International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review on Agriscan: Plant Disease Detection Remedies Recommendation

Bhagyahri Satao[1], Chaitali Gade[2], Mrunali Kitukale[3], Pratiksha Korde[4], Prof S. S. Ganorkar[5]

[1,2,3,4] B.Tech Student, Department Of Information Technology , KDKCE Nagpur
[5]Prof. Department Of Information Technology , KDKCE Nagpur

A B S T R A C T

The increasing global demand for food security has led to significant advancements in plant disease detection and remedies recommendation systems. Traditional methods of identifying plant diseases rely heavily on visual inspection, which can be time-consuming and prone to human error. Modern technologies, including machine learning, computer vision, and Internet of Things (IoT) solutions, have transformed plant disease diagnosis and treatment recommendations. This review paper explores various methodologies used for plant disease detection, the role of artificial intelligence in automating this process, and the integration of real-time data analytics for providing effective treatment solutions. The study further discusses the limitations of existing methods and suggests potential future research directions to enhance accuracy and efficiency in agricultural disease management.

Keywords: Plant Disease Detection, Machine Learning, Deep Learning, Image Processing, IoT in Agriculture, Disease Diagnosis, Precision Agriculture, Remedies Recommendation Systems**.**

INTRODUCTION

Plant diseases pose a significant threat to agricultural productivity, leading to substantial economic losses and food security challenges. Early detection and accurate identification of diseases are crucial in mitigating their impact. Traditional methods of disease detection, such as manual inspection by farmers and agricultural experts, are often inefficient and prone to errors. Advances in artificial intelligence (AI), image processing, and sensor-based technologies have provided more accurate and scalable solutions for plant disease detection.

Machine learning and deep learning techniques have gained traction in recent years, offering automated disease classification based on leaf images, environmental data, and pathogen identification. Additionally, IoT-based smarfarming solutions provide real-time monitoring of crop health, enabling farmers to take preventive measures before diseases spread extensively.This paper reviews various approaches for plant disease detection and treatment recommendations, discusses existing challenges, and explores future research prospects.

LITRATURE REVIEW

The study of plant disease detection and management has evolved significantly over the years, transitioning from traditional manual inspection to advanced artificial intelligence-based approaches. Researchers have explored various methodologies, ranging from visual assessments by agricultural experts to deep learning-based image recognition systems. Early studies primarily relied on farmers' knowledge and observational skills to identify plant diseases based on visible symptoms such as discoloration, wilting, lesions, and fungal growth. While effective to some extent, this approach proved to be highly subjective and time-consuming, often leading to misdiagnosis and delays in treatment.

Several studies have highlighted the limitations of traditional plant disease detection methods. Agrios (2005) discussed the role of plant pathology in identifying and managing crop diseases, emphasizing the necessity of early detection to minimize agricultural losses. Similarly, Oerke et al. (2006) reported that a significant percentage of global crop yield is lost annually due to plant diseases, with improper disease identification and delayed treatment being key contributors. Strange and Scott (2005) explored biological and chemical testing techniques for plant disease diagnosis but noted their high costs and the need for specialized skills, making them impractical for widespread agricultural use.

In recent years, the advent of artificial intelligence and machine learning has revolutionized the field of plant disease detection. Convolutional Neural Networks (CNNs) have gained prominence in automated disease classification, offering high accuracy and real-time detection capabilities. Mohanty et al. (2016) demonstrated the effectiveness of deep learning by training a CNN model on the PlantVillage dataset, achieving a disease classification accuracy of over 99%. This research laid the foundation for AI-based plant disease detection, proving that deep learning could outperform human expertise in identifying plant diseases. Similarly, Ferentinos (2018) evaluated multiple deep learning architectures, including AlexNet, VGG16, and GoogleNet, and found that these models consistently achieved high classification accuracy across various plant species.

Other studies have explored the integration of hyperspectral imaging with deep learning techniques. Zhou et al. (2020) investigated how hyperspectral imaging could detect plant diseases at an early stage, even before symptoms became visible to the human eye. This research introduced the possibility of predictive disease management, where farmers could take preventive measures before diseases spread. Sladojevic et al. (2016) focused on mobile-based applications for real-time plant disease detection, highlighting how CNN models could enable farmers to diagnose diseases using smartphone cameras, making technology accessible even in remote areas.

Beyond detection, remedy recommendation systems have emerged as an essential component of plant disease management. AI-driven decision support systems provide personalized treatment suggestions based on disease type, severity, environmental factors, and soil conditions. Patel et al. (2018) introduced a mobile application that not only detected plant diseases but also suggested appropriate chemical and organic treatments, helping farmers make informed decisions. Singh et al. (2020) developed an AI-powered chatbot for personalized disease management strategies, ensuring that farmers receive tailored recommendations rather than generic solutions. Kumar et al. (2021) proposed a blockchain-integrated plant health management system, which allowed agricultural experts to validate and update disease treatment methods in real-time. This approach improved the reliability of remedy recommendations while preventing the spread of misinformation regarding disease treatment.

