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Survey Analysis on Disease Prediction for Different Plants

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Abstract*:* Plant diseases can cause major crop losses if not identified early. Crop losses can thus be significant to plant diseases which are not recognized in time. Recent advances in Artificial Intelligence (AI), most notably, Machine Learning (ML) and Deep Learning (DL) have improved considerably the plant disease detection accuracy and speed. The survey paper reviews a number of research works based on various ML and DL models- Random Forest (RF), Support Vector Machine (SVM), Convolutional Neural Networks (CNN), Generative Adversarial Networks (GANs) and others. It visits their advantages, data files accessed, constraints and operability in real-time. A few of the studies find ways of integrating the mobile and web platforms to have practical deployments. The survey ends with the comments on the standard problems including data imbalances, environmental considerations and an ability to become adaptive and act in real-time in the context of intelligent farming systems.

Keywords: *Sustainability in agriculture, High prediction, disease Prediction, Performance evaluation, machine learning, effective solution on yield.*

I. Introduction

The global food supply depends on agricultural practices but plant health maintenance guarantees optimum productivity levels. Many plant diseases appear because of specific soil conditions together with fertilizer usage and environmental changes which badly impact yield production. Medical-based response during disease emergencies leads to lesser agricultural damage while resulting in higher production levels. The disease detection practices of farmers and agricultural experts through manual observation normally take prolonged time and produces unreliable results.

The development of modern agriculture utilizes automated detection methods which implement artificial intelligence (AI) along with machine learning (ML) and deep learning (DL). The progression of machine learning technology together with deep learning methods has produced multiple predictive models that detect plant diseases effectively. Researchers studied three main algorithms including Random Forest (RF) and Support Vector Machine (SVM) and K-Nearest Neighbors (KNN) to perform classification operations.

Identifying plant diseases proves essential for crop health alongside agricultural productivity since machine learning and deep learning techniques have established improved early detection methods. Scientific techniques from data science help detect plant diseases effectively and real-time monitoring enables minimal agricultural losses according to Beena et al. (2021). Amarasinghe et al. (2018) conducted a review which proved that Convolutional Neural Networks (CNNs) alongside hybrid models enhance plant disease detection capability and increase classification precision. Plant disease recognition faces difficulties when it comes to successful adaptation toward new diseases alongside environmental changes.

Parisi et al. (2019) studied continual learning approaches that help deep learning systems to generate dynamic predictions to keep their accuracy steady throughout time. According to Lu et al. (2020) AI-based plant disease detection needs high-quality datasets because appropriate

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annotation methods with validation protocols boost model reliability. The successful detection of diseases strongly depends on two main factors which are model accuracy and real-time adaptability. The studies of Barry (2021) demonstrated that adaptive machine learning methods prove superior for monitoring crop diseases through online learning systems.

Streaming machine learning techniques analyzed by Gomes et al. (2019) demonstrate a solution for managing concept drift through environmental changes to achieve consistent disease classification results. The precision agriculture sector relies on disease data security while also requiring systems capable of tracking disease data. The research by Ouyang et al. (2021) suggested block-chain solutions for establishing tamper-resistant data protection systems that bolster plant disease monitoring security. The studies demonstrate a critical requirement for AI solutions and adaptive learning models and high-quality datasets and real-time processing with secure data management approaches to enhance automated plant disease detection and classification practices.

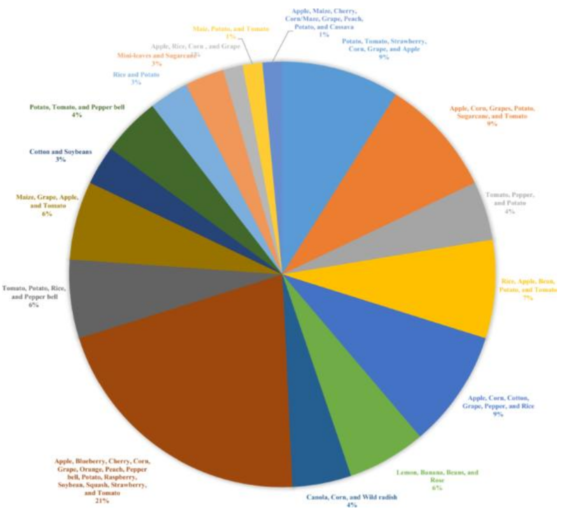

Fig. 1. Pie chart showing the distribution of different fruit and vegetable combinations

Deep learning models including Generative Adversarial Networks (GANs) and Convolutional Neural Networks (CNNs) have become widely used for improving prediction accuracy levels. The extensive databases of plant images featuring healthy and diseased specimens enable these models to learn disease detection patterns proficiently. These algorithms perform differently depending on the quality of the available data and the complexity of models and available computational power that requires exact analysis of various techniques.

