MACHINE LEARNING TECHNIQUES IN PLANT DISEASE DETECTION AND CLASSIFICATION – A STATE OF THE ART

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MACHINE LEARNING

ഉപയോഗിച്ചുള്ളവിളകളിലെരോഗനിർണയവുംകണ്ടെത്തലും – ഒരുപഠനം

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ABSTRACT

As we belong to a developing country, the agricultural importance is a known criterion. Majority of the Indians depend on agriculture for their basic living. It also serves as the backbone of the Indian economy. Therefore this sector should be considered important and taken care of. Diseases affecting the plants and pest are the two major threats of agriculture production. Naked eye observation followed by the addition of chemical fertilizers is the traditional method adopted by most of the farmers to avoid plant diseases. But the main limitation to this method is that it works only in the case of small scale farming. In order to tackle this issue many automatic plant disease detection systems have been developed from the early 70s. This paper is intended to survey some of the existing works in plant disease recognition that include various procedures, materials and approaches. They use different machine learning algorithms, image processing techniques and deep learning methods for disease detection. This paper also compares and suggests novel methods to recognize and classify the various kinds of infections affecting agricultural plants.

ABSTRACT

ഇന്ത്യയിൽവളരെയധികംപ്രാധാന്യമർഹിക്കുന്നഒരുമേഖലയാണ്കാർഷികമേഖല. പകുതിയിലധികംവരുന്നരാജ്യത്തെപൗരന്മാർഇന്നുംകാർഷികമേഖലയെആശ്രയിച്ചാണ്ജീവിക്കുന്നത്.
അതുകൊണ്ട്തന്നെഈവിഭാഗംനേരിടുന്നഎല്ലാവിധവെല്ലുവിളികളുംപ്രാധാന്യമർഹിക്കുന്നതുംഗൗരവത്തോടെകാണേണ്ടതുമാണ്.
കാർഷികവിളകളെബാധിക്കുന്നരോഗങ്ങൾഒരുപ്രധാനവെല്ലുവിളിതന്നെയാണ്. ഇവമൂലംഉണ്ടാവുന്നനഷ്ടങ്ങളുംവളരെകൂടുതലാണ്. അതിനാൽ 70 കൾമുതൽഇതിനുപ്രതിവിധിയെന്നോണംപലരോഗനിർണ്ണയ applications *ഉംനിലവിൽവന്നു. Machine learning ഉപയോഗിച്ചുള്ളപലപുതിയരോഗനിർണയരീതികളുംഅവയുടെപ്രാധാന്യവുമാണ്ഈപഠനത്തിലൂടെവ്യക്തമാക്കുന്നത്.*

INTRODUCTION

A developing country like India depends on the agricultural sector to a large extent. Around 70% of its population relay upon agriculture for food and livelihood. Also, this sector has a vital role in contributing to the Indian Economy. Recent studies show that several types of diseases and pest infections are causing serious yield losses across the farmlands. Therefore, it requires great care and attention during the whole cultivation process. Naked eye observation followed by the addition of chemical fertilizers is the traditional method adopted and practiced by most of the farmers. The main limitation to this method is that it works only in small scale farming. Also many farmers are unaware of the different diseases affecting the agricultural crops and their respective control measures.

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Manually observing plants and expertise in plant diseases is a time consuming, tedious process. For these reasons, it has become important to automatically detect diseases and classify them accordingly.

Hence, this paper gives an idea about the latest methods and techniques introduced in the plant disease detection and classification. Also the established existing techniques such as image processing, MATLAB, Machine learning algorithms, Neural networks etc. are studied and compared accordingly. Image processing is a vast and highly recommended area. This approach includes many steps such as data collection, image pre-processing, image segmentation, selected feature extraction and disease classification. Pre-processing is nothing but improving the input image data by suppressing the unwanted noises or distortions and also enhancing the image features that are necessary for further processing. After pre-processing the image is segmented or simplified into something that is easier for the system to analyze. Further, the features are extracted, so that when an unknown image is given, the system can identify whether it is a diseased or healthy image. There are many classification techniques to classify the various diseases affecting the plants. These techniques are compared, analyzed and discussed in this paper in terms of its performance level and accuracy.

RELATED WORKS

This area of study deals with some of the works associated with the plant disease recognition and classification using machine learning techniques and they are presented below.