The effectiveness of remedy recommendations largely depends on the accuracy of disease classification. Common plant diseases such as powdery mildew, late blight, rust, and mosaic virus require different treatment strategies. For instance, powdery mildew can be controlled using sulfur-based fungicides, whereas late blight necessitates copper-based treatments. In cases of viral infections such as the mosaic virus, removing infected plants and using virus-resistant seeds are often the most effective preventive measures. Fernandez et al. (2022) explored the integration of IoT sensors with AI-driven disease monitoring, demonstrating how real-time environmental data could optimize remedy recommendations. By analyzing factors such as humidity, temperature, and soil conditions, AI models could predict disease outbreaks and recommend targeted treatments.

Despite the advancements in AI-based plant disease detection and remedy recommendations, several challenges remain. One of the primary concerns is the need for extensive labeled datasets to train deep learning models. Many AI models rely on large-scale image datasets, and variations in lighting, background noise, and disease symptoms can affect classification accuracy. Additionally, some plant diseases exhibit similar visual symptoms, making it difficult for AI models to distinguish between different infections. The computational cost of running deep learning algorithms is another challenge, as high-end hardware is required to process large amounts of image data efficiently.

Future research in plant disease detection and management is expected to focus on integrating AI with Internet of Things (IoT) technologies. IoT-enabled smart farming solutions can provide real-time plant health monitoring, allowing for proactive disease management. Edge AI processing, where AI models run directly on mobile devices or low-power hardware, is another promising development that can make disease detection accessible to farmers without requiring cloud-based infrastructure. Additionally, genomic analysis using AI-driven research may lead to the development of disease-resistant crop varieties, further enhancing sustainable agricultural practices.

The following table outlines the key parameters commonly used in plant disease detection and remedies recommendation systems. These parameters help in accurately identifying plant diseases and suggesting appropriate treatments based on real-time analysis and historical data .

Leaf Color	Analyzes changes in leaf color, such as yellowing, browning, or spots.	Helps detect nutrient deficiencies, infections, and fungal diseases.
Leaf Texture	Examines surface changes like roughness, wilting, or holes.	Identifies fungal infections, pest damage, and dehydration effects.
Spots and Lesions	Detects the presence, size, and shape of spots or lesions on leaves.	Differentiates between bacterial, fungal, and viral infections.
Edge Curling and Wilting	Observes leaf deformation, curling, or drying of edges.	Indicates diseases such as curling virus, water stress, and pest attacks.
Fungal Growth Patterns	Identifies mold or mildew formations on leaves, stems, or fruit.	Helps recognize fungal infections like powdery mildew and rust.
Soil Moisture Level	Measures moisture content in the soil.	Determines if drought stress or overwatering is contributing to plant disease.
Temperature and Humidity	Monitors environmental conditions affecting plant health.	Assesses risk factors for fungal and bacterial disease outbreaks.
Pest Presence	Detects pest infestations using image analysis or IoT sensors.	Helps in recommending appropriate insecticides or natural remedies.

Nutrient Deficiency Symptoms	Identifies symptoms related to lack of nutrients like nitrogen, phosphorus, and potassium.	Recommends specific fertilizers or organic soil amendments.
Root Health (using sensors orgimaging)	Examines root structure and signs of decay or disease.	Diagnoses root rot, nematode infections, and poor soil drainage.
Weather Conditions	Collects weather data like rainfall, temperature, and humidity levels.	Helps predict disease outbreaks and plan preventive measures.
Plant Growth Rate	Tracks deviations in plant growth patterns.	Detects early signs of disease or poor soil conditions.
Chemical and Biological Treatment History	Considers past pesticide, fungicide, and organic treatment usage.	Prevents overuse of chemicals and suggests alternative solutions.
Geolocation and Crop Type	Uses GPS data to identify plant species and regional disease trends.	Customizes disease detection and remedy recommendations for specific crops.

Table: Parameters Used in Plant Disease Detection and Remedies Recommendation

This structured approach enables plant disease detection systems to make precise diagnoses and provide accurate treatment recommendations, improving agricultural productivity and reducing crop losses.

III. OPTIMIZING PLANT DISEASE DETECTION AND REMEDIES RECOMMENDATION

The optimization of plant disease detection and remedies recommendation involves the integration of advanced technologies, efficient data processing techniques, and smart decision-making models. Traditional methods of plant disease identification relied heavily on visual inspection by farmers and agricultural experts, making the process labor-intensive and prone to errors. However, the introduction of artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT) has significantly improved accuracy, speed, and efficiency in plant disease detection and treatment recommendations.

