A SURVEY ON LATEST METHODOLOGIES FOR THE IDENTIFICATION OF PLANT LEAF DISEASES

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ABSTRACT:

Agriculture is the science and art of cultivating plants and livestock. Several studies show that the quality of agricultural products can be decreased by some causes. Plant diseases are one of the most important factors in this quality. For an agriculture-dependent state, early and precise identification of the diseased plants is a priority. Several works are presented in the area of plant leaf disease identification by using deep learning. But still, this field is challenging to the researches to improve the better accuracy and efficiency. This survey will help researches to identify the diseases in plants by using the latest methodologies. And also our survey helps to recognize key problems and shortcomings in this field of research.

Keywords: Leaf disease identification, CNN, Deep Neural Networks, AlexNet

INTRODUCTION

Agriculture is a Latin word incorporating two Latin words: Agric/Ager + Cultura= Agriculture. Agric / Ager means Soil & Culture means Cultivation. The food we consume whether directly or indirectly, comes from agriculture itself. Agriculture is very broad-related to crop production-cereals & pulses, fruit and vegetable production, milk production, meat production, fish production, oil production, sugar production, forage production, fiber production, and all processed food products are part of agriculture.

In India, yields per hectare of crops are generally low compared to international norms, despite the vast scale of the agricultural sector. Another issue in India's agriculture is plant disease. Grain loss due to plant diseases and pests constitutes about 10 percent of the total loss of crop production[1]. Since recent days, farmers are also often detected with their naked eyes on crop diseases, which makes them take tough decisions regarding the use of fertilizers [12]. This needs a thorough understanding of diseases and a lot of experience required to ensure the diagnosis of the actual disease. Some of the diseases appear almost similar which leads to farmers confused with the disease occurred to their crop. We need more accurate and optimal instructions on how to use fertilizer to properly identify diseases and to differentiate two or more related kinds of diseases in the visual field to avoid this.

Microscopic diagnosis, spectroscopic approaches and molecular biological are the strategies for diagnosing plant diseases. Microscopic diagnosis takes a lot of time and can be arbitrary, even professional plant pathologists can identify diseases incorrectly. The spectroscopic detections and molecular biological are more precise, but research is more difficult, complex and costly.

Different modern technologies have evolved to reduce post-harvest production, improve farm resilience and optimize profitability. Many laboratory methods were utilized for disease detection, such as polymerase chain reaction, gas chromatography, mass spectrometry, thermogram, and hyper-spectral techniques [1]. Such methods, though, are not inexpensive and time consuming.

Many approaches, whether under managed or actual circumstances have been used to establish methods of recognition for cultivated environments. The techniques were primarly based on near-infrared and visible reflection analysis, the creation of different indices of vegetation or even model analysis.

New approaches, such as deep learning and machine learning algorithms, have been used to increase the detection rate and precision of tests. Several studies have been conducted for the identification and diagnosis of plant disease in the area of machine learning, such as traditional approaches of machine learning artificial neural networks, random forest and support vector mechanism [1] (SVM). And also several kinds of research have been done on image object detection based on CNN (convolutional neural networks), R-CNN (region-based convolutional neural network), Fast-RCNN and Faster-RCNN.

LITERATURE REVIEW

In the paper "**Deep learning models for plant disease detection and diagnosis"**, K.P. Ferentinos et al. [2] Proposed a CNN architecture to distinguish 25 Different crop types with 58 distinct numbers of diseases. The author uses the Dataset contains 87,848 no of images that are collected from the open database. They use 70,300 images for the train network and 17,548 images for the test network. The trained model gets the best performance of 99.53% by using AlexNet and VGG deep learning aproaches. The main motive of the research is to implement the automated plant disease detection system that enables the formers to buy appropriate pesticides for their crop disease.

In the paper "**Classification of Maize leaf diseases from healthy leaves using Deep Forest"**, Jatin Arora et al. [3] Proposed a deep forest algorithm built on 3 major principles. Layer by layer processing, In model feature transformation and appropriate model complexity, are the reason behind the rich accomplishments of deep models. The author uses an original dataset containing 100 images for each category (Exserohilum (northern corn leaf blight disease), Puccinia sorghi (common rust disease) and Cercospora (gray leaf spot disease) and healthy leaves) for maize leaves each having a dimension of 64*64. The author shows that gcForest outperforms some well-established Deep Neural Networks (CNN, LeNet5) and other traditional machine learning algorithms including SVM, RandomForest, LogisticRegression, kNN and Decision Tree for image classification. And also by using the Deepforest algorithm authors achieve maximum accuracy of 96.25%and maximum F1 score of 0.9624 among all other models [4].

Jing Chen et al. [5] presents a framework for CNN, known as LeafNet, built with different size extractive filters, which automatically extract images from features of tea-plant diseases in his paper "**Visual tea leaf disease recognition using a Convolutional neural network model**". Dense Scale-Invariant Feature

Transform (DSIFT) features are extracted used to construct a bag of visual words (BOVW) model to identify diseases by multi-layer perceptron (MLP) and support vector machine (SVM) classifiers. The three classifiers were then independently tested for the accuracy of disease identification. The LeafNet algorithm more efficiently recognized tea leaf diseases, with an overall identification accuracy of 90.16 %, while the MLP algorithm was 70.77 % and the SVM algorithm was 60.62%. With the background investigation, the authors found that the LeafNet was technically superior to the SVM an MLP algorithms for the identification of tea leaf diseases.

