International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

Early Detection of Plant Leaf Disease Using Deep Learning

Shivam Ardalkar [1], Aishwarya Waghmode [2], Aniket Jadhav [3], Parimal Bhosale [4], Prof. Afsha Akkalkot [5]

[12345]Computer Engineering, Zeal College of Engineering and Research, Pune, Maharashtra, India

---***---

Abstract - Farmers face the challenge of preventing and controlling the spread of crop diseases to improve productivity and yield. The impact of plant diseases extends beyond the plants themselves, affecting market access and agricultural production. To address this issue, researchers have recognized the potential of using leaf images to detect and classify diseases at an early stage. In this study, a dataset comprising diverse leaf diseases, including Yellow Curved, Late Blight, Leaf Spot, and Bacterial Leaf Spot, was collected from the internet. These images were utilized to train a Convolutional Neural Network (CNN), which is considered one of the most effective models for image classification. The trained CNN weights were then applied to test new leaf images. By employing CNNs and deep learning techniques, a system was developed to accurately classify plant leaf diseases. To ensure the best model was selected, performance analysis was conducted, focusing on accuracy and finding effective solutions to the problem at hand. By adopting a hybrid approach, the proposed model demonstrates its capability to accurately identify and classify plant leaf diseases.

***Key Words*:** Plant Leaf Disease, Deep Learning, CNN Algorithm, Image processing, Neural Network, Agriculture

1. INTRODUCTION

Agriculture has played a crucial role in the development of human civilizations, focusing primarily on increasing productivity while often neglecting the environmental consequences. The emergence of environmental degradation has highlighted the need to address the impact of diseases on agricultural development, as they can significantly affect both the quality and quantity of crops. Plant diseases encompass a range of pathogens such as fungi, bacteria, viruses, and molds. Traditionally, farmers and specialists visually identify diseased plants and diagnose the specific disease. However, this approach can be time-consuming, costly, and prone to inaccuracies. To overcome these limitations, the use of deep learning techniques for the detection and classification of plant diseases offers a faster and more accurate alternative.

By utilizing photographs capturing symptoms of plant infections, deep learning techniques, including image processing and deep neural networks, enable quick and accurate diagnosis of plant diseases. Extensive research has demonstrated the effectiveness of these techniques in accurately classifying plant diseases. The main objective has been to enhance reliability, correctness, and accuracy in detecting and classifying plant illnesses. The development of an automated system capable of diagnosing plant diseases based on visual signs and symptoms would greatly benefit learners in the field of agriculture.

Researchers have employed visualization techniques to extract disease-related information from the data generated by Convolutional Neural Networks (CNNs). The field of image processing and computer vision sees numerous studies each year, and we propose a system that utilizes machine learning techniques for identifying and classifying plant diseases. Our work in deep learning, specifically leveraging CNN technology, has achieved significant success in this domain. The dataset used in our research was obtained from a global repository known as "Plant Village," encompassing several plant species.

2. LITERATURE SURVEY

2.1 **Advanced Deep learning Algorithm based System for Crops Leaf Diseases Recognition** In this work, we propose an automated system for recognition of potato and corn leaf diseases. Three core phases architecture includes handcrafted features are extracted such as histogram-oriented gradient (HOG), Segmented Fractal Texture Analysis (SFTA)and local ternary patterns (LTP). In the second phase, principal component analysis (PCA) along entropy Skewness based score values are computed and resolve the problem of curse of dimensionality. In the last phase, classification is performed using various classifiers. The Plant Village dataset is utilized for validation and classify selected potato and corn diseases. Competent results are obtained in the range of 92.8% to98.7% on chosen crops diseases which are better as compare to existing techniques.

2.2 **Individual Grape Leaf Disease Identification Using Leaf Skeletons and KNN Classification** In this paper, the classification of grape leaf diseases is proposed along with the leaf identification. Initially, the leaf skeletons are identified based on grape images. Since, the leaf skeletons are used for estimating the positions and directions of the leaves. The Tangential Direction (TD) based segmentation algorithm is proposed for retrieval of skeletons. If the grape leaf images are classified, then the histograms of H and a color channels are generated and the pixels values are observed to distinguish the healthy and diseased tissues. Then, extract the features and classify by using the KNN classification algorithm in order to find the leaf diseases.