Azim et al., (2021), developed a feature extracting method for the rice plant leaf disease classification. In this work, 3 types of diseases affecting the rice leaves are detected. The unwanted parts of the image are separated using saturation threshold and the diseased areas are segmented using hue threshold. Extreme gradient boosting decision tree ensemble is used in this system for its better performance. This system shows an accuracy of 86.58% for the rice leaf image dataset collected from UCI. *Bisen D., (2021),* developed a plant species recognition system using deep convolutional neural network. The CNN classifier used here study the features of leaves through hidden layers such as convolutional layer, max pooling layer, dropout layers and fully connected layers. This system makes use of the extracted features from the leaves for the species detection process. The features are collected using Swedish leaf dataset which consist of 15 tree classes and results in 97% accuracy. *Andhare et al., (2020),* compared several machine learning techniques namely clustering, classification, regression etc. in their work and a detailed study on different plant disease detection systems are also done. Data collection using real time images and wireless sensor networks are also discussed in this work. *Hassan et al., (2021),* developed a deep convolutional neural network system for the recognition of plant species utilizing the plant leaf images. Due to the similarity in the morphological features of plant species, it is difficult to classify using the traditional techniques. Features such as shape, size, color etc. are considered in this work to recognize the leaf species. *Poonguzhali et al., (2019),* developed a crop assessment system using machine learning. It stresses on the assessment of the crop condition with the help of its leaves. In this work, K-means clustering is used for segmentation. TensorFlow and machine learning algorithms are the techniques adopted in classification. The images of diseased and healthy leaves are taken directly from the real time environment in order to assess the crops. *Badage. A., (2018),* suggested a plant disease recognition model using machine learning algorithms. The aim of this work is early detection of diseases. The identification of crop diseases is done using the canny edge detection algorithm. *Goel et al., (2021),* outlined a system to automate farming by interconnecting agricultural systems with Big Data and Internet of Things, which can also provide rapid data analysis. Study of different technologies and models are also done in this work for areas such as yield estimation, crop sowing dates etc.

Singh V. et al., (2017), developed an algorithm for image segmentation technique. The proposed algorithm is tested on 10 species such as sapota, banana, jackfruit, tomato, lemon, potato, beans and mango. *Singh T. et al., (2021),* discussed various algorithms such as ANN and image processing tools that are used by researchers in plant disease detection. *Vashisht et al., (2021),* analyzed different machine learning approaches that are adopted in the plant disease detection. This paper also explains the functioning and comparative measures of many algorithms with other technologies. *Singh. A et al., (2021),* proposed a method for the recognition of potato leaf diseases. In this paper, the classification of diseases is done using SVM and grey-level co-occurrence matrix. *Kadoli V. et al., (2021),* developed a dissimilar disease recognition system using machine learning tools by taking the leaf images as the input data. This approach aims at the early detection of plant diseases. Classification is done using the two machine learning algorithms, K-means clustering and support vector machine.

Rahman et al., (2020), developed a rice disease detection system based on the image processing techniques such as data segmentation, feature extraction and classification using the convolutional neural networks. *Kumar R. et al., (2021),* introduced a model to locate the fungal blast disease in rice seed using the classifiers such as random forest, SVM, decision tree, logistic regression and Naïve Bayes. Here, the results from the traditional classifiers are taken and compared using transfer learning. *Mohapatra et al., (2021),* developed a rice disease detection system using the Naïve Bayes algorithm. This system uses both machine learning and image processing technologies. In this work, the classification is done using Convolutional neural networks.

Aliyu. M. A et al., (2020), in their work used large diseased plant leaf image datasets to compare support vector machine, a machine learning technique with deep learning. Factors such as architecture, the amount of training data and computational power are considered to evaluate the two. *Sethy P.K et al., (2020),* displayed a study on the development of the rice plant disease detection using image processing techniques by referring various research papers. This work also discusses the limitations, achievements and suggestions for future work in this area. *Karthik R. et al., (2020),* developed a tomato leaves disease detection system based on deep residual network. Two different deep architectures are used for the disease recognition and classification. *Sharma P. et al., (2020),* proposed a solution to the fatal flaw of the deep learning models that when tested once on the unseen dataset, their performance diminishes. This problem can be rectified using segmented images to train the convolutional neural network models. *Singh V. et al., (2020),* illustrated a study on various computer vision approaches and imaging tools utilized in the plant disease detection. This paper also discusses the challenges and current trends in this field. *Panigrahi et al., (2020)* focused on supervised machine learning techniques to develop a disease detection system for the diseases affecting maize leaves. Decision Tree, Naïve Bayes, KNN, Random Forest and SVM are the classification techniques analyzed and compared here. Also it concluded that RF algorithm shows an accuracy of 79.2% when compared with the other classification methods.

