A Systematic Review on Artificial Intelligence Based Detection and Classification Technique of Major Crops Diseases

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Abstract:

In our country, Agriculturesector is playing important role due to population growth and increased demand for food. Agriculture sector provides food to all the human beings even in case of rapid increase in the population. Detection of crops disease is a one of the important and tedious tasks in agricultural sector. It requires huge time as well as skilled labour. But it unfortunate to predict the diseases at the early stage of the crops. Crops diseases are one of source of embarrassment. In the quality and productivity of crops which can lead to the shortage of food supply. Therefore, crops disease classification and detection are essential to the agriculture sector. In the field of agriculture, it is recommended to predict the crops diseases at their early stage. The disease in crops can be detected and treated at an early stage. One of these important effects on low crop yields is diseases caused by bacteria, fungi and viruses. So, machine learning and deep learning techniques could play a pivotal role in detecting and classifying the crops diseases at an early stage. This research article proposes a smart and efficient technique for detection and classification of crop diseases which uses computer vision and machine learning techniques. In this article, the authors addressed and evaluated the various currently existing states of art methods and techniques based on machine and deep learning. In this survey it observed that Convolution Neural Network gives high accuracy and detects a greater number of diseases of multiple crops.

Keywords: Agriculture, Crops Diseases, Detection, Classification, Machine Learning.

Introduction:

Agriculture is the backbone of Indian economy, to contribute the overall economic growth of the country. As compared to world our productivity is very less due to the use of obsolete farming technology. Nowadays people from rural areas migrate toward an urban area for other profitable businesses, and they

can't focus on agriculture. India is a land of agriculture. Two-third of population relies upon farm for their livelihood. This is basic foundation of economic development of the country. The quantity and quality of agricultural productivity gets affected and reduced by crop diseases. Nowadays, in monitoring large area of crops, detection of diseases of crops receives much greater attention. The symptoms and signs of diseases are apparent in distinct crop parts, but among all different parts, the most noticeable parts for disease detection are considered to be leaf. Agriculture isn't just a sustaining source in present times, but it has become much greater than that. Agrarian productivity reflects a broad part of profitable affair, which is the major cause that recognition of complaint plays a major task.

Crop disease diagnosis is very crucial task for every farmer and individual in order to prevent various losses like less productivity, less quality and quantity or it can also lead to defective yield. Therefore, early identification and early detection can help to save the crop yield and also the quantity and quality of the production can be preserved by proper treatment and solution required from time to time. The automation system will help in identification and also diagnose the disease of the crop. Since crop disease is one of the important factors which can affected on the quantity and quality of the product. Machine learning and image processing can be used to detect the disease and identify the diseases on the crop. Farmers are facing various problems like global climate change; vegetation diseases are many causes of crop loss the product that causes farmers to commit suicide. To overcome these problem researchers had come with several solutions through the development of new technologies such as object detection, and image processing for the quality assessments.Our proposed system includes various phases of implementation namely dataset creation, feature extraction(includes shape, colour, and texture), training the classifier and classification. The extraction of leaf helps to identify the actual level of chlorophyll and nitrogen which may help to interpret future predictions. Due to the several reasons like that lack of awareness about latest technology, high cost of the technology; many farmers cannot go to embrace modern agriculture.

In recent era, learning based on artificial Intelligence applications has achieved productive output and also machine learning based techniques have good performance in many image processing applications. Machine learning is a one of techniques which train the system; it can learn automatically and improve the results with its own experiences. Crops have suffering from many different types of diseases which exist in the crops like fungal, bacterial, viral etc. It is necessary to take action for control the crop diseases as well as detection and classifications using machine learning and deep learning can help the famer to identify the diseases. to detection of crops diseases machine learning and deep learning techniques are more accurate and less time consuming compared to the traditional image processing techniques. Sometimes texture property of crops leaf varies due to the change of environment. Researchers are facing major issues in the agriculture field of unavailability data set for each and every disease like background noise in captured images, low resolution images. This proposal intends to develop a new model that accurately detect and classify the crop diseases of leaves at the early stage of diseases by using Artificial intelligence based on various supervised machine learning classification techniques such as NB, KNN, DT, SVM, CNN, ANN and RF for crop disease detection and classification from crop leaf and also a comparison is made among the several classification techniques. Depending on location, season and environment there are many

diseases that affect yields. Out of them blight, canker, rust, scab, mosaic and rot are most common diseases which affect the crops.

