



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 4, April 2025

Automated Crop Disease Identification System Using OpenCV and Machine Learning

G. Vidya Sagar, G. Sahithi, V. Pavani, U. Ramanjaneyulu, K. Praveen Kumar

Assistant Professor, Department of AI&DS, SVCN Engineering College, North Rajupalem, Nellore, AP, India

U.G. Student, Department of AI&DS, SVCN Engineering College, North Rajupalem, Nellore, AP, India

U.G. Student, Department of AI&DS, SVCN Engineering College, North Rajupalem, Nellore, AP, India

U.G. Student, Department of AI&DS, SVCN Engineering College, North Rajupalem, Nellore, AP, India

U.G. Student, Department of AI&DS, SVCN Engineering College, North Rajupalem, Nellore, AP, India

ABSTRACT: Agricultural productivity is significantly affected by the prevalence of crop diseases, which can lead to reduced yields and economic losses. Early detection and accurate diagnosis of such diseases are crucial for effective crop management. This paper presents an Automated Crop Disease Identification System that utilizes OpenCV and Machine Learning to analyze plant leaf images and detect potential diseases. The system incorporates image preprocessing techniques using OpenCV to enhance image quality and applies Convolutional Neural Networks, enhanced through Transfer Learning, for precise disease classification. A user-friendly web interface, developed using Flask, allows users, particularly farmers, to upload leaf images for real-time analysis. Upon processing, the system provides detailed diagnostic results, enabling users to take timely and informed actions. The proposed solution not only enhances the efficiency of disease detection but also contributes to sustainable agricultural practices by promoting early intervention strategies. The integration of advanced image processing and machine learning techniques makes this system a reliable and scalable tool for modern agricultural diagnostics.

KEYWORDS: Crop Disease Detection, Plant Leaf Analysis, Image Processing, Convolutional Neural Network, OpenCV, Machine Learning, Transfer Learning, Image Classification, Smart Farming, Real-Time Prediction.

I. INTRODUCTION

Agriculture plays a pivotal role in the global economy and food security. However, crop diseases significantly threaten agricultural productivity, often leading to substantial losses for farmers. Traditional methods of disease detection typically rely on manual inspection by experts, which can be time-consuming, inconsistent, and inaccessible to farmers in remote regions. With the rapid advancement of computer vision and machine learning technologies, there is a growing opportunity to automate the process of crop disease identification, making it more accurate, efficient, and widely accessible. The proposed system integrates image preprocessing techniques, feature extraction, and classification models to ensure robust and real-time disease prediction. By employing Convolutional Neural Networks (CNNs) and transfer learning, the model achieves high accuracy in classifying various crop diseases. The implementation of the system using Python, Flask, OpenCV, and PyTorch demonstrates its potential as a scalable and accessible solution for smart agriculture. The system is designed to deliver reliable and efficient classification of various plant diseases. A user-friendly web interface, built using Flask along with HTML and CSS, allows farmers to easily upload images of affected crops and receive instant feedback regarding the health status of their plants. This solution aims to bridge the technological gap in rural and agricultural communities by providing an accessible tool for early disease detection, thereby supporting timely intervention, reducing crop losses, and ultimately contributing to enhanced agricultural productivity and sustainability.

This paper introduces Advances in artificial intelligence researches now make it possible to make automatic plant disease detection from raw images. Deep learning can be thought as a learning method on neural networks. One of the advantages of deep learning is that it can extract features from images automatically. The neural network learns how to extract features while training. CNN is a multi-layer feed-forward neural network and is the popular deep learning model.

1.1 Basic Idea

For increasing growth and productivity of crop field, farmers need automatic monitoring of plant diseases instead of manual. Manual monitoring of disease do not give satisfactory results as naked eye observation is old method that requires more time for disease recognition and also needs experts; hence it is non-effective. So in this, we introduced a modern technique to find out disease related to both leaf and fruit. To overcome the disadvantages of traditional eye observing techniques, we used digital image processing techniques for fast and accurate disease detection of plant.