Iniyan S. et al., (2020), developed a model to detect and classify the diseases using machine learning algorithms such as SVM and artificial neural network. This paper also discusses on the pros and cons of methods used. *Sreehari R. et al., (2020),* illustrated a system in which the work is done on a web portal. Traditional wholesale services are discussed in this work. The plant disease identification is done using image processing tools and machine learning. *Sujatha R. et al., (2021),* compared the performance of deep learning and machine learning in terms of citrus plant leaf diseases. This paper also discusses the advantages and disadvantages of machine learning over deep learning. *Ganatra N. et al., (2020),* developed a multi class disease recognition system. Plant leaf images of various classes are taken and two different datasets are being used here. Many classification techniques are taken for comparison and Random Forest gives the highest accuracy. *Wei et al., (2020),* used Random forest algorithm to build a carrot yield mapping system. The databases used in this model are satellite spectral data and carrot ground-truth yield sampling. *Abdullahi et al., (2017),* developed a plant image recognition and classification system with an accuracy of 99.58%. Here the datasets are collected using remote sensing techniques. Features are extracted and segmented using the image processing techniques. Classification techniques such as SVM, CNN, fuzzy logic and neural networks are compared and evaluated. *Deepalakshmi P. et al., (2021),* introduced a plant disease detection model. The feature extraction and classification is done using DCNN. The model produced an accuracy of 94.5%. *Oo Y.M et al., (2018),* developed a model to classify diseases such as Powdery Mildew, Bacterial Blight, Cercospora leaf spot and Rust. The major algorithms used in this system are Local binary pattern, SVM and KNN. In this work, Histogram Equalization is done to enhance the image context. K-means clustering is utilized to segment the leaf images. GLCM and LBP features are extracted after applying K-means clustering. *Dhingra. G et al., (2018),* did a comprehensive study on image processing techniques such as segmentation, feature extraction of the dataset and classification in the field of plant disease detection. An analysis of previously proposed works is also done in this paper. *Sambasivam G et al., (2021),* developed a model using CNN and Rectifier Linear Unit to detect and validate the diseases affecting Cassava with an imbalanced dataset. The system provides an accuracy of 93%. *Huang. Z. et al., (2020),* developed a system to identify and classify grape leaf disease by using four modified deep learning models. Based on 3 pre-trained machine models VGG-16, AlexNet and MobileNet, transfer learning technique has been used here. *Dahiya S. et al., (2020),* reviewed the recent studies in which machine learning has been applied to detect and classify various plant diseases. They had also discussed about CNN and its various parameters, transfer learning and factors that can affect the performance level of the deep learning model. *Sivasangari et al., (2021),* used Standard Area Diagrams (SADs) to show the seriousness of the plant disease in terms of percentage using image processing and neural

networks. This model is based on TensorFlow and MobileNet architectures. *Vashisht et al., (2021),* analyzed the predictive measures for the better understanding of existing architectures of commonly used artificial neural networks in the recognition and classification of plant diseases. In this work, they had proposed a Gaussian filter as a predictive measure or value to improve the efficiency of trained model at minimal computational costs.

Ferentinos K.P., (2018), used 90 thousand images as datasets and 58 classes of plant varieties in his Plant disease detection and diagnosis system. DCNN is used to build this model. *Türkoğlu M. et al., (2019),* proposed a system which utilizes transfer learning and deep feature extraction methods. The system is built using 9 architectures of deep neural networks. The classification is done using KNN, SVM and extreme learning machine. *Ramcharan et al., (2017),* trained a deep convolutional neural network model by applying transfer learning to identify the three commonly occurring diseases and 2 types of pest damage. In order to avoid the complex feature extraction step, transfer learning from CNN inception V3 is used here.

Francis J. et al., (2016), developed a pepper plant leaf disease identification system by applying image processing tools and MATLAB. The proposed system identifies and informs the user if any variation from the characteristic features of the plant parts is observed. *Ngugi. L.C. et al., (2021),* reviewed the recent development achieved in the area of crop pest and disease identification utilizing both image processing and machine learning tools. This work is narrowed to those methods designed for pest and disease identification using visible light images (RGB). They conducted an experiment to study about ten commonly used CNN architectures and concluded that ResNet-101, DenseNet201 and VGG16 are the high accuracy performers when compared to the other deep learning models. *Shruthi U et al., (2019),* through their work concluded that Convolutional Neural Networks provides better accuracy than the other techniques and detects large number of diseases. This paper gives an insight about the various stages of plant disease detection and their comparative studies. *Vishnoi V.K et al., (2020),* used image processing tools such as segmentation, image preprocessing, feature extraction and classification to detect the diseases affecting the agricultural crops. This paper also summarizes the difficulties during the feature extraction module. *Golhani et al., (2018),* studied and compared the varieties of artificial neural networks that are applied in the plant disease recognition using hyper spectral data. This work gives a detailed review on the different mechanisms, types and many other features of the neural networks. *Giraddi S. et al., (2020),* proposed an automated system to detect the fungal diseases affecting the maize leaves. This model uses the image processing techniques for extracting features and segmenting. Deep learning algorithms are followed in the disease classification.