2.3 **Hierarchical Learning of Tree Classifiers for Large-Scale Plant Species Identification** In this paper, a hierarchical multi-task structural learning algorithm is developed to support large-scale plant species identification, where a visual tree is constructed for organizing large numbers of plant species in a coarse-to-fine fashion and determining the inter-related learning tasks automatically. For a given parent node on the visual tree, it contains a set of sibling coarse-grained categories of plant species or sibling fine-grained plant species, and a multi-task structural learning algorithm is developed to train their inter-related classifiers jointly for enhancing their discrimination power. The inter-level relationship constraint, e.g., a plant image must first be assigned toa parent node (high-level non-leaf node) correctly if it can further be assigned to the most relevant child node (low-level non-leaf node or leaf node) on the visual tree, is formally defined and leveraged to learn more discriminative tree classifiers over the visual tree. Our experimental results have demonstrated the effectiveness of our hierarchical multi-task structural learning algorithm on training more discriminative tree classifiers for large-scale plant species identification.

2.4 **Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques** This Proposed Work exposes, a advance computing technology that has been developed to help the farmer to take superior decision about many aspects of crop development process. Suitable evaluation and diagnosis of crop disease in the field is very critical for the increased production. Foliar is the major important fungal disease of cotton and occurs in all growing Indian regions. In this work we express new technological strategies using mobile captured symptoms of cotton leaf spot images and categorize the diseases using HPCCDD Proposed Algorithm. The classifier is being trained to achieve intelligent farming, including early Identification of diseases in the groves, selective fungicide application, etc. This proposed work is based on Image RGB feature ranging techniques used to identify the diseases (using Ranging values) in which, the captured images are processed for enhancement first. Then color image segmentation is carried out to get target regions (disease spots). Next Homogenize techniques like Sobel and Canny filter are used to Identify the edges, these extracted edge features are used in classification to identify the disease spots. Finally, pest recommendation is given to the farmers to ensure their crop and reduce the yield loss.

Table -1: Researched Survey Papers

	Paper Name	Author	Publication year	Alogorithm
01	Design and Development of Efficient Techniques for Leaf Disease Detection using Deep Convolutional Neural Networks	Meeradevi And Team	2021	CNN and VGG16 algorithm
02	Plant Leaf Diseases Detection and Classification Using Image Processing and Deep Learning Techniques	M.A. Jasim J.M. Tuwaijari	2021	CNN algorithm
03	Advanced Machine Learning Algorithm based System for Crops Leaf Diseases Recognition	Khursheed Aurangazeb	2020	Local Ternary Pattern (LTP) PCA
04	Advanced Machine Learning Algorithm based System for Crops Leaf Diseases Recognition	P.Revathi, M.Hemalatha	2019	HPCCDD algorithm
05	Hierarchical Learning of Tree Classifiers for Large-Scale Plant Species Identification.	Jianping Fan, Ning Zhou, Jinye Peng, Ling Gao.	2019	Hierarchical multi-task structural Learning algorithm.
06	An Individual Grape Leaf Disease Identification Using Leaf Skeletons and KNN Classification	N.Krithika, Dr.A.Grace Selvarani.	2018	Tangential Direction (TD) based segmentation algorithm

3. PROPOSED SYSTEM

This part of the article discusses a computer vision system that can identify plant diseases. The procedure is shown step by step of the purpose system. fig1. shows the main structure of the proposed system.

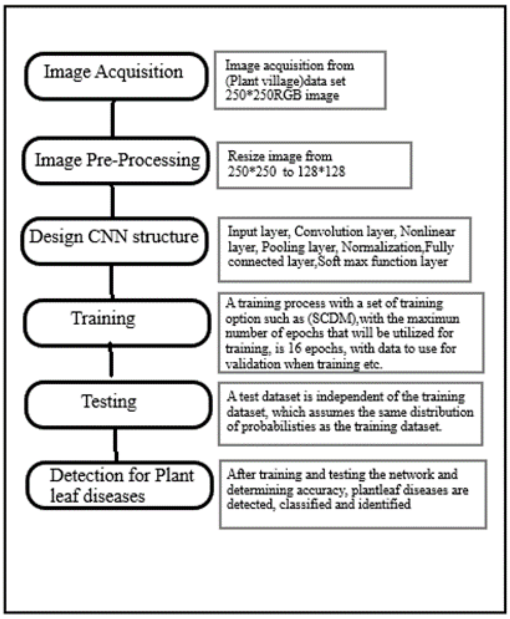

Fig -1: General Diagram for Plant Leaf Diseases Detection and Classification System

There is a lot of potential for growth in this figure 1, which shows the construction of our proposed system for detection and classification of plant leaf diseases, the first stage in it is the stage of image acquisition.

We propose an end-to-end trainable system for plant leaf disease detection. In contrast to the existing deep neural network-based methods which directly estimate the latent clean image, the network uses filter to remove noise.
First, the leaf samples were collected, and images were acquired. The leaf images were then pre-processed and fed into the feature extraction step. Lastly, the extracted features were trained and classified by using convolutional neural

network algorithm. And finally, it detects plant leaf disease and gives instant solutions.

