, Mobile net model, SVM classifier.

1. INTRODUCTION

1.1 Fruit Farming

Fruit farming is referred to as growing fruits including dry fruits in a particular area of isolated land. It may be cultivated for domestic purpose, industrial purpose or for commercial purpose. Many fruits are exported from India and it fetches profit. It has a very important part in Economy. India ranks first in the production of bananas, papayas and mangoes. The advantages of fruit farming are it provides foreign exchange, it provides employment to many people,

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provides raw materials for industries and it also provides very good nutritional value when consumed.

1.2 Traditional Methods for Fruit Farming

Traditional farming is one of the oldest methods of farming done to prevent diseases from affecting the plants. It makes use of traditional tools, organic fertilizers to the soil and it does not make use of industrial pesticides and tools. It is bio friendly in nature and food production can be increased and it protects the world's natural resources. Some of the traditional farming methods still in use are, Agro-forestry, crop rotation, Intercropping, Polyculture and Water harvesting. Though the traditional farming was bio-friendly, it was not suitable for an increasing number of people so the focus slowly shifted to the idea of modern farming which produced high yield for a larger population.

1.3 Fruit Diseases

There are many types of diseases that occur in fruits and vegetables. The common diseases occurring in many fruits and vegetables are:

1. Bacterial speck
2. Clubroot
3. Leaf spot diseases
4. Damping-off
5. Downy mildew
6. Powdery mildew
7. Tuber diseases
8. White mould
9. Wilt diseases

2. LITERATURE REVIEW

As per the paper, [1] authors have performed detection and classification of oil palm diseases through image processing techniques. For the purpose of disease detection, K-means clustering algorithm was used and for classification purpose, SVM classifier was employed to determine two oil palm diseases based on its symptoms on leaf. By using k-means clustering technique, thirteen types of features were extracted from the leaf images. The SVM classifier achieved accuracy of 97% for Chimaera and 95% for Anthracnose, the two oil palm diseases.

In another paper [2], authors have proposed a technique that uses 1AA approach of multiclass SVM to classify diseases in cucumber leaves. Authors have considered diseases such as leaf spot

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disease, leaf miner and CMV of cucumber leaves for analysis purpose. After preprocessing, the authors have used k-means algorithm for segmenting the diseased cluster. From that cluster, features were extracted using GLCM and this was used for classification of diseases.

Authors in [3] have used deep learning-based approach which identifies the mango diseases automatically. Leaves being the food source for plants, the early and accurate detection of leaf diseases is important. The authors have considered a dataset of 1200 images of both healthy as well as infected mango leaves. In this dataset they have identified five mango leaf diseases namely, Anthracnose, Alternaria leaf spots, Leaf Gall, Leaf webber, Leaf burn of mango. The authors have proposed a CNN model which can identify the five diseases of mango leaf. The model has achieved an accuracy of 96.67%.

In another paper [4], authors have proposed convolutional neural network models for plant disease detection and diagnosis using only simple leaf images of healthy and infected plants. The training of these models was done using an openly available database of 87,848 photographs, taken in both laboratory conditions and real conditions in cultivation fields. Out of all the models, a VGG convolutional neural network achieved an accuracy rate of 99.53%. From the experiments performed, it was clear that convolutional neural network is highly suitable for automatic detection and diagnosis of plant diseases through analysis of simple leaves images.

In the paper [5], authors dealt with the following diseases in this project, i.e., Alternata, Antracnose, Bacterial Blight and Cercospora Leaf Spot. The pictures of the leaves were used for detection of plant disease. Automatic illness detection using image processing was performed in MATLAB. The authors have loaded the image, preprocessed it, segmented the image, extracted its features and then classified it.

In the paper [6], authors have proposed a novel plant leaf disease identification model based on Deep CNN. This model was trained using open dataset consisting of 39 distinct classes of plant leaves and background images. Six data augmentation methods were used: flipping of image, gamma correction, injection of noise, principal component analysis (PCA) color augmentation, rotation, and scaling. Results showed that data augmentation increased the performance of this model. The proposed model achieved better performance when used with validation data compared with popular transfer learning approaches. The proposed model was trained using different training epochs, batch sizes and dropouts. After many simulations, this model achieved 96.46% classification accuracy.

Authors in [7] have used picture handling for recognizable proof of leaf infection in MATLAB. It includes K-means grouping, and SVM. The five stages used for leaf illness distinguishing are picture procurement, picture pre-preparing and division, include extraction, characterization. The

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authors have explained that by processing the measure of sickness in the leaf, adequate measure of pesticides can be used to control the bugs and thus, the harvest yield can be expanded.

In the paper [8], the system for developing image processing technique for disease detection and alerting was developed. Steps involved in this were image acquisition, image processing, image segmentation, feature extraction, classification and disease categorization. After detecting the disease, it sends the alerts through the buzzer. In this paper, the authors have used k-means algorithm for leaf detection and alerting, in two methods, i.e., in GUI and Real time. GUI results gave 95.16% accuracy for Alternaria Alternata and in Real Time, when the disease is detected it alerts the people using a buzzer and when the healthy leaf is detected it doesn't turn on the buzzer and remain silent.