Ashok S. et al., (2020), reviewed about the different levels of plant disease identification system and did a comparison between various machine learning classification algorithms. This paper also concludes that CNN provides better accuracy than others and detects a large number of diseases. *Venkataramanan A. et al., (2019),* introduced a model that uses multi stage classification in order to provide better accuracy. Here, a leaf from the input image set is extracted using a YOLOv3 object detector. Many ResNet18 layers which are trained using the transfer learning are used to analyze the extracted leaf. One of the layers detects the disease type and the rest classify the leaf type. *Singh V. et al., (2015),* developed a system to detect the unhealthy region of plant leaves. In this work, the image segmentation is done using generic algorithm. *Mukhopadhyay S. et al., (2021),* developed a system that utilizes the image clustering algorithm NSGA-II to detect the diseased area in the tea leaves.

Patidar S. et al., (2020), introduced a rice leaf disease recognition model. Deep residual learning is the algorithm used here to detect the 3 common rice plant diseases. *Ramya R. et al., (2020),* used MATLAB and cloud computing for the fruit disease detection and classification. K-means clustering and support vector machine are the techniques used for the disease classification. *Geetharamani et al., (2019),* implemented a system that uses 6 data augmentation methods and deep CNN model with thirty nine varieties of plant leaves classes and their background images. Data augmentation is used in order to improve the conduction of the model. *Nandhini et al., (2021),* focused on the diseases affecting tomato, corn and apple leaf diseases. The implemented CNN architecture consists of 5 layers. *Shrestha G. et al., (2020),* illustrated a simulation study and analysis in terms of the area of infected region and time complexity. Around 15 diseases are identified and classified using the image processing. *Bedi P et al., (2021),* proposed a model using the deep learning architecture LeNet -5. Peach plant leaves are considered in this paper. Discussions on many CNN architectures such as AlexNet etc. are also done here. *Goncharov P. et al., (2018),* used deep Siamese convolutional neural network, a deep learning tool to detect three main types of diseases that infect the grape leaves. *Hussein M.A et al., (2019),* developed a computer based model to detect the diseases affecting the plant leaves.

Here the preprocessing is done using the cropping, filtering and histogram equalization techniques. The classification process of the diseases is done using SVM. *Gunasekaran S. et al., (2021),* introduced delta tributary network, a novel deep learning technique that can replace the bottleneck DCNN architectures for plant disease detection and classification. *Nihar V. et al., (2021)* proposed a novel neural network ModCNN that produces an accuracy of 97.69% in finding the common diseases affecting the plant leaves.

Ghorai A.K. et al., (2021), illustrated a model to detect the nutritional deficiencies and diseases affecting the plant leaves. In this paper, pre-processing is done using color space models. The major filtering techniques followed here are Gaussian, Mean, Rank, Laplacian and Bilateral. *Selvaraj M.G. et al., (2019),* introduced a DCNN based detection system to detect the diseases and pests infecting banana plants. A deep transfer learning is used here to develop a network that can make accurate predictions. ResNet50, InceptionV2 and MobileNetV1 are the three architectures used in this system.

Lin H. et al., (2021), developed a model that can process the leaf disease image using the color features compositing and detection method for the lesion segmentation. PCA method is used to remove the features and simplify them. *Afzaal. H et al., (2021),* explained a system to investigate the Early Blight disease in potato plant throughout its growing stages. Deep Learning models mainly GoogLeNet, VGGNet and EfficientNet are trained using the PyTorch framework. *Brenes et al., (2021),* proposed a system to detect the diseases infecting horticultural crops. Tomato and bell pepper leaves are taken to perform the experiment. In order to classify the diseases a custom created model classifier along with a pre trained DenseNet-161 classifier is implemented. *Gargade A. et al., (2021)* introduced an automated computer based model to detect the nutritional deficiencies and some of the leaf diseases in custard apple plant. The algorithms applied for the classification are SVM and K Nearest neighbor. Supervised machine learning is adopted in this work using image processing tools. *Kartikeyan P. et al., (2021),* reviewed some of the emerging trends in the area of plant disease identification and classification. This paper discusses the established techniques used for the extraction of features and image segmentation. Some classification techniques such as SVM, ANN, and KNN are studied and compared based on the accuracy and performance. *Patel A. et al., (2021),* made a brief report on the image processing tools and machine learning algorithms that are used to identify the variety diseases affecting the banana plant. The other methods and technologies used in the detection and classification processes are also analyzed and discussed.

