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Plant Disease Prediction System Using Machine Learning

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Abstract:
Plant diseases pose a significant threat in agriculture, leading to reduced crop yields and economic losses. Early and accurate detection of plant diseases will help to mitigate these effects by allowing timely intervention. This system uses a dataset of plant images infected with various diseases, which will pre-process and classified using advanced algorithms like convolutional neural network. This paper presents a plant Disease and system that leverages machine learning and image processing techniques to identify and predict diseases of plants [1]. It will assist in good decision making and prediction of the correct output. They proposed system can recognize disease and pattern of leaves, steam, and fruits. This innovation has potential to significant contribute in agriculture, food and we can enhance agriculture productivity and reduce on chemical treatments.

Keywords: Plant disease prediction, machine learning, image processing computer network

1. Introduction:

Plants needs tremendous quantity of labor, expert with the plant disease, and need more time of interval. Hence, image processing and machine learning model which can employed for the detection of plant diseases. We described the technique for the detection of plant diseases with help of their leaf's pictures. The main aim is to know the training data and fit it into model which should be useful for the people in the field of agriculture. It is the part of artificial artificial intelligence which can work automatically to do given task. So, it will assist you in better decisions making and predicting the correct solution using the data.

In order to obtain the highest accuracy, we examined several textural parameters and images in this research to identify various plant leaves. Classification is based on the color of the leaves, the degree of leaf damage, and the area and textural parameters. Identification of plant disease is important to prevent the losses within the yields [1].

Hence, image processing and machine learning can be used for detection of plant. In this project we described the technique for the detection of the diseases with help of their leaf photo. A subset of signal processing called image processing is capable of extracting information and features from images. It requires less time for prediction the deep learning approaches.

Plant disease and pests' detection is very important research in the fields of machine learning. At present, this equipment has been used in agriculture and has replaced the traditional eye identification on

some extent. Agriculture biodiversity is essential for providing humans with raw material and foods which is an essential component of human needs. [3]

The disease can occur when pathogenic organism, like fungi, bacteria, and nematodes, temperature extremes; changes in the quantity of moisture and humidity in the air. Plant disease can have an impact on the growth, structure and function of plant and leaves, affecting people to relay on them. The majority of people stills use traditional method to detects and classify plant elements [2]. If the proper precaution is not taken, it will cause serious consequences to the plant by the quality and the quantity of productivity of the corresponding product. Atomic disease prediction and detection and classification will recognize symptoms at an early stage of growth.

2. Main Concepts:

A wide range of agriculture diseases will arise at various stages of development and harm the plant's growth ,which will have a negative impact on overall crop production. Plant disease are caused by a variety of condition at various phases of development. As summarized in, crop disease-causing variables of categorized into two: biotic factors. Biotic factors such as viruses, fungi, bacteria emerge as a result of microbial infection in plants, whereas abiotic variables like temperature, irradiation, water and nutritional deprivation damage plant growth [4]

Consequently, a few plant leaf specimens with various diseases from the plant database, as well as other images from other databases that depict both healthy and diseased plant leaves, have been incorporated into the study. Additionally, other datasets that depict both healthy and infected leaves have been compiled in the works of and in accordance with [1]. Also, this detail computer vision grounded on ways and processes including field crops, image accession leaves image dataset, image preprocessing, data splitting, and performance assessment styles for bracket and plant disease have been easily indicated in work.

In early detection and classification of plant diseases which is critical for increasing agriculture productivity. Diseases reduce crop result by having negative impact on plant. For farmers and specialists, predicting plant diseases is a significant difficulty in the agricultural industry. With the help of Artificial intelligence we can increase crop productivity by detecting and classifying plant leaves diseases at the very early stage so they doesn't get spread to the other plant in the field.

Machine learning and artificial intelligence play significant roles in plant detection by analyzing large amounts of plant data. Convolutional neural networks (CNNs) and other deep learning algorithms can be trained to recognize and classify plants based on their unique features, enabling high accuracy in distinguishing between different species and conditions. These models improve over time as they are exposed to more diverse data, making plant detection more efficient and scalable. In agriculture, this technology aids in detecting diseases, pests, and nutrient deficiencies, while in ecological monitoring, it assists in identifying plant species and tracking biodiversity changes.

