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A Survey on Plant Disease Detection Using Machine Learning

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Abstract: Plant Health monitoring and disease detection is essential for sustainable agriculture. Effective plant disease detection can greatly reduce the use of toxic chemicals, pathogens by identifying the diseases associated with infected plants and thereby increasing agriculture farming and leading to a better environment. Pathogens causing plant diseases include viruses, fungi, bacteria which are the main sources of causing diseases in plants. Our system goes beyond mere detection, providing personalized cure recommendations based on learned the affected and diseased plants using deep learning models like convolutional neural networks (CNN) for early detection of diseases in plants. Deep learning approaches are used to classify and identify the diseases in plants and also the model which is best suited for early detection of plants is suited to give the correct and accurate output for the given plants. Early detection of plant diseases can be detected and recommend possible cures.

KeyWords **- Plant Health Monitoring, Plant Disease, Image Processing, Deep Learning, CNN, Cure Recommendation.**

I. INTRODUCTION

Agricultural productivity plays a crucial role in sustainable agriculture, driving economic growth. With a focus on increasing food production, the agricultural sector is exploring innovative methods. Precision agriculture empowers farmers to make informed decisions for maximizing plant output. Machine learning-based software has been developed to detect plant diseases and suggest appropriate pesticides. Early detection of plant diseases reduces reliance on harmful chemicals, thereby promoting safer plant growth practices. Accurate classification of diseases in a timely manner is vital for minimizing economic losses for farmers. Deep learning techniques, particularly convolutional neural networks (CNNs), are employed to identify and classify plant diseases, providing actionable recommendations for treatment. Our project aims to leverage advanced machine learning and deep learning strategies, specifically CNNs, to precisely identify and classify diseases in plants, facilitating prompt intervention to minimize the impact of harmful chemicals and enhance overall agricultural productivity. Improved detection and identification of plant diseases are particularly beneficial in complex and dynamic agricultural environments. Automatic detection of plant diseases is highly desirable in agricultural farming, especially as new diseases emerge and environmental conditions change. Adaptive machine learning and deep learning models ensure the longevity of plant disease detection systems. By implementing recommendation systems for treatment based on accurate disease identification and classification, farmers are equipped with actionable insights to mitigate the impact of diseases on crops and improve agricultural output. Furthermore, our project integrates deep transfer learning techniques to enhance accuracy in predicting disease outcomes, particularly in the early stages of infection.

II. RELATED WORK

This literature review serves as a foundational exploration of methodologies, technologies, and best practices relevant to the development of desktop applications for Plant Disease Detection and Cure Recommendation using Machine Learning. It is imperative to delve deeper into each area through academic papers, case studies, and documentation to gain more specific insights and guidance for your project.

[1] The paper provides an overview of machine learning techniques, including deep learning, CNN, and other approaches for processing image data.[2] Introduces Convolutional Neural Network (CNN) and Local Binary Pattern (LBP) algorithms for extracting and classifying plant leaves.[3] Conducts experiments to evaluate the performance of classification and object detection models, suggesting model ensembling and image segmentation as promising approaches.[4] Surveys CNN based disease detection systems for various crops, investigating lightweight and transfer learning algorithms, CNNs, GANs, attention mechanisms, and autoencoders.[5] Proposes a deep CNN model for identifying diseases in apple crops, achieving 98% accuracy on the Plat Village dataset.[6] Introduces deep learning neural networks for image classification and disease detection.[7] Develops a system to extract

affected areas from complex background images, utilizing detailed feature extraction techniques.[8] Compares and evaluates machine learning based disease detection, identification, and classification methods using digital images of plant leaf signs and symptoms.[9] Highlights the need for deep learning models to adapt to diverse disease datasets for improved detection.[10] Develops leaf and fruit disease detection and classification using MATLAB, employing fuzzy c-means, histogram-based equalization, and artificial neural networks.[11] Explores supervised learning scenarios for CNN architectures using different datasets and benchmarks via Matlab/Python scripting.[12] Utilizes deep convolutional neural networks for detecting and classifying healthy and unhealthy coffee plants.[13] Develops deep learning models through transfer learning techniques, enhancing pre-trained machine models such as VGG16, MobileNet, and AlexNet.[14] Uses HSV and Lab color models for segmenting healthy and diseased parts of grape plant leaves.[15] Demonstrates that CNN classifiers detect a higher number of diseases with high accuracy, with SVM classifiers being commonly used for disease classification by many authors.[16] Achieves the goal of detecting and recognizing 32 different plant varieties and diseases using convolutional neural networks.

This literature survey encompasses various researchers' exploration of different algorithms for plant disease detection techniques. It reviews relevant literature, methodologies, technologies, and best practices for developing desktop applications for plant disease detection and cure recommendation using machine learning.