Patil A. et al., (2021), developed a system that uses SVM and KNN algorithms for the classification of diseases. The feature extraction technique used here is GLCM (5). Comparison with the existing traditional methods is also done in this paper so as to prove the high efficiency of the proposed system. *Dalal T. et al., (2021),* illustrated a study of leaf disease recognition and classification using multiple CNN algorithms. A comparative study on various training methods and feature extraction techniques are also done in this work. *Xiao et al., (2021),* introduced a CNN based model to identify the diseases affecting strawberry plant leaves. The architecture of this model is based on ResNet50. *Anagnostis et al., (2021),* proposed a system that can detect and classify anthracnose infected trees from the walnut orchards. A deep learning methodology is followed and achieved an accuracy of 87%. *Shah et al., (2021),* illustrated a model utilizing image processing techniques such as segmentation, feature extraction and disease classification to detect the infections affecting the plants. Cotton leaves images are considered for the process. *Maheshwari K. et al., (2021),* introduced a model to analyze the performance of diseases affecting the mango leaves using machine learning techniques. This model is based on the LeNet architecture. Here the classification is done using KNN and CNN algorithms. *Nandhini et al., (2021),* developed a model that utilizes CNN approach to classify bacterial spot, Septoria leaf spot, late blight, and Tomato mosaic virus, four types of diseases affecting the tomato leaves without any manual intervention. The model achieved an accuracy of 99%. *Hasan M.Z. et al., (2021),* proposed a system that is able to detect and classify the diseases affecting the Betel Vine leaves by applying machine learning tools. Various computer vision and machine learning approaches are compared here. *Yadav S. et al., (2021),* developed a bacteriosis detection and evaluation system in peach leaves. Here the image processing technique, segmentation of the leaves images is done automatically. This model achieved an accuracy of 98.75% on 240 testing images.

Islam M.A. et al., (2021) introduced a paddy leaf disease recognition system using deep convolutional neural networks. This system detected four different types of diseases affecting the paddy leaves. Four architecture models VGG-19, Inception- ResNet –V2, ResNet-101, Xception are analyzed and computed in this paper. Inception – ResNet – V2 gives an accuracy of 92.68%, which is the highest. *Tiwari et al., (2021)* illustrated a plant disease detection system that uses deep convolutional neural networks to classify the diseases.

In this work, six crops of twenty seven categories are considered to check laboratory and on field conditions. *Pandey C. et al., (2021),* developed a system that consists of fully automatic segmentation of plant leaves which is followed by spatial domain feature extraction and SVM to predict the diseases. *Bhargavi K. et al., (2021),* reviewed the common CNN architectures that are used for plant disease recognition such as AlexNet, ZFnet, VGGNet, ResNet, GoogleNet, and LeNet. They are compared using the design and advantages. In terms of accuracy and error rate ResNet and ZFnet gives higher efficiencies.

Hu G. et al., (2021), proposed a tea leaf blight identification system that uses a deep learning technology also called faster region based convolutional neural network. It improves the recognition performance of the blurred images. The severity of the TLB is accurately classified using the VGG16 deep learning model.

RESULTS AND DISCUSSIONS

This survey provides an overview of the latest works done in the plant disease recognition and classification field using machine learning techniques. We have taken 80 research papers that used various machine learning techniques for the comparison study. Articles *(Bisen D., 2021; Badage, 2018; Singh. V., 2017; Kadoli V., 2021; Singh V., 2020; Ganatra N., 2020; Abdullahi H.S., 2017; Deepalakshmi P., 2021; Oo, Y.M., 2018; Geetharamani, 2019; Nandhini S., 2021; Shrestha G., 2020; Gunasekaran S., 2021)* have taken many varieties of plant leaves as the input data (Table1). The performances of these models are studied with the other papers that are focusing on some particular plants and diseases. Also the accuracy rates of these models are very high. Convolutional neural network, Support vector machine, K-means clustering and random forest are the common architectures followed in most of the recent works.