4. METHODOLOGY

Dataset collection: A dataset comprising images of healthy and diseased plant leaves is collected. This dataset may be obtained from various sources, such as online repositories or by capturing images in the field.

Data preprocessing: The collected dataset is preprocessed to enhance the quality of the images and remove any noise or irrelevant information. This step may involve resizing, cropping, and normalizing the images.

Training data preparation: The preprocessed dataset is divided into training and validation sets. The training set is used to train the deep learning model, while the validation set helps evaluate the model's performance during training.

Model selection: A suitable deep learning architecture, such as a Convolutional Neural Network (CNN), is chosen for the task of plant leaf disease classification. CNNs are particularly effective for image-based tasks due to their ability to capture spatial features.

Model training: The selected CNN model is trained using the labeled training data. During training, the model learns to recognize patterns and features indicative of different plant diseases by adjusting its internal parameters.

Model evaluation: The trained model is evaluated using the validation set to assess its performance and fine-tune the hyperparameters if necessary. Metrics like accuracy, precision, recall, and F1 score are calculated to measure the model's effectiveness.

Testing and prediction: Once the model is trained and validated, it is ready to make predictions on unseen leaf images. New leaf images are fed into the model, and the model classifies them into different disease categories.

Performance analysis: The performance of the model is analyzed by comparing its predictions with ground truth labels for the test images. Metrics such as accuracy, precision, and recall are calculated to measure the model's performance on the test set.

5. APPLICATIONS

Disease diagnosis and management: Deep learning models can accurately identify and classify plant leaf diseases, providing farmers and specialists with an efficient tool for disease diagnosis. Early detection allows for timely intervention and appropriate management strategies to prevent disease spread and minimize crop losses.

Precision agriculture: Deep learning-based disease detection can be integrated into precision agriculture systems. By deploying sensors or cameras in the field, farmers can continuously monitor their crops and receive real-time alerts when diseases are detected. This enables targeted interventions, such as precise application of fungicides or adjustments to irrigation and fertilization strategies.

Yield optimization: By detecting diseases at an early stage, deep learning models help optimize crop yields. Farmers can take proactive measures to control the spread of diseases and protect their plants, leading to improved productivity and increased crop yields.

Disease surveillance and monitoring: Deep learning-based disease detection systems can be deployed in large-scale agricultural operations or across different regions to monitor disease prevalence and track its spread. This information is valuable for disease surveillance, allowing for effective control measures and preventing the establishment of new disease hotspots.

Plant breeding and research: Deep learning models can assist plant breeders and researchers in studying disease resistance and developing new disease-resistant crop varieties. By accurately identifying disease symptoms and patterns, researchers can analyze the genetic and environmental factors associated with disease susceptibility and resistance, leading to targeted breeding efforts.

Education and training: Deep learning-based disease detection systems can serve as valuable educational tools for students and farmers. By providing a visual interface and accurate disease classifications, these systems help learners understand the different types of plant diseases, their symptoms, and appropriate management practices.

6. CONCLUSION

Given the global and national significance of agriculture and plants, this study proposes a robust methodology to detect and classify plant diseases accurately and efficiently using computer facilities and deep learning techniques. The focus of this research was to employ the CNN algorithm to achieve precise and rapid disease detection, specifically identifying the type of disease and the corresponding plant through leaf analysis. The dataset included 51 different classes of plant diseases, encompassing prominent crops such as tomatoes, potatoes, and peppers, which hold significant importance in India and globally.

The results obtained from this study were highly promising, demonstrating the effectiveness of the CNN algorithm in achieving accurate and speedy disease detection. As future work, exploring various learning rates and optimizers could further enhance the proposed system's performance. Additionally, expanding the dataset to include a broader range of plant types and diseases, as well as employing multiple techniques, can contribute to the development of an expert system for comprehensive plant leaf disease detection and classification.

REFERENCES

1. Plant Leaf Diseases Detection and Classification Using Image Processing and Deep Learning Techniques.By-" Marwan Adnan Jasim" and " Jamal Mustafa AL- Tuwaijari" .
2. Advanced Machine Learning Algorithm based System for Crops Leaf Diseases Recognition (2020) Khursheed Aurangzeb
3. Design and Development of Efficient Techniques for Leaf Disease Detection using Deep Convolutional Neural Networks (2021) Meeradevi and Team
4. Plant Disease Detection Using CNN (2022) Garima Shrestha; Deepsikha; Majolica Das; Naiwrita Dey
5. Recognition of Plant Diseases using Convolutional Neural Network (2020) G. Madhulatha; O. Ramadevi
6. Plant Disease Detection using CNN and Transfer Learning (2021) Vishal Menon; V Ashwin; Raj K Deepa