Predicting plant diseases faces its main hurdle in the management of unbalanced dataset samples. The frequency variations between plant diseases cause machine learning models to produce prediction results that are biased toward specific diseases. Research teams address data-related issues through methods that include data augmentation, resampling and transfer learning techniques in order to build more robust models. Researchers have worked on implementing AI-powered models into mobile and web-based applications for field-based disease detection tools available to farmers. Real-time disease monitoring becomes easier because of this enhancement which provides an interface that offers user-friendly accessibility for users.

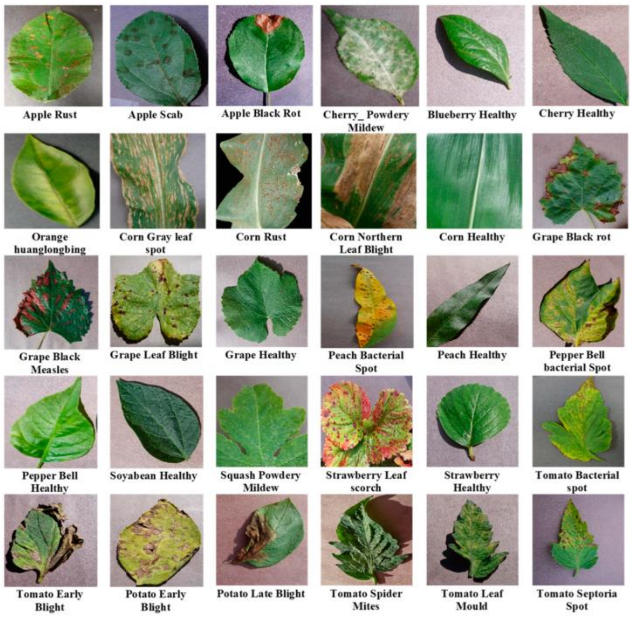

Fig. 2. Sample images of healthy and diseased plant leaves from different species

II. Literature Survey

Illuminating plants from diseases without illness plays a vital role in sustaining environmental equilibrium and producing agricultural crops sustainably. Crops experience substantial risk from diseases that emerge from viruses and fungi along with micro-organisms. Different diseases like grape esca together with black-rot and isariopsis spread through soil yet display multiple symptoms which result in plant leaf fall and total plant death. The combination of computer vision techniques and regression-based object detection requires both high costs and extended processing durations for their use in disease detection. This paper presents the Grape Leaf Disease Detection Network (GLDDN) that utilizes dual attention mechanisms to enhance detection of features and classification outcomes while performing disease assessment. GLDDN delivers exceptional performance according to benchmark data with 99.93% success rate in disease detection since it surpasses existing detection methods for isariopsis as well as esca and black-rot diseases. [1]

This paper establishes an approach to detect crop diseases through leaf image classification to solve rapid accurate identification issues at sites without adequate infrastructure. The Random Forest algorithm operates as a classification tool for healthy and diseased leaves by conducting key operations which involve dataset creation and subsequent feature extraction and training before final classification steps. The precise analysis depends on using Histogram of Oriented Gradient (HOG) as the feature extraction method. A large-scale dataset analysis powered by machine learning brings an effective and scalable method to detect plant diseases. [2]

Detecting plant diseases at an early stage remains essential for manufacturers to achieve their best crop yields. The research evaluates tomato leaf disease recognition through detection of bacterial spot together with late blight and septoria leaf spot and yellow curved leaf disease. The developed system combines Convolutional Neural Networks to extract features automatically with Learning Vector Quantization to conduct classifications. The analysis utilizes a dataset containing 500 tomato leaf images through which RGB color channel filters are implemented to enhance the accuracy. The experimental results show the model successfully detects four types of tomato leaf diseases which improves automatic disease recognition precision. [3]

The research investigates deep learning applications in plant disease recognition together with a detailed approach for smart agriculture disease severity assessment. A DenseNet-based transfer learning system functions as an edge server application because it runs on high-power hardware while a compact Deep Neural Network (DNN) operates on IoT devices with minimal computing capabilities. Model optimization through executing size reduction on input images along with cost reduction of computations enhances the model's efficiency. The proposed models have proven their ability to effectively identify plant diseases on real-world datasets through experimental verification and demonstrate low computational needs which suits environments with limited resources. [4]