Among these architectures, VGG16, ResNet50 and LeNet5 of Convolutional Neural Network provide high efficiency systems. This is described in article *Huang Z., (2020); Ngugi. L.C, (2020); Bedi P., (2021); Lin H., (2021); Xiao, (2021); Islam M.A, (2020); Bhargavi, (2021)*. In most of the papers, we can see that the crop leaf images are used as the input dataset. This should be rectified in the future research works by including other plant part images also as the datasets. The crops considered for disease detection in these 80 research papers are listed in Fig 1. From this graph we can say that only few works have been done in some plants (*Xiao et al., 2021; Anagnostis et al., 2021*). Equal care and importance should be given to all plants so that we can improve the agricultural sector.

Table 1

Summary of the review papers in terms of Architecture and Accuracy

Article	Architecture and Validation	Leaf type	Accuracy
[7]	Extreme gradient boosting decision tree (XGBOOST)	Rice Leaf	86.58%
[11]	CNN	15 classes of leaves are considered.	97%
[53]	TensorFlow, ANN	Paddy leaf images	
[8]	Canny Edge Detection	Wheat, Cotton	
[64]	Grey level Co-occurrence, SVM	Potato	95.99%
[35]	K-Means Clustering, SVM	many varieties	85%-88%
[38]	SVM, Logistic Regression, Decision Tree, Naïve Bayes, Random Forest.	Rice Leaf	90%
[54]	CNN	Rice Leaf	90%
[60]	Deep Residual Neural Network	Tomato	98%
[67]	CNN	many varieties	98.60%
[49]	Naïve Bayes, Decision Tree, KNN, SVM, Random Forest	Maize	79.23%
[19]	DCNN	many varieties	88.80%
[1]	ANN, SVM, Fuzzy logic, CNN	many varieties	99.58%
[15]	CNN	many varieties	94.50%
[47]	K-Means Clustering, SVM, Local Binary Pattern	many varieties	89%
[57]	CNN, ReLU	Cassava	93%
[55]	DCNN	Cassava	93%
[21]	DCNN	39 Leaf varieties	96.46%
[44]	CNN	Tomato, corn, apple	96%- 98%
[62]	CNN	many varieties	88.80%
[9]	LeNet-5	Peach	90%

Table 1
(continuation)

[26]	Deep Siamese CNN	Grape	90%
[27]	Delta Tributary Network	many varieties	96%
[39]	PCA and Machine Learning	Pumpkin	97.30%
[20]	KNN, SVM	Custard	99.50%
[30]	VGG16, Faster Region based CNN	Tea leaf	95.74%

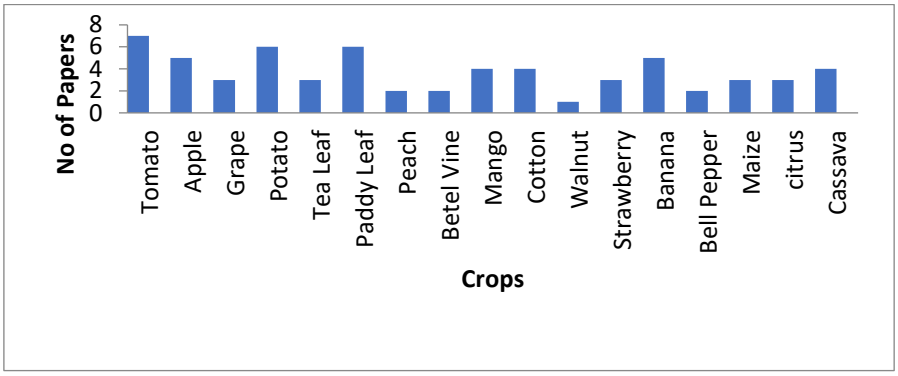

Fig. 1 -Agricultural crops considered for the computer based automated plant detection system

CONCLUSIONS

This survey gives an idea about the importance of the plant disease detection and also about the adverse effects if it is not done on time. Early recognition of the disease and subsequent treatment is the best solution to adopt in such cases. For this, we need accurate automated plant disease detection systems. With the help of such technologies the plant disease detection system automatically detects the symptoms that are visible on leaves and stem of the plant and helps in nurturing healthy plants of the farmland. Thus increases the yield and quality of the agricultural products. In this paper, study on the existing systems have been done and compared in terms of the time and accuracy. The architectures that are used to build the models are also studied and analyzed based on the performance and accuracy.

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