1.2 Need of project

Automatic detection of plant diseases and the cultivation of healthy plants is of great importance and agricultural automation. The case of a plant, the term disease is defined as any impairment happening to the normal physiological function, producing characteristic symptoms. The studies of plant diseases refer to studying the visually observable patterns of a particular plant. The identification of plants, leaves, stems and finding out the pests or diseases, or its percentage is found very effective in the successful cultivation of crops. Naked-eye observation is the approach adopted by many of the farmers for the detection and identification of plant diseases.

II. LITERATURE SURVEY

In Concept of Plant Leaf Disease Detection System, one of the earliest frameworks was introduced by Zhang et al.[1]. using digital image processing. Their study focused on extracting features such as color, shape, and texture from leaf images, utilizing segmentation and filtering techniques to isolate disease-affected areas. K-means clustering for leaf segmentation was proposed by Rathore et al.[2].Enhanced using Support Vector Machines (SVM) for classification. Their model demonstrated the feasibility of combining machine learning with basic image processing for agricultural purposes. The Deep learning model using a convolutional neural network is first applied by Mohanty et al.[3] to plant disease identification using the PlantVillage dataset. Their work involved training deep CNN models on 54,306 images across 38 classes (26 diseases + 12 healthy classes). They achieved a classification accuracy of over 99%, demonstrating that CNNs are highly effective in visual-based crop disease recognition. The deep learning based plant disease recognition system using CNNs was developed by Sladojevic et al.[4].They used a self-created dataset of leaf images and built a real-time system capable of recognizing 13 different plant diseases. Their model used five convolutional layers and showed the potential for mobile integration. Mohanty's work was expanded by Ferentinos[5].By training five different deep CNN architectures on a dataset of 87,848 images. He achieved up to 99.53% classification accuracy and emphasized the significance of deep learning in large-scale agricultural diagnostics.A transfer learning algorithm was applied by Hassan et al.[6] using pre-trained models such as VGG16 and ResNet50 for plant disease classification. Their model achieved high accuracy even with limited training data, proving the effectiveness of transfer learning in data-constrained agricultural applications. The web-based platform is developed by Jain et al.[7]. integrating OpenCV for image preprocessing and TensorFlow for inference. The user uploads a plant image, which is then processed and analyzed for disease classification. Their work highlighted the practical benefits of combining machine learning models with cloud/web services. The cloud-based deep learning system was introduced by Sharma et al.[8].that provides disease classification through a farmer-friendly web interface. Their model used a hybrid CNN architecture and addressed backend scalability for use in rural regions.

III. METHODOLOGY

The proposed Automated Crop Disease Identification System follows a structured pipeline comprising image acquisition, preprocessing, model training, and disease prediction. The process begins with the acquisition of leaf images, which can be captured using a smartphone or a digital camera under natural lighting conditions. These images are then subjected to a preprocessing phase using OpenCV, a powerful computer vision library. Preprocessing includes resizing the images to a standard dimension, converting them to grayscale or other suitable color spaces, and applying filters to remove noise and enhance important features. Segmentation techniques are used to isolate the leaf from the background, ensuring that the disease-affected regions are clearly highlighted. Once the images are preprocessed, feature extraction is performed to identify patterns such as color, texture, and shape that are indicative of specific diseases. These features are then used to train a machine learning model. The methodology is designed to ensure accurate, efficient, and real-time identification of crop diseases using deep learning and computer vision. Firstly, in image acquisition, the system begins with the user uploading an image of a plant leaf through a user-friendly web interface. These images may be captured using a smartphone or camera in field conditions. Secondly, in image processing, once an image is uploaded, it undergoes several