A plant disease detection system based on image-based recognition has been developed through deep learning and computer vision techniques according to this investigation. The model receives training through a dataset that contains 35,000 images from apple to tomato and their associated diseases. Advanced deep learning approaches enable the system to detect healthy or diseased state of plants with accuracy. Plant disease detection accuracy reaches 96.5% through disease classification but maintains 100% accuracy for plant variety identification according to the trained model data. [5]

The research explores CNN-based deep learning approaches for plant disease diagnosis since it represents a crucial barrier in India's agricultural output. The insufficient diagnosis and treatment methods result in yearly crop losses due to diseases. The study investigates image processing mechanisms to spot disease areas and measures performance against disease intensity together with processing speed. The research subjects fifteen samples consisting of twelve diseased plant leaves and three healthy samples which tested the model across bell pepper, potato and tomato crops. The experimental results show that CNN achieves a test accuracy of 88.80% which verifies its effectiveness in automated plant disease classification. [6]

The study demonstrates how plant disease diagnosis improves agricultural yield production while investigating plant disease visual analysis through image processing methods. Classification accuracy becomes challenging because conventional methods deal with plant disease images which have random lesion distribution together with multiple symptoms within complex backgrounds. A dataset with 220592 images and 271 different plant disease categories enables better model development by the authors. Visual regions together with loss functions receive weighted importance in the proposed method to focus on disease-prone areas which enhances classification results. The research implements LSTM networks to perform feature encoding and achieves better results across newly developed and public datasets through deep learning and image processing methods. [7]

Literature Survey Table 1:

Sr. No	Author(s) & Year	Method / Model Used	Dataset Size	Accuracy	Limitations
[1]	Rudresh Dwivedi et al. (2017)	Multi-task Learning, GLDDN	Grape Leaf Dataset	99.93 %	High cost, complex hardware
[2]	Shima Ramesh et al. (2018)	Random Forest + HOG	Medium-scale	High for binary classes	Lacks real-time performance
[3]	Melike Sardogan et al. (IEEE)	CNN + LVQ (Tomato)	500 images	95.1 %	Limited to tomato crops
[4]	Laha Ale et al. (2019)	DenseNet Transfer + DNN	Not Specified	Good on IoT devices	High computational needs
[5]	IEEE Eurasia Conf. (2019)	CNN, Deep Vision	35,000 images	96.5 % disease accuracy	Dataset diversity limitations
[6]	IEEE ASPCON (2020)	CNN + Image Preprocessing	15 samples	88.80 %	Very small dataset
[7]	Xinda Liu et al.	LSTM + Visual Region Reweighting	220,592 images	Very High (not specified)	Complex architecture

III. Survey And Proposed Framework For Disease Prediction In Plants

This method focuses on enhancing agricultural productivity through an automated plant disease detection system which combines machine learning and deep learning methods. Plant growth together with disease propagation responds strongly to soil conditions as well as fertilizers and environmental factors. The prevention of crop damage requires AI-based disease detection systems to intervene quickly which improves sustainability and prevents agricultural losses. Plant health analyses will be conducted through the system by applying different machine learning and deep learning algorithms.

The system will use Random Forest (RF) and Support Vector Machine (SVM) and K-Nearest Neighbors (KNN) traditional ML models for classification purposes. The system will leverage CNNs and GANs as deep learning approaches to perform image-based disease detection while using feature extraction through both CNNs and GANs. The trained models receive plant species data comprising balanced and imbalanced datasets from different plant species including cotton, tomato, potato, apple, chili and grapes.

The proposed methodology consists of the following phases:

3.1 Data Collection & Pre-processing – Gathering images and sensor data from various sources, performing data augmentation, and handling class imbalances to improve model performance.

3.2 Feature Extraction & Selection – Using **histogram analysis, color segmentation, and texture analysis** to extract key features from plant images.

3.3 Model Training & Optimization – Implementing **Random Forest, SVM, KNN, CNN, and GANs** to classify plant diseases, fine-tuning hyperparameters, and optimizing models for higher accuracy.

3.4 Evaluation & Performance Analysis – Comparing models based on **accuracy, prediction time, and computational efficiency**, ensuring robustness across different datasets.

