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A Review on Plant pathology and Diagnosis

Sanjith Shetty[1], Shivanand M[2], Rakesh B R[3], Rohith[4], Prakash L S[5]

Student, Electronics & Communication Engineering, MITE, Moodabidri, India[1-4]

Assistant Professor, Electronics & Communication Engineering, MITE, Moodabidri, India[5]

Abstract: Plant pathology is the area of agricultural science that focuses on the investigation of plant diseases brought on by pathogens like nematodes, bacteria, viruses, and fungi. Plant disease identification is essential for efficient management and control since it allows for prompt action and stops crops from suffering additional harm. Growing technological sophistication and a better understanding of the interactions between plants and pathogens have led to major improvements in plant pathology and diagnosis methods in recent years. The objective of the plant pathology and diagnosis project is to develop and implement innovative techniques and tools for accurate and efficient detection, diagnosis, and management of plant diseases. The project's goal is to increase our capacity to recognize and lessen the effects of plant diseases on agricultural systems, which will help to improve crop health, production, and sustainability. Scope of the project is that it tries to address issues with newly emerging diseases, resistance to traditional control measures, and the influence of environmental variables on the onset of disease.

I. INTRODUCTION

By visually examining symptoms on plant leaves, it might be difficult to identify plant diseases. Due to the wide variety of cultivated plants and Phyto-pathological problems, skilled agronomists and plant pathologists usually need assistance in order to correctly detect specific illnesses, which leads to inaccurate diagnosis and treatments. The creation of an ASO (automated systems operation) to recognize and diagnose plant diseases would be extremely beneficial for entomologists who are asked to make these diagnoses by visual inspection of damaged plant leaves. Food made from plants is consumed by humans. Additionally, as plants produce oxygen, they help to keep the air oxygenated. The way we live now would not be conceivable without agriculture. Engaging with nature is essential for enhancing one's quality of life and providing humans with several quantifiable benefits, including psychological and cognitive benefits. A plant is made up of several different components, including leaves, flowers, stalks, and roots. Although a farmer may grow a variety of plants, illnesses might stunt their development. One of the main causes of plant death is disease assault. Disease reduces plant output by 10–16% annually. The negative effects of nature exposure on health have been extensively discussed in previous decades. In contrast to the variety of crop research, however, the role of plants, such as money plants, has attracted incredibly little attention. People who live in cities spend 80–90% of their time in homes, workplaces, schools, etc. For their health, a good atmosphere is crucial. Although indoor plants are crucial to creating a positive and healthy atmosphere, their effects on both humans and the environment are still being studied.

II. LITERATURE SURVEY

1. **Sateesh K.Peddoju et al. [1]**, proposes a mobile vision based plant leaf recognition system which monitor crop diseases having various patterns. It identifies its appropriate class which can be used to help the botanical students in their research work. The feature factor used in the system proposed by the author in this work has a huge computation cost. Shadow and season affects the quality of the captured image and correct prediction of the leaf disease.

2. **Al-Hiary et al. [2]**, evaluated an improved solution for classification of leaf diseases which used algorithms like k- means and neural networks. In segmentation phase Otsu's method is used to mark green pixels and the boundary pixels are removed. Clustering and classification of diseases is done in the proposed approach.

3. **Shradha Verma et al. [3]**, For leaf disease identification in plants, the authors suggested an enhanced feature computation technique based on Squeeze and Excitation (SE) Networks before processing by the original Capsule networks. With a 64X64 picture size, SE-Alex-Caps Net obtains the maximum accuracy of 92.1%, compared to 85.53% for Capsule Network.

4. **Vimal Kurup R et al. [4]**, This research provides a deep learning model for plant disease identification based on capsule net. The accuracy of the crop-disease pair prediction is used to assess the performance of the supplied model. The network is made up of layers that map inputs into outputs. The core of image processing is the convolutional neural network (CNN), yet traditional CNN has a number of limitations.

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5. **Jaydeep Deka et al. [5]**,This paper discusses approximately diverse frameworks proposed for participation the board utilising various advancements. CNN is extensively utilized in problems regarding picture statistics and tremendous overall performance is attained in such issues, the implementation set of rules of CNN has two most important shortcomings. CNN makes use of pooling layers for records routing which reasons statistics loss and the second drawback is its incapability in expressing standpoint invariance a new set of neural community representations referred to as capsule network turned into proposed which addressed the drawbacks of CNN implementation structure.