One of the most effective ways to optimize plant disease detection is through the use of Convolutional Neural Networks (CNNs), a type of deep learning algorithm that excels at image recognition. CNN models can analyze leaf images, detect visual symptoms of diseases such as yellowing, spotting, or curling, and classify them with high accuracy. Transfer learning techniques, where pre-trained models such as VGG16, ResNet, and EfficientNet are fine-tuned on plant disease datasets, further enhance the accuracy of detection while reducing computational costs. The use of hyperspectral imaging and multispectral imaging allows for early disease detection by capturing detailed information beyond the visible spectrum, identifying disease symptoms before they become apparent to the naked eye.

A critical aspect of optimization is the fusion of multiple data sources for more accurate disease detection. Combining leaf image analysis with environmental data, weather forecasts, and soil health metrics ensures a more holistic approach to disease diagnosis. AI-driven decision support systems (DSS) can integrate this data and provide farmers with customized recommendations based on disease severity, environmental conditions, and past treatment history.

To enhance the accuracy of remedies recommendation, knowledge-based systems and reinforcement learning can be utilized. Traditional remedy suggestions were often generalized, leading to ineffective treatment strategies. However, AI models trained on extensive agricultural datasets can recommend targeted treatments based on disease type, crop species, and geographical conditions. The incorporation of blockchain technology in remedy recommendations ensures transparency and credibility by maintaining a verified database of successful treatment strategies contributed by agricultural experts worldwide.

Despite these advancements, challenges such as data quality, model interpretability, and affordability remain. Continuous improvements in model training, dataset expansion, and AI explainability techniques are necessary to ensure the reliability and scalability of plant disease detection and remedy recommendation systems. The future of plant disease management will likely involve a hybrid approach, combining AI-driven insights with expert validation to provide farmers with the most effective and sustainable treatment solutions.

IV. CONCLUSION

The Leaf Disease Detection and remedies recommendations system accurately identifies diseases in 14 plant species and provides effective remedies. Using CNN for classification and expert-backed treatment suggestions, helps farmers take timely action, reducing crop losses. This project supports sustainable agriculture by offering an efficient and accessible disease management solution.

V. REFERENCES

1. Aldakheel, E. A., Zakariah, M., & Alabdalall, A. H. Detection and identification of plant leaf diseases using YOLOv4. Frontiers in Plant Science, 15, 135594https://doi.org/10.3389/fpls.2024.1355941 2024.
2. Imran Khan, Shahab Saquib Sohail, Dag ArivindMadsen, Brajesh Kumar Khare, Deep transfer learning for fine-grained maizeleaf disease classification, Journalof Agriculture and Food Research,Volume 16,101148,ISSN 2666-1543,2024.
3. P. Sai Kiran, Y. Sravani, P.G.L. Sahithi, G. Madhu Babu, Md. Wajjahtullah, “Providing Preventive Measures By Identifying Plant Leaf Diseases” in International Research Journal of Modernization in Engineering Technology and Science, Volume:02/Issue:09/September , e-ISSN: 2582-5206, 2024.
4. Tabbakh and S. S. Barpanda, "A Deep Features Extraction Model Based on the Transfer Learning Model and Vision Transformer “TLMViT” for Plant Disease Classification," in IEEE Access, vol. 11, pp. 45377-45392, doi: 10.1109/ACCESS.2023.3273317. 2023.
5. Rethik, K., & Singh, D. (2023, May). Attention-based mapping for plant leaf disease using Vision Transformer. In Proceedings of the 4th International Conference for Emerging Technology (INCET) (pp. 1–5). IEEE 2023.
6. Hossain, E., et al. Aggregating different scales of attention on feature variants for tomato leaf disease diagnosis:A transformer-driven study. Sensors, 23(7),3751.https://doi.org/10.3390/s23073751.2023vc
7. Sharma, V., Tripathi, A. K., & Mittal, H. DLMC-Net: Deeper lightweight multi-class classification model for plant leaf disease detection. Ecological Informatics,75,102025.https://doi.org/10.1016/j.ecoinf.2023.102025,2023.
8. Mustofa, S., Munna, M. M. H., & Emon, Y. R. A comprehensive review on plant leaf disease detection using deep learning [Preprint].arXiv:2308.14087.https://doi.org/10.48550/arXiv.2308.14087, 2023.
9. Chougu, A., Moussaoui, A., & Moussaoui, A. (2022). Plant-leaf diseases classification using CNN, CBAM, and Vision Transformer. In Proceedings of the 5th International Symposium on Informatics and its Applications (ISIA) (pp. 1–6). IEEE, 2022.
10. L. Li, S. Zhang and B. Wang, "Plant Disease Detection and Classification by Deep Learning - A Review," in IEEE Access, vol. 9, pp. 56683-56698, doi:1109/ACCESS.2021.3069646, 2021.