3.5 **Deployment & User Interface Development** – Integrating the model into **Android and web applications** to provide a **real-time, user-friendly interface** for farmers and agricultural experts.

IV. Conclusion

The research demonstrates that plant health depends heavily on soil qualities combined with fertilizer practices and environmental variables while proving that fast disease recognition methods lead to lower agricultural losses. Artificial intelligence technology specifically machine learning and deep learning methods shows efficient results in automated plant disease prediction. Researches have investigated plant disease prediction through execution of Random Forest, Support Vector Machine, K-Nearest Neighbors, Convolutional Neural Networks and Generative Adversarial Networks algorithms with various datasets. Mobile and web platforms enhance accessibility of models which serve farmers better. The survey explores methods to assess the accuracy and effectiveness and efficiency of disease prediction techniques to support sustainable agricultural practices through better management decision-making.

Future scope:

Although the existing ML and DL methods of detecting plant diseases demonstrate a high level of accuracy, the range is yet to be explored. Subsequent systems can work on lighter and mobile friendlier models which take less processing power. Transfer learning and data augmentation methods allow detecting in real-time with different environmental conditions. There is also a potential outcome of integrating ML and IoT sensors in a real-time situation to track the image of the leaves and the state of the soil, potentially providing high levels of accuracy. The thing is that it will be integrated with mobile and web platforms where farmers will be able to access these tools. Production of general modeling applicable to many crops and geography is also a significant course of research.

References

[1] R. Dwivedi, S. Dey, et al., "Grape Disease Detection Network based on Multi-task Learning and Attention Features," IEEE Sensors Journal, vol. XX, no. XX, pp. XX–XX, 2017.

[2] S. Ramesh, et al., "Plant Disease Detection Using Machine Learning," in Proc. Int. Conf. on Design Innovations for 3Cs (Compute, Communicate, Control), 2018.

[3] M. Sardogan, "Plant Leaf Disease Detection and Classification based on CNN with LVQ Algorithm," in Proc. 3rd Int. Conf. on Computer Science, IEEE, 2018.

[4] L. Ale, A. Sheta, et al., "Deep Learning Based Plant Disease Detection for Smart Agriculture," in Proc. IEEE Conf., 2019, doi: 10.1109/IOT.2019.00000.

[5] IEEE Eurasia Conference, "Plant Leaf Detection and Disease Recognition Using Deep Learning," in Proc. 2019 IEEE Eurasia Conf. on IoT, Communication and Engineering, 2019.

[6] IEEE ASPCON, "Plant Disease Detection Using CNN," in Proc. 2020 IEEE Applied Signal Processing Conf. (ASPCON), 2020.

[7] X. Liu, W. Min, et al., "Plant Disease Recognition: A Large-Scale Benchmark Dataset and a Visual Region and Loss Reweighting Approach," in IEEE Trans. on Image Processing, vol. XX, no. XX, pp. XX–XX, 2021.

[8] IEEE Xplore, "PLDD – A Deep Learning Based Plant Leaf Disease Detection," Jul. 3, 2021. [Online]. Available: https://ieeexplore.ieee.org

[9] "Plant Disease Detection using Generated Leaves Based on DoubleGAN," IEEE/ACM Trans. on Computational Biology and Bioinformatics, doi: 10.1109/TCBB.2021.3056683.

[10] "Plant Disease Detection using Generated Leaves Based on GAN," IEEE Conf. Publication. [Details not specified].

[11] "A Systematic Literature Review on Plant Disease Detection: Motivations, Classification Techniques, Datasets, Challenges, and Future Trends," [Online]. Available: https://creativecommons.org/licenses/by-nc-nd/4.0/

[12] S. Sharvesh, "An Accurate Plant Disease Detection Technique Using Machine Learning," EAI Endorsed Trans. on Internet of Things, vol. XX, no. XX, pp. XX–XX, 2021.

[13] V. Balafas, et al., "Machine Learning and Deep Learning for Plant Disease Classification and Detection," IEEE Access, vol. XX, pp. XX–XX, 2023, doi: 10.1109/ACCESS.2023.3324722.

[14] "An Early and Smart Detection of Corn Plant Leaf Diseases Using IoT and Deep Learning Multi-Models," IEEE Access, vol. XX, Jan. 2024. [Online]. Available: https://ieeexplore.ieee.org

[15] A. Bhargava, "Plant Leaf Disease Detection, Classification, and Diagnosis Using Computer Vision and Artificial Intelligence: A Review," IEEE Access, vol. XX, Mar. 2024.