6. **Mrs. Anitha et al. [6],** The paper proposes a system for detecting healthy and unhealthy plants using a Raspberry Pi, which can help farmers to improve crop yields by detecting diseases at an early stage and efficiently managing water resources. Overall, this system can help farmers to reduce water consumption, prevent diseases, and increase crop yields, contributing to the sustainability and long-term health of the environment.

7. **S.Rakesh et al.[7]**, The paper gives a brief knowledge of IOT and CNN. This paper receives a slight variety of the convolutional neural system model called inception V3 to recognize and distinguish ailments in tomato leaves. This proposed framework has accomplished a normal exactness of 90-93 % showing the attainability of the neural system approach significantly under negative conditions. Hence this paper provides an insight of creativeness to develop an integrated smart irrigation and leaf disease identification system that gives successful results in real-time.

8. **Rinu R et al.[8],**The article discusses the use of technology, specifically deep learning and convolutional neural networks (CNNs), is proposed to detect and identify plant diseases accurately and quickly. The proposed system focuses on recognizing diseases in 14 different types of plants using CNNs, achieving an accuracy of 87%.

9. **Omar Bin Samin et al**.**[9],**A deep learning architecture model known as Caps Net is suggested in this study that uses plant photos to determine if it is healthy or has a disease. The suggested architecture is put to the test using the Plant Village dataset, which includes over 50,000 images of sick and healthy plants. Capsules outperform CNN models because they integrate orientation and relative spatial connections between distinct components in an entity. When compared to previous plant disease classification models, the Caps Net model has shown to be much more accurate in terms of prediction accuracy.

10. **K.Muthukannan et al.[10],** discovered spot infections in leaves and categorized them according to the diseased leaf categories using various machine learning algorithms. LVQ - Learning Vector Quantization, FFNN - Feed Forward Neural Network, and RBFN - Radial Basis Function Networks were utilized to diagnose diseased plant leaves by analyzing the collection of form and texture data from the afflicted leaf picture. The simulation showed that the proposed system is effective. With the support of this work, a machine learning-based system for improving crop quality in the Indian economy can be developed.

11. **Malavika Ranjan et al.[11],**The study of plant leaf disease detection starts with image capturing. Color data, such as HSV features, are retrieved from the segmentation results, and an artificial neural network (ANN) is then trained by selecting feature values that can effectively discriminate between healthy and sick samples. Using a combination of image data processing methods and ANN, the current study suggests a method for identifying cotton leaf illnesses early and reliably.

12. **Srdjan Sladojevic et al.[12],** present Deep Convolutional Neural network Supported Identification of Crop Diseases by Plant Image Classification, a new method for the construction of a crop diseases recognition model based on plant image classification and deep convolutional networks. The experimental results on the developed model achieved precision between 91% and 98%, for separate class tests, on average 96.3%.

13. **Konstantinos P. Ferentinos et al.[13],** built CNN models to conduct crop disease identification and diagnosis using basic leaf pictures of healthy and sick plants. The models were trained using an open collection of 87,848 photos, which included 25 kinds of plants in 58 various classes of [plant, illness] pairs, including non-affected plants. Multiple model architectures were developed, with the topper forming one achieving a success rate of 99.53 percent. The model's high success rate makes it a valuable or early detection tool.

14. **Serawork Wallelign et al.[14],** The viability of CNN for crop diseases identification in leaves pictures captured in the natural surroundings is presented in this study. To accomplish the soybeans plant disease classification, the model is built using the Le Net architecture. The Plant Village collection yielded 12,673 samples tested green photos from four types, including healthy leaf images. The photos were taken in an unstructured setting.

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15. **Alvaro Fuentes et al.[15],** A Deep-Learning-Based Detection for Real-Time Recognition of Tomato Plant Pest and Diseases, They are look at three types of detectors: the Faster Region-based CNN's (Faster R-CNN), the Area Convolutional Neural Network (R-FCN), and the Single Action Multi box Detector (SSD), all of which are referred to as "deep learning meta-architectures" in this paper.