An approach "**Identification of Apple Leaf Diseases Based on Deep Convolutional Neural Networks"**, Bin Liu et al. [6] was using 1,053 original images of apple diseased leaves, followed by creating 13,689 augmented images by pre-processing. The project involved evaluating SVM, BPNN and five CNN architectures such as, GoogLeNet, VGGNet-16, ResNet-20 and AlexNet. The redefined AlexNet has obtained the best results by detecting four types of specific apple leaf diseases, which is 97,62 % accurate. This work focused on the preprocessing of images so that the real environment would be simulated and an improved CNN could be generated by utilizing computational resources efficiently. As for future work, the authors recommended the Faster R-CNN, YOLO and Single Shot Detector (SSD) algorithms for disease identification and the extension of the dataset was noted.

Jayme Garcia Arnal Barbedo [7] describes the problem of automated detection of plant disease is due to the deficient in image databases that represent the broad diversity of conditions and symptoms encountered in the Approach "**Plant disease identification from individual lesions and spots using deep learning**". Data enhancement strategies reduce the impact of this issue, but they can not replicate most of the realistic complexity. This paper discusses the utiliation of specific spots and lesions instead of bringing the whole leaf into account. As every region has its own features, the consistency of the data is improved without the use of extra images. On the other side, the appropriate segmentation of the symptoms must still be done manually to avoid full automation. On average, the accuracy obtained by using this method was 12% better than the accuracy achieved using the original images. However, even if 10 diseases are considered, no crop has less than 75% precision. While the dataset does not cover all the practical problems, the results shows that deep learning techniques are successful for the identification and classification of plant diseases as long as adequate data are available.

Malusi Sibiya et al. [8] ("**Classification of Maize Leaf Diseases Out of Healthy Leaves Using Convolutional Neural Networks"**) describes the problem for the identification of plant disease using experimental methods where time utilization cannot protect large areas for the identification of plant diseases. They are designing a CNN model to distinguish three specific types of diseases of maize crop from healthy leaves. Exserohilum (Northern corn leaf blight), Puccinia sorghi (common rust) and Cercospora (gray leaf spot) are the three popular diseases for maize. In order to identify and distinguish maize leaf diseases from healthy leaves, the Neuroph Studio Platform was commonly used to develop a CNN with hidden layers of 50. The network has been trained by 100 color images of healthy leaves and diseased leaves with 10* 20* 3 (height* width* RGB) resolution The average accuracy of CNN classification was 92.85%. Future work is planned to determine the output of the CNN, which is trained on biotic stressed and evaluated on the abiotic stressed data.

A research was conducted out by Pujai et al. [9] ("**SVM and ANN Based Classification of Plant Diseases Using Feature Reduction Technique"**) to compare the support vector machine (SVM) and Artificial Neural Network (ANN). To extract the texture and colour features algorithms have been evolved which were used by training ANN and SVM classifiers. The research introduced a reduced feature-set strategy for identifying and classifying images of plant diseases. Findings showed that the SVM classifier was increasingly accurate to detect plant diseases and for classification. The SVM classifier scored 92.17% better than the 87.4% accuracy of the ANN classifier.

In the approach "**Can Deep Learning Identify Tomato Leaf Disease?"** by K Zhang et al [10] apply a Deep Convolutional Neural Network (DCNN) to the detection of diseased tomato plant leafs through a transfer learning. GoogLeNet, ResNet and AlexNet have been used as backbone of the CNN. The combined model was used to remodify the structure, with the goal of improving the efficiency of full training and fine tuning of Convolutional neural networks along with the Adam optimization process and SGD. The optimized ResNet model of stochastic gradient descent (SGD) reaches the best precision of 97.28% for detecting tomato plant leaf diseases.

Sladojevic et al. [11] ("**Deep Neural Networks Based on Leaf Image Classification Recognition of Plant Diseases"**) developed a fine-tune deep convolutional neural network to automatically identify and diagnose 13 types of diseased plant leafs in 4 crop species. In the meantime, their model was capable of distinguishing plants from their backgrounds. With the available database of 4483 original images they created a total of 33469 augmented images. In that they use 30880 images for training the network, and 2589 images for testing the network. They got an average of 96.3% precision. It is noted that the precision of the learned model was marginally less for smaller image classes in the training dataset.

In the paper "**Plant disease and pest detection using deep learning-based features**" Davut HANBAY et al. [4] proposed a deep CNN based system which is developed by a classification issue for the identification of plant and pest diseases.. In this approach, a dataset is used which contains real field diseased plants and pest images from Turkey. Authors first use the same data set for deep feature extraction dependent on the deep learning frameworks: VGG16, VGG19, AlexNet, GoogleNet, ResNet101, ResNet50, InceptionResNetV2, InceptionV3, and SqueezNet. The features obtained from these deep learning models are classified by SVM, ELM, and KNN. Finally, authors evaluate the overall performance by deep feature extraction and using transfer learning methods. The findings indicate that the suggested model is more accurate than transfer-learning-based networks in terms of computational complexity and classification accuracy.

CONCLUSION

The backbone of the Indian economy is agriculture. Automated plant disease diagnostics was one of the most successful fields of research in agriculture. Plant diseases are doing substantial harm to crops by major yield declines. In order to avoid losses of production and failure or decreased quantities of agricultural goods, prompt and effective detection of plant diseases has a significant role. Methods focused on deep learning may be utilized to solve such problems. This survey will help the researches to identify the plant diseases by using the latest deep learning methodologies.

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