preprocessing steps using OpenCV to enhance the quality and relevance of the image data. This includes resizing, noise reduction, and segmentation. Thirdly, in model training, the core of the system's intelligence lies in its deep learning model built using PyTorch. A Convolutional Neural Network (CNN) is employed to classify crop diseases. The model is trained on a labeled dataset comprising images of healthy and diseased leaves of various crops. Fourth, in real-time prediction, the trained model is integrated into a Flask-based backend that interacts with the HTML/CSS frontend. When a user uploads an image the backend invokes the trained CNN model to predict the disease class. The prediction results, confidence score, and disease description are displayed on the web interface. The system may also provide suggestions or possible remedies based on the identified disease. Farmers can receive immediate feedback and recommendations for disease management based on the identified issue.

IV. EXPERIMENTAL RESULTS

Figures show the results of the automated crop disease identification system. Figs. 1, 2, and 3 show the different crop diseases as the model is trained on various distinct crop disease symptoms based on the plant leaf images and it gives high accuracy prediction and also it displays the cause of the disease and give preventive measures for that disease.

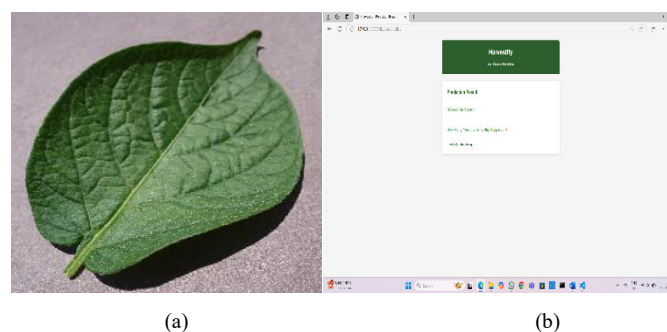


Fig. 1 The input image, i.e, a potato healthy leaf where the user can upload (a) the web interface where the prediction results displayed as leaf is healthy and is displayed as “no disease” and Don’t worry your crop is healthy; keep it up (b)

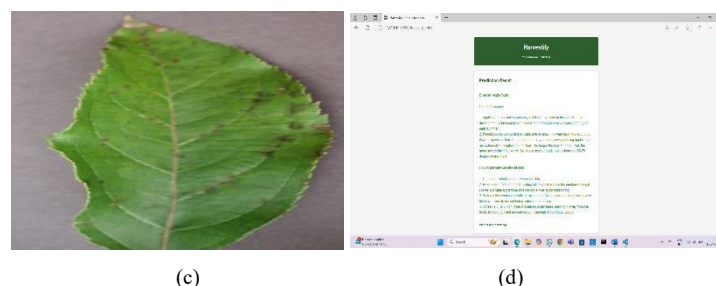


Fig. 2 The input image, i.e, apple leaf, which is diseased where the user can upload (c) the web interface where the prediction results displayed as apple scab disease; it displays the cause of the disease and give preventive measures and recommendations to the user (d)

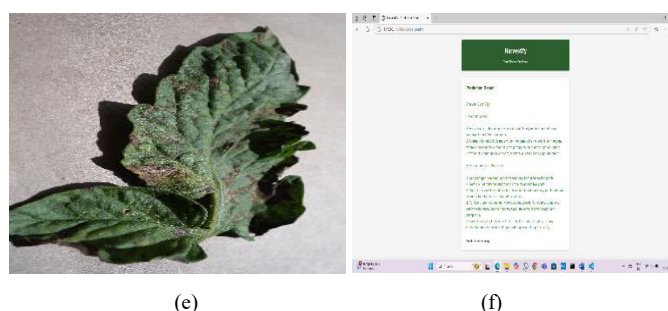


Fig.3 The input image, i.e, potato leaf, which is diseased where the user can upload(e) the web interface where the prediction results are displayed as potato earlybright,it displays the cause of the disease and gives preventive measures and recommendations to the user (f)