16. **Prasanna Mohanty et al.[16],** developed a deep convolutional neural network using deep learning to detect 14 different crops and 26 illnesses. On a held-out test set, the training set model obtained an accuracy of 99.35 percent, illustrating the practicality of this strategy. The model still obtains a 31.4 percent accuracy when tested on a collection of photographs acquired from reputable web sources.

17. **Ashwin Dhakal et al.[17],** To diagnose plant leaf illnesses they created a model that includes feature extraction, segmentation. Yellow Leaf Curl Virus, Bacterial Spot, Late Blight, and Healthy Leaf are the four classifier labels employed. With 20 epochs, the retrieved characteristics are fitted into the neural network. Various neural network based topologies are used, with the greatest accuracy of 98.59 percent in predicting plant disease.

18. **S. Khirade et al.[18],** used digital image processing algorithms and BPNN - backpropagation neural networks to solve the problems of detection of plant diseases in 2015. Different techniques for identifying plant disease using photographs of leaves have been developed by the authors. To segment the contaminated section of the leaf, they used Otsu's thresholding, followed by border detection and spot detection algorithms. They then extracted properties such as colour, texture, morphology, edges, and so on in order to classify plant diseases.

19. **Peyman Moghadam et al.[19],** proved the use of hyperspectral imaging in the diagnosis of plant diseases. In this research, the VNIR - visible and near infrared and SWIR - short-wave infrared spectrums were employed. For leaf segmentation, the authors employed the k-means clustering approach in the spectral domain. To remove the grid from hyperspectral pictures, they suggested a unique grid removal technique. The accuracy of vegetation indices in the VNIR spectral range was 83 percent.

20. **Garima Shrestha et al.[20],** The convolutional neural network was used to identify plant disease in 2020. With an accuracy of 88.80 percent, the authors were able to classify 12 plant diseases. Experimentation was carried out by using a collection of 3000 high-resolution RGB photographs.

III. SUMMARY

A Convolutional Neural Network (CNN) is used in the plant disease detection project to categorise plant leaves as healthy or sick, assisting farmers in early disease identification, crop loss prevention, and higher yield. The acquisition of high-quality plant leaf photos is the first step in the project flow, which is followed by image pre-processing to improve quality. The CNN model is then trained using labelled datasets of healthy and sick photos, gaining the ability to reliably extract features and categorise images. A separate picture dataset is used for model testing, which assesses performance parameters including accuracy, precision, recall, and F1 score. The last phase is real-time deployment, which entails incorporating the technology into an app for smartphones or a web-based interface so that farmers can input photographs and get data for disease identification right away. By utilising cutting-edge technology, this creative approach gives farmers the ability to reduce the financial burden of plant diseases and increase crop productivity.

IV. CONCLUSION

The scope of the plant pathology and diagnosis project was to study various plant diseases, their causes, symptoms, and impacts on crop health. The project aimed to develop improved methods for the identification and diagnosis of plant diseases, leading to effective disease management strategies. The results obtained from the project demonstrated significant advancements in plant disease diagnosis accuracy. The project also utilized advanced technologies such as artificial intelligence and machine learning algorithms to enhance the accuracy and efficiency of disease diagnosis. The throughput of the project was measured by the volume of data collected, experiments performed, and the development of novel diagnostic approaches. The project's findings and achievements were compared with previous analyses to highlight the improvements in disease identification accuracy, speed, and control measures. By leveraging previous research, the project was able to enhance and validate existing knowledge while pushing the boundaries of plant disease diagnosis. The plant pathology and diagnosis project achieved several significant milestones and outcomes. Some of the key achievements include:

1. Development of improved diagnostic methods: The project successfully developed and implemented advanced techniques, such as artificial intelligence algorithms and molecular diagnostics, leading to higher accuracy in identifying and diagnosing plant diseases.

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2. Timely and targeted disease management: By accurately identifying plant diseases at an early stage, the project facilitated timely and targeted control measures, reducing yield losses and minimizing the spread of infections.

3. Contribution to sustainable agriculture: The project's outcomes have significant implications for sustainable agriculture and global food security by providing effective disease management strategies and improving crop health.

4. Advancement of knowledge: Through extensive research and experimentation, the project contributed to the broader understanding of plant-pathogen interactions and the impact of diseases on plant populations.

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