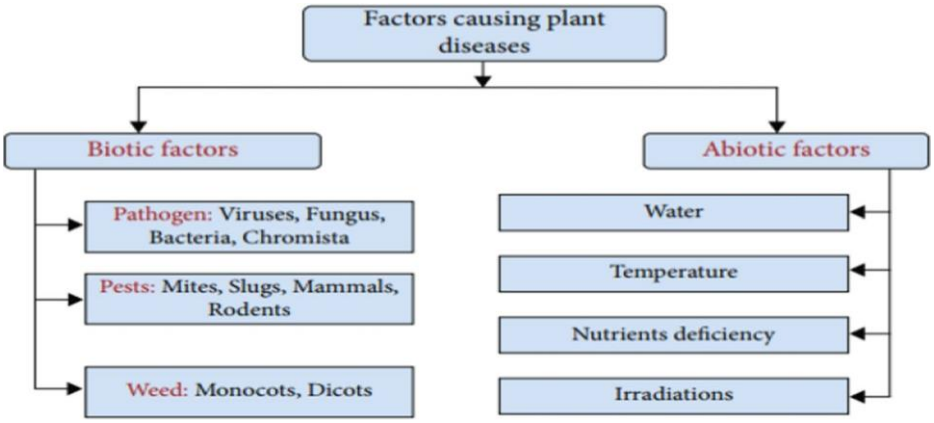

Fig. 1 Factors responsible for plant diseases [1]

The main aim is to develop techniques and algorithm which is based on images of leaves and other features of plant that can automatically classify and detect diseases. This will assist farmers in effectively managing and addressing agricultural diseases. Following are the details and critical study of numerous recent machine learning and deep learning based approaches and techniques to developed plant diseases prediction [1]. A few challenges in a plant disease prediction and classification allowing the research community to investigate the cause that will have significant impact on real time system for plant diagnosis and identification.

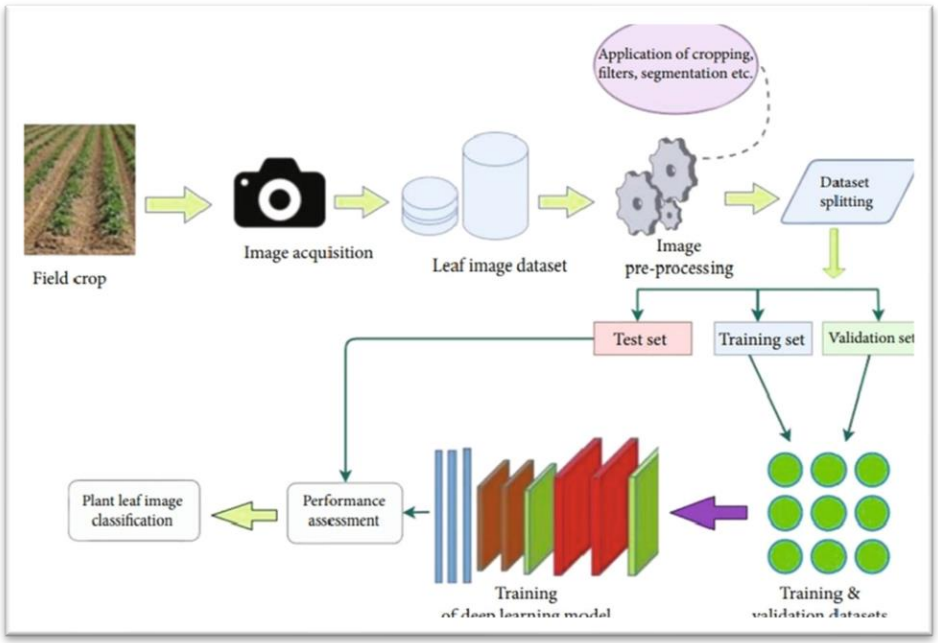

Fig.2 Computer vision-based techniques for plant disease detection and classification [1]

