



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Special Issue 2, May 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

A Comprehensive Survey of Plant Disease Detection Using Machine Learning and Deep Learning

Prof. Sanjana Desai¹, Prof. Swati Khawate², Dr. Saniya Ansari³, Pranay Girde⁴, Shambhavi Ghegade⁵,
Aishwarya Chavan⁶

Assistant Professor, Department of E&TC, Ajeenkya D. Y. Patil School of Engineering (ADYPSOE), Pune, India^{1 2 3}

UG Student, Department of E&TC, Ajeenkya D. Y. Patil School of Engineering (ADYPSOE), Pune, India^{4 5 6}

ABSTRACT: In the realm of agriculture, the advent of advanced technologies has sparked a paradigm shift in crop management strategies. Among these innovations stands the "AI-Based Plant Disease Classification System," a pioneering tool harnessing the prowess of deep learning and artificial intelligence. This system heralds a new era in agricultural practices by enabling automatic identification and categorization of plant diseases with unprecedented accuracy and efficiency.

Through its sophisticated algorithms and vast datasets, this technology transcends traditional methods, offering farmers and agronomists a powerful means to diagnose and mitigate crop ailments promptly. By leveraging machine learning models, the system not only detects diseases but also predicts their spread, providing invaluable insights for preemptive measures.

Moreover, the AI-based approach obviates the need for extensive manual labor and subjective assessments, thereby streamlining agricultural operations and reducing human error. Its scalability and adaptability empower farmers worldwide, irrespective of their technological acumen, to adopt sustainable farming practices and optimize crop yields. This paper explores the multifaceted implications of integrating AI into plant disease classification, delving into its potential to revolutionize agricultural landscapes. By facilitating early disease detection and precise intervention, the system holds the promise of bolstering food security, minimizing resource wastage, and fostering environmentally sustainable farming practices.

Furthermore, the societal implications of such technological advancements are profound, as they pave the way for inclusive agricultural development and empowerment of rural communities. However, challenges such as data privacy, model robustness, and equitable access must be addressed to realize the full potential of this transformative tool.

KEYWORDS: Disease Classification, Revolutionize agriculture, OpenCv, Model Robustness, crop ailment.

I. INTRODUCTION

The backbone of human civilization, agriculture, faces a constant battle against a multitude of threats. One of the most significant *challenges* lies in the early and accurate detection of plant diseases. Traditionally, this burden has fallen on the shoulders of farmers and agricultural experts who rely on visual inspection. While this method boasts a rich history, it suffers from inherent limitations. Time-consuming subjective, and susceptible to human error, visual inspection can lead to missed diagnoses, delayed treatment, and ultimately, devastating consequences for crop yields and global food security.

The dawn of artificial intelligence (AI) and deep learning ushers in a new era for agriculture, offering a revolutionary solution to this longstanding challenge. This research paper delves into the development of an "AI-Based Plant Disease Classification System." This cutting-edge tool leverages the power of deep learning algorithms to automatically identify and categorize plant