V. CONCLUSION

We implemented the system using Python, with OpenCV for image preprocessing and enhancement, and PyTorch for building and deploying a robust Convolutional Neural Network (CNN) model. Transfer learning is employed to boost the accuracy and efficiency of the model, enabling it to accurately classify a variety of crop diseases based on leaf images. The user-friendly web interface, developed using Flask along with HTML and CSS, allows farmers to upload leaf images and receive instant feedback on potential diseases. This end-to-end solution not only streamlines the disease identification process but also empowers farmers to make timely decisions for disease management and crop treatment. By improving early detection and intervention, the system contributes significantly to enhancing crop yield and overall agricultural productivity. The successful implementation validates the potential of combining computer vision and machine learning to solve real-world problems in the agricultural sector.

REFERENCES

- [1] Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016). Using deep learning for image-based plant disease detection. *Frontiers in Plant Science*, 7, 1419.
- [2] Ferentinos, K. P. (2018). Deep learning models for plant disease detection and diagnosis. *Computers and Electronics in Agriculture*, 145, 311–318.
- [3] Brahimi, M., Boukhalfa, K., & Moussaoui, A. (2017). Deep learning for tomato diseases: Classification and symptoms visualization. *Applied Artificial Intelligence*, 31(4), 299–315.
- [4] Too, E. C., Yujian, L., Njuki, S., & Yingchun, L. (2019). A comparative study of fine-tuning deep learning models for plant disease identification. *Computers and Electronics in Agriculture*, 161, 272–279.
- [5] Zhang, S., Wu, X., & You, Z. (2017). Leaf image-based cucumber disease recognition using sparse represents classification. *Computers and Electronics in Agriculture*, 134, 135–141.
- [6] Ramcharan, A., Baranowski, K., McCloskey, P., Ahmed, B., Legg, J., & Hughes, D. P. (2017). Deep learning for image-based cassava disease detection. *Frontiers in Plant Science*, 8, 1852.
- [7] Barbedo, J. G. A. (2013). Digital image processing techniques for detecting, quantifying and classifying plant diseases. *SpringerPlus*, 2(1), 660.
- [8] Picon, A., Alvarez-Gila, A., Seitz, M., Ortiz-Barredo, A., Echazarra, J., & Johannes, A. (2019). Deep convolutional neural networks for mobile capture device-based crop disease classification in the wild. *Computers and Electronics in Agriculture*, 161, 280–290.
- [9] Amara, J., Bouaziz, B., & Algergawy, A. (2017). A deep learning-based approach for banana leaf diseases classification. In *BTW (Workshops)* (Vol. 2017, pp. 79–88).
- [10] Fuentes, A., Yoon, S., Kim, S. C., & Park, D. S. (2017). A robust deep-learning-based detector for real-time tomato plant diseases and pests recognition. *Sensors*, 17(9), 2022.
- [11] Sladojevic, S., Arsenovic, M., Anderla, A., Culibrk, D., & Stefanovic, D. (2016). Deep neural networks based recognition of plant diseases by leaf image classification. *Computational Intelligence and Neuroscience*, 2016, 1–11.
- [12] Lu, Y., Yi, S., Zeng, N., Liu, Y., & Zhang, Y. (2017). Identification of rice diseases using deep convolutional neural networks. *Neurocomputing*, 267, 378–384.
- [13] Arsenovic, M., Karanovic, M., Sladojevic, S., Anderla, A., & Stefanovic, D. (2019). Solving current limitations of deep learning based approaches for plant disease detection. *Symmetry*, 11(7), 939.
- [14] Kamilaris, A., & Prenafeta-Boldú, F. X. (2018). Deep learning in agriculture: A survey. *Computers and Electronics in Agriculture*, 147, 70–90.
- [15] Durmus, H., Gunes, E. O., & Kirci, M. (2017). Disease detection on the leaves of the tomato plants by using deeplearning. In *2017 6th International Conference on Agro-Geoinformatics* (pp. 1–5). IEEE.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details