Authors in [9] have used MobileNet model for apple leaf disease identification. The model is first low cost because it can be deployed in mobile devices; second, it is a stable algorithm because it can be used by non-experts also and gives stable results. Thirdly, the precision of MobileNet is nearly the same with existing complicated deep learning models. To check the effectiveness of the MobileNet model, several experiments have been carried out. The authors have compared the efficiency and precision of this model with the famous CNN model i.e., ResNet152 and InceptionV3. It provided a good balance between efficiency and precision by comparing several deep learning models.

In the paper [10], authors have considered 4 common grapes diseases namely: Black rot, Black measles, Leaf blight and Mites. The authors have first constructed the grape leaf disease dataset (GLDD). Based on GLDD and faster R-CNN detection algorithm, a deep-learning-based Faster DR-IACNN model with higher feature extraction capability was proposed for detecting grape leaf diseases by introducing the Inception-v1 module, Inception-ResNet-v2 module and SE-blocks. The experimental results showed that this detection model achieved a precision of 81.1% mAP on GLDD and the detection speed reached 15.01FPS.

In [11], authors have used feature extraction and classification algorithms to classify the leaf diseases and also to suggest pests. In this paper, the authors have also proposed an approach to increase accuracy based on Back Propagation NN to classify the leaf diseases. This approach had the ability to recognize and discriminate between healthy and infected leaves. By the experimental findings, the output was free from errors.

In another paper [12], authors have used automatic detection framework based on deep learning is investigated for classification of apple leaf diseases. The authors have used different pre-trained models, VGG16, ResNetV2, InceptionV3, and MobileNetV2 for transfer learning. A combination of parameters like learning rate, batch size, and optimizer was analyzed, and the

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best combination of ResNetV2 with Adam optimizer provided the best classification accuracy of 94%. The effect of different optimizers was also studied in this work, and the Adam optimizer was effective in the transfer learning of the ResNetV2 model.

Authors in [13] have proposed a detection method of oil palm leaf disease to distinguish healthy and infected leaves. The feature extraction was carried out in the RGB, L*a*b, HSI, and HSV color spaces by splitting the histogram of each color channel into 8 bins. It was then applied to the segmented leaf areas produced by the k-means clustering. A total of 41 selected features are generated using the principal component analysis (PCA) and then fed into the artificial neural network (ANN) classifier. The proposed method was evaluated using a local dataset consisting of 300 leaf images (150 healthy and 150 infected) with 10-fold cross-validation. The evaluation produced sensitivity, specificity, and accuracy of 99.3%, 100%, and 99.67%, respectively.

3. RESEARCH GAP TABLE

Table 1: Research Gap Table

Paper ID	Findings	Research Gap
1	The SVM classifier achieved accuracy of 97% for Chimaera and 95% for Anthracnose, the two oil palm diseases.	Can be applied to other plant diseases
2	The leaf diseases of cucumber were detected using this algorithm.	The proposed model can be extended to bigger farms by installing cameras, can be developed in mobile application
3	The proposed CNN model is also feasible in real time applications.	The accuracy of classification can be increased by adding more images in the dataset and by tuning the CNN model parameters, obtaining optical parameters is still a research challenge
4	VGG convolutional neural network achieved an accuracy rate of 99.53%.	Can be integrated in mobile applications, automated pesticide prescription system can be developed
5	Development of automatic detection system helped farmers to identify disease at an early stage.	Can be performed on other plant diseases as well.
6	the proposed model achieved 96.46% classification accuracy.	Can be extended for leaf disease diagnosis.

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7	The infection distinguishing proof is accomplished for a variety of leaves and client can know the infected area.	This methodology can be expanded by utilizing distinctive calculations for division order.
8	The leaf detection and alerting are done using k-means clustering algorithm.	can be modified into automatic disease detection, alerting and Pesticides Selection through mobile, for better accuracy and detection, hyperspectral imaging can be implemented in the system.
9	Good balance between efficiency and precision was obtained.	For improved precision, the datasets can be increased. A deep learning model can be developed to check the quality of apples.
10	Achieved a precision of 81.1% mAP on GLDD and the detection speed reached 15.01 FPS	Can be applied to other fruit diseases as well.
11	The proposed approach is error-free in producing the output	early detection system of pests can be developed and an alert can be sent to farmers.
12	Classification accuracy was 94%	To improve the performance, more classes and images can be added.
13	The evaluation produced sensitivity, specificity, and accuracy of 99.3%, 100%, and 99.67%, respectively.	erroneous occurs because an infected leaf was misclassified as a healthy leaf.

4. CONCLUSION

In this review paper, various methods are discussed that can be used to detect the diseases of plants particularly in leaves have been included. Through the SVM classifier, an accuracy of 97% was obtained. By using k- means clustering algorithm, the features were extracted. The CNN model can also be used in real time applications. The proposed methods can be extended to larger farms and a mobile application can be developed for early detection of fruits. The datasets can be further increased for more accurate results. This paper provides a better understanding of plant disease detection methods thereby strengthening different research in this area.

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