3. Literature Survey:

Sr. No	Paper Title and it's Author	Details of Publication	Findings
1	Plant disease detection and classification techniques: A comparative study of the	J. Big Data 11, 5(2024)	K-means clustering, naïve byes, feed- forward neural network, support vector machine, fuzzy

	performances Author: Wubetu Barud Demilie		logic.
2	An Accurate Plant Disease Detection Technique Using Machine Learning Author: Sai Sharvesh R, Suresh Kumar K, C.J Raman.	EAI on Internet of Things(2024)	Agriculture, Plant diseases detection, Image Processing, Machine Learning.
3	Plant disease detection using leaf images and an Involutional neural network. Author: Priyanka pradhan	Environmental Conversation Journal(Jan 15, 2024).	Convolutional neural network, Image classification, Involutional Neural network, pre-trained network, Transfer Learning.
4	Feature Engineering to identify plant diseases using image processing and artificial intelligence: A comprehensive review.++ Author: Seyed Moahmmad Javidan, Ahmad Banakar, Kamran Rahnama	Smart Agricultural Technology(Aug 2024).	Textual features, feature extraction, machine learning.
5	Revolutionizing agriculture with artificial intelligence: plant disease detection metods, applications, and their limitations. Author: Abbas Jafar, Rizwan Ali Naqvi	Internet of things for Smart Agriculture.	Artificial intelligence, machine learning, internet of things.

4. Future Scope

The comprehensive evaluation of machine learning algorithms in this study reveals Random Forest as the most effective approach for plant disease classification within SmartPlantCare. Random Forest consistently outperforms KNN and Naive Bayes across metrics, achieving an impressive accuracy of 88% and demonstrating superior precision, recall, and F1-score. Leveraging its ensemble learning and feature Selection capabilities, Random Forest proves pivotal in accurately identifying disease and capturing a high percentage of actual cases. These findings emphasize the critical role of algorithm selection in developing reliable plant disease detection systems. By harnessing the strengths of Random Forest, SmartPlantCare offers farmers and agricultural stakeholder a depending tool for monitoring and managing plant diseases, thus contributing to enhanced agricultural practices and productivity [2].

Looking ahead, further optimization and exploration of alternative approaches, such as extensive hyperparameter tuning and the integration of deeper learning architecture like CNNs,hold promise for enhancing performance. Through continuous refinement and innovation, smart Care remains poised to advance plant disease detection and management practices, effectively addressing the evolving challenges of modern agriculture. [5]

- To predict the appropriate plant disease based on the image factor.
- To analyze the data to get the inference.
- To analyze and compare the cleaned dataset with various machine learning algorithms.
- In future we would like to explore this domain even further, expanding to other corps and applying transformers to improve the results even further.
- A mobile application could also be development to maximize the reach at minimal cost.
- This would involve the selection of corps in which the individual want to examine the disease and the uploading the image of the corp.
- By gathering data from surrounding government fields and sectors and creating our own dataset, the model can be enhanced, leading to a a more optimized model.
- K Fold Validation technique can be used in addition to the blending technique when ensembling, which might product better results. [5]

5. Discussion:

A comparative review of various research efforts focused on plant leaf disease detection and classification utilizing Deep Learning (DL) and Machine Learning (ML) techniques has been thoroughly examined by numerous researchers. The Accordingly, when sufficient data are plant is available for training, Deep learning techniques are capable of detecting and classifying plant leave disease detection and classification system by using plant leave image. Here, the most of the researchers have tested their proposed system on different plant leaves.

They have computer the evaluation metrics such as accuracy, precision, recall, F1-score Maintenance analysis program (Map), IOU, the sensitivity, specificity, and Mattews correlation coefficient Medical counselling committee (MCC) for training and testing purpose. [1]

6. Conclusion:

In conclusion, a plant disease prediction system is a vital innovation for modern agriculture, significantly improving crop health and yield by enabling early detection and timely intervention. This proactive approach allows farmers to take preventive actions, minimizing crop loss and maximizing production. By predicting diseases in advance, the system also promotes efficient resource management, helping farmers reduce the excessive use of pesticides and optimize other inputs like water and fertilizers, contributing to more sustainable farming practices. Furthermore, early disease detection can lower the overall costs associated with disease control, making farming more cost-effective [4]. The integration of advanced technologies such as machine learning, image processing, and remote sensing enhances the system's accuracy and efficiency, providing farmers with real-time, actionable insights. These systems are adaptable, scalable, and flexible, making them suitable for various crops and environmental conditions.

In this paper, we employed deep learning approaches, utilizing pre-trained Convolutional Neural networks and transfer learning, to detect plant diseases in precision agriculture. We started with image preprocessing to enhance quality and accuracy. The models were trained and tested on the Plant Village data collection, that compromises both diseased and healthy plant leaves. Results of this study, demonstrated impressive testing accuracies of 96.63% respectively. By leveraging advanced technologies such as machine learning, image processing, and sensor data, it helps in the early detection n diagnosis of diseases, allowing farmers to take timely and informed actions. [1] This is not only

reduces the use of harmful pesticides but also minimizes crop losses and boosts yield quality. Such systems can be integrated with IOT devices for real-time monitoring and prediction, offering a cost-effective, scalable solution to global food security challenges. The continuous improvement of models and data sources will further enhances the system's accuracy and reliability, promoting healthier crops and more sustainable farming practices.

In the future, we plan to achieve more accurate results and real time applicability. This can be achieved by expanding the dataset, exploring more advanced deep learning architectures, and incorporating optimization methods data fusion for early disease detection. There are several enhancements that could be investigated to increase the predictability and scalability of this method. We will use this method to analyze various data sets from different countries in the future since we created a generalized system. Handling multiple class labels in the prediction phase can dramatically improve crop yield efficiency, and this could be another promising research path.

7. References:

List of Books/Papers/Daigrams:

Daigrams:

1. Fig 1. Factors responsible for plant disease:- Plant disease detection and classification techniques: a comparative study of the performance by Wubetu Barud Demilie. [1]
2. Fig 2. Computer vision-based techniques for plant disease detection and classification:- Plant disease detection and classification techniques: a comparative study of the performance by Wubetu Barud Demilie.[1]

Books:

1. "Plant pathology" by George N. Agrios. This is a comprehensive textbook covering all aspects of plant pathology, including the identification, diagnosis, and management of plant diseases.
2. "Dieseases of Trees and Shrubs" by Wayne A. Sinclair and Howard H. Lyon. This is a comprehensive guide specifically focusing on diseases affecting trees and shrubs, covering identification, symptoms and management.

Papers:

1. Plant disease detection and classification techniques: A comparative study of the performances by Wubetu Barud Demilie. J. Big Data 11,5(2024).[1]
2. Plant disease detection using leaf images and an Involutional neural network by Priyanka pradhan. Environmental Conversation Journal(Jan 15, 2024).[2]
3. Plant Disease Detection in precision Agriculture: Deep Learning approaches by Puja Dev
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6. An Accurate Plant Disease Detection Technique Using Machine Learning by ResearchGate(Jan 2024) Authors are Sai Sharvesh R and Suresh Kumar K.[3]
7. Plant disease prediction system using advance computational Technique by Mayuresh B. Gulame and Trupti G. Thite published under IOP publishing Ltd on 4 May 2023. DOI: 10.1088/1742-6596/2601/1/012031.
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Agriculture and Food Research(Dec 2023) Authors are Md. Manowarul Islam and Abdul Ahad Adil.[4]

9. P. Moghadam, D. Ward, E. Goan, S. Jayawardena, P. Sikka and E. Hernandez, "Plant Disease Detection Using Hyperspectral Imaging," 2017 International Conference on Digital Image Computing: Techniques and Applications (DICTA), 2017, pp. 1-8, doi: 10.1109/DICTA.2017.8227476.
10. Plant Leaf Detection and Disease and Recognition using Deep Learning by S.V. Miliante , B. D. Gerardo (2019) IEEE Eurasia Conf. IOT.[5]