III. LITERATURE TABLE

Sr. No.	Paper Name	Authors	Mechanism	Advantages	Disadvantages
1	Pathogen-Based Classification of Plant Diseases: A Deep Transfer Learning Approach for Intelligent Support System (2023)	K. Asha Rani, S. Gowrishankar	Summarizes techniques such as deep learning CNN and other approaches.	Clear understanding of systematic and accurate techniques	Does not provide any clear information about the recent advancements and datasets used.
2	Multi-Class Classification of Plant Leaf Diseases Using Feature Fusion of Deep CNN and Local Binary Pattern (2023)	Khalid M. Hosny, Walaa M. EL-Hady	CNN and local binary pattern(LBP) to extract the images of plant leaves	Advancement of information technology.	Critical task involvement.
3	FieldPlant: Dataset of Field Plant Images for Plant Disease Detection and Classification With Deep Learning (2023)	Dongmo Wilfrie, Florent Retraint.	Deep learning approach CNN to detect classify diseased plants	Advanced deep learning techniques are used.	Plant conditions can lead background variations affect the model performance.
4	A Systematic Literature Review on Plant Disease Detection: Classification Techniques, Challenges and Future Trends (2023)	Wasswa Shafik, Ali Tuffail, Abdallah Namoun	Summarizes techniques such as deep learning, machine learning CNN and other approaches.	Clear understanding of systematic and accurate techniques.	Does not provide any clear information about the recent advancements and datasets used.
5	Detection of Apple Plant Diseases Using Leaf Images Through Convolutional Neural Network (2022).	Krishan Kumar, Brajesh Kumar,Vibhor Kumar	CNN models are used for analyzing and identifying the plant diseases.	Takes smaller execution time	Limited only to apple plant, Needs more accurate dataset.
6	A Machine Learning Technique for Identification of Plant Diseases in Leaves (2021)	Ms Deepa, Ms Rashmi N, Ms Chinmai Shetty	deep learning neural networks are used.	Accurately classify the plant diseases in leaves.	Incorrect training data may lead to inaccuracies or biases.
7	A Review of Machine Learning Approaches in Plant Leaf Disease Detection and Classification (2021)	Majji V. Applalanaidu, G Kumar-avelan	Uses feature extraction techniques include colour, shape	Help the researchers to be informed about techniques used.	More research is required for capturing the recent advancement and techniques.

8	A Comparative Study on Disease Detection of Plants using Machine Learning Techniques (2021))	Vishnu S Babu, R. Sateesh Kumar, R. Sundar.	Select models like decision tree deep learning models.	Effective techniques are used to classify plant diseases.	Quality of output depends on the dataset to reduce biases.
9	Plant Disease Detection and Classification by Deep Learning—A Review(2021)	Shujuan Zhang, Bin Wang	Deep learning models such as CNN, RNN are used.	avoid the disadvantages caused by artificial selection of disease spot features.	Widespread use of HIS in the early detection of diseases remain to be resolved.
10	Detection of Banana Leaf and Fruit Diseases Using Neural Networks (2020)	Mrs N . Saranya, Ms L. Palvitra, Ms.Ragavi	Neural networks are used to improve the accuracy of the model	Efficient networks are used to automate the process.	Detects only two diseases banana sigatoka, banana speckle
11	Analysis and Characterization of Plant Diseases using Transfer Learning (2020)	Sumathi Bhimavararpu, Vinitha Panicker	Utilizes CNNs for the automatic detection and classification of plant diseases based on image analysis.	Transfer learning can enhance performance	Complex pre-trained models require expertise for deep learning models.
12	Disease Detection in Coffee Plants Using Convolutional Neural Network(2020)	Manoj Kumar, Pranav Gupta, Puneet Madhav	Uses Transfer Learning and Data augmentation	CNNS are used to identify and classify the plant diseases at an early stage.	The accuracy of the model depends on the amount of data.
13	Grape Leaf Disease Detection and Classification using Machine Learning (2020).	Zhaohua Huang, Ally Qin, Aparna Menon	Transfer learning to create deep learning models for early grapevine disease detection.	Machine learning techniques detect the plant diseases at an early stages and to reduce extensive crop damage	Inaccuracy or biases reduce the performance of the training data. High accuracy depends on the quality of training data.
14	Black Rot Disease Detection in Grape Plant (Vitis vinifera) Using Color Based Segmentation and Machine Learning (2020).	Kirti, Navin Rajpal	HSV and Lab color models for segmenting healthy and diseased parts of grape plant leaves.	Detect Black Rot disease in grape vines using color-based segmentation and machine learning.	Relies on color segmentation, which may not be as effective when dealing with images of grape plant leaves
15	A Review on Machine Learning Classification Techniques for Plant Disease Detection (2019).	Mrs. Shruti, Dr. Nagaveni, Dr. Raghavendra B.K	Transfer learning to create deep learning models for early grapevine disease detection.	Machine learning techniques detect the plant diseases at an early stage and to reduce extensive crop damage .	Inaccuracy or biases reduce the performance of the training data. High accuracy depends on the quality of training data.
16	Plant Leaf Detection and Disease Recognition using Deep Learning (2019).	Sammy Militante, Bobby Gerardo	Employs a Convolutional Neural Network (CNN) to achieve 96.5% accuracy.	Efficient in extracting features through its multi-layered structure.	Relies on color segmentation, which may not be as effective when dealing with images of grape plant leaves.

IV. CONCLUSION

Plant disease detection using machine learning presents a significant opportunity to transform agriculture by enhancing crop health, minimizing chemical usage, and boosting productivity. However, realizing its full potential requires overcoming challenges, ensuring widespread accessibility to farmers, and promoting collaboration among stakeholders in the agriculture and technology domains.

As machine learning techniques evolve, we anticipate the development of increasingly precise and effective solutions for plant disease detection. By harnessing the power of technology and fostering cooperation within the industry, we can pave the way for a more sustainable and prosperous future in agriculture.

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