Review of Literature:

Sunil S. Harakannanavara et al. [2022]this article study that machine learning approaches such as SVM, KNN and CNN are used to distinguish diseased or non-diseased leaf on tomato. The proposed model system is well suited for CNN machine learning classification technique with a desired accuracy compared to other state of the art method. Thesemodels may be improved using fusion techniques for extraction of significant features and examined for other crops leaf samples of datasets in future. The techniques such as SVM, KNN and CNN are used for classifying the samples. The CNN is a type of ANN which is designed to process the data. The extracted features are classified.

Chetan HRet al. [2022] proposed machine learning algorithm is to identify and categories the disease that occurs in plants. In his research work they consider early blight, sectorial leaf spot, curl leaf and late blight four diseases that mainly occurring in tomato and chilly plant. They propose machine learning and image identification technique to recognize and classify the disease. In their work they have considered total 450 images involving the image of disease like Septoria leaf spot, curl leaf early blight and late blight; also, they used Gaussian filter use to remove noise in images. Feature segmentation was done by K-means clustering. For converting color from RGB to HIS, Feature extraction was used. Researcher was used only one classifier technique such that CNN to classify and identify the plant disease. Their proposed work provided an overall efficiency of 85.03 percent.

Khalil Khan et al. [2022] studied of this article, I conclude that the proposed model system predicts the nature of the disease of the tomato crops and tells how much area of a specific leaf is affected due to a certain disease. This proposed model successfully classifies tomato crops leafsinto ten distinct classes. They evaluate their model with the standard dataset Plant Village and notice much better results than previous results. Along with the Plant Village database, they also collected a database of more than 20000 images and tested their framework on it. In the future, they intend to analyze some more tasks to develop robust continual DL models and considering some complex combinations of the neural network along with information extraction.Researcher tests the proposedCNN-based model on the publicly available database and they get an average accuracy of 97.6 percent.

J. Karthika et al. [2021], the research is focused on developing a model to boost the detection of cotton leaf disease and pests using the deep learning CNN technique. Researchers have used common cotton crop leaf disease and pests such as bacterial blight, spider mite, and leaf miner. K-fold cross validation strategy was worn to dataset splitting and boosted generalization of the CNN model. The model applied made a supervised learning technique on datasets with four prime feature extraction process and 2400 datasets.

N. Nandhini et al. [2021], in this article the diseases in the initial stage were addressed by pre- processing the image. Then the features are extracted and then the green masking pixel is done by using the thresholding constant value 0-255.The performance measures are taken into consideration for better results

by comparing the two algorithms Principal Component Analysis (PSA) and Support Vector Machine (SVM).

Habiba SU et al. [2021], in this paper author work on deep convolutional neural network model were used to recognize unhealthy crops from the healthy crops and to classify the tomato crop diseases. Author was used VGG16 deep CNN classifier to recognize unhealthy crops and their diseases from the images of tomato crops. Author will use Plant Village dataset which is contains ten different classes of tomato leaf images including healthy plants. Using transfer learning method in a pre-trained VGG16 model, this dataset shows a satisfying classification performance which about 95.5 percent.

Patil B. and Barkpalli V. [2021], give the view of cotton crops healthy and unhealthy condition using different machine learning algorithms with WEKA. Under controlled conditions cotton leaf dataset was created by taking images in the field with natural background. He has been collected dataset contained near about 3000 images of two different classes healthy and unhealthy leaf for training and testing. Modified factorization-based active contour was used for image segmentation. Two different features based on texture and color were extracted from segmented images which were used for training and testing by different machine learning algorithms like RF, NB, SVM, Ada Boost, KNN and MP. Performance of classifiers was better with color feature to classify healthy and unhealthy leaves. WEKA was used for the analysis of different classifiers by feeding the same features. Multilayer perceptron gave classification performance of 96.69% from other classifiers.

RehanSarwaret al. [2021], In this research article performed object detection on cotton leaf images collected in Pakistan to detect diseases on leaves in field conditions. To increase the yield and correctly identifying the cotton crop leaf diseases, machine learning and deep learning is used to train an object detection algorithm on a dataset collected. Firstly, they trained the Plant Village dataset which is contained leaves of fruits and vegetables in laboratory conditions. Author apply different models are used to find the best feature extractor that could be applied as a base model in object detection. They are VGG-16, inceptionV1, and V2. In here research result says InceptionV2 extracted the best features from the dataset and mean average precision (map) is 0.871 or 87.1 percent.

Tejashree Soni et al. [2020], In the paper researchers proposed a machine learning approach for crop yield improvement using plant leaf disease detection. Detecting and classifying sorghum leaf diseases as Leaf blight, Sooty Stripe, Zonate Leaf Spot, and Rough Leaf Spot are the main objectives of the proposed model. Researcher collects the necessary data from field. Hence, to get the quality data different preprocessing techniques were applied. Towards creating a classifier model, the researchers have used the Alex-Net classification algorithm. The developed classifier model, Alex-Net consists of the first 5 Convolutional layers and the last 3 fully connected layers, in between; there is a pooling and activation layer. However, in this study, the researcher concludes that the selected algorithm is the better classifier without any justification may other classifiers will achieve better accuracy. Nothing was reported on the accuracy of their classifier model. In addition, what kind of test options are implemented, and the number of images is not stated.

KarunaM. et al. [2019] Smartphone-based diagnostic system for chili crop health that use machine learning technique to solve the problem of identifying disease in the field from analysis of plant leaf images, author presented it. They have shown how extract the relevant features that represent disease from the leaf images and train machine learning algorithms to be able to differentiate diseases based on these features. Basically, author developed a system that successfully recognizes different diseases in images collected in real scenarios. Their proposed detector uses images captured in place by smart phone camera that are processed by a real-time hardware and software system using graphical processing units (GPUs). He used to consist of 225 images of leaves of chili plants and these datasets are collected from Plant village website also they are not mentioning accuracy of testing model. One of drawback of these system is to Particular dependencies of the system are the farmer must have a Smartphone and a working data connection.

Summarizes various researchers conducted for crop diseases detection and Classification:

Year	Author	Crops	Data set	Methodology	Algorithm / Technique
2023	HoudaOrchi et al.	Crop images	PlantVillage	Image Preprocessing, Image Segmentation, Feature extraction	SVM, LDA, KNN, CART, RF, and NB
2022	Sunil S. Harakannanavar et al.	Tomato	PlantVillage &Own dataset	Convolution Neural Network, Conventional Method	SVM, KNN and CNN
2022	Muhammad Suleman Memon et al.	Cotton	Own dataset	Image pre-processing Image Annotation, Image Augmentation	CNN, VGG16 Transfer Learning, ResNet50
2022	Chetan H R et. al.	Tomato and Chilli	Own dataset	Pre-processing, Feature segmentation, Feature extraction	CNN
2022	Sandeep Kumar et. al.	Cotton	Own dataset	Image Classification, Feature Extraction, Activation Function	CNN /Tensor Flow
2021	Singh B P et. al.	Soyabean	Plant Village	Image pre processing Feature extraction	CNN
2021	DagimFirideYimenu	Sorghum	Own dataset	image pre-processing Gabor filter	CNN
2021	Consuelo Gonzalo-Martín et al.	Sorghum	Open Dataset	Image pre processing Feature extraction	RetinaNet
2020	Tejashree Soni et al	Sorghum	Plant Village	Image pre processing feature extraction, Filtering,	MobileNet, R-CNN, Alex-Net
2020	Chen Junde, Zhang, et. al.	Rice, Maize	Public dataset & Own	-----	CNN, ImageNet
2020	Kshyanaprava Panda Panigrahi Et. al.	Maize	Plant Village & Own dataset	Pre-processing, Image Segmentation, Feature extraction	NB, DT, KNN, SVM, RF
2019	M. Karuna	Chilli	Own dataset	Leaf features inspection, Color transformation, Feature extraction	CNN

Outcome from Literature Review:

From the above survey it can be concluded that the machine learning and deep learning is far better than the traditional methods. Lots of researchers use SVM, KNN and CNN classification technique. Some dataset has been captured in standard situation that means in absence of noise. So, the performance of an algorithm will be degraded due to noise comes in a picture. After surveying most of research article one major limitation was found that many researchers have research in their work to detect and classify plant leaf diseases. This is not suited for detection and classification of crops leaf diseases. Many researchers have research in their work on some crops but they found very few diseases and classified them with low accuracy.

Research Questions:

1. What factor influence the performance of AI algorithm in crop diseases detetction and classification?
2. Which features extraction techniques is the best for classifying crop leaf diseases?
3. Can artificial intelligence algorithm accuraly detect and classify different type of crop diseases?
4. Which training methods are more appropriate for classifying crop leaf diseases?
5. What are the benefits of Artificial Intelligence based crofs leaf diseases detection and classification ?

Expected Research Outcomes with Beneficiaries:

The main motive of this research study is to may be achieved objective and to find out the research questions answered. The researcher will try to find the proper answer of research question; and will be try to improve and achieve high level of accuracy using this method.The expected output of this research is to analyze various artificial intelligent techniques used to detect and classify crop leaf diseases and also try to develop a new model for major crop leaf disease detection and classification with higher accuracy. Advantages of this proposed system is to reduce the human effort and automatic detect the diseases with high accuracy and increase crop production of former. Proposed system is cost effective and scalable.

Significance of the study:

The proposed system will help the farmers to periodically monitor the cultivated crop. As a result of the study, pathologists, agricultural extension specialists, farmers, and the government will be better able to comprehend the significance of artificial intelligence in general. In addition following are some significance of this research.

- It will help farmer and agricultural workers to easily detect and classify the major crop disease at the beginning stage. And also, the developed model provides reliable, less time-consuming, coast effective.
- For the government, the annual production of major crops will increase; hence the crop will not only be for local consumption rather the opportunities for exporting the crop this can increase foreign currency.
- Last but not least, this study will provide information to other academics who are interested in conducting additional research into the issues associated to image processing and crop disease.

Conclusion:

The purpose of this review article is to study the existing technology of detection and classification technique of major crops diseases using machine learning. The proposed system used to make present technologies for real time monitoring. Also the study helps us to understand the various problems in existing research methods. We know that crop leaf majorly suffering from the microorganisms such as bacteria, fungus and viruses. This crop production is damaged due to different factors among them. These diseases reduce the quality and quantity of major crops. These diseases affect different parts and stages of the crop that significantly reduce its productivity. Hence, detection of these diseases through a system is critical. Therefore, in agriculture field artificial intelligence with Image processing techniques are plays important role in the research.

After surveying as well as review most of research article should be found that many researchers have research in their work to detect and classify plant leaf diseases using deep learning and machine learning. Deep learning can be thought as a learning method on neural networks and deep learning is that it can extract features from images automatically. The neural network learns how to extract features while training. Researches now make it possible to make automatic crops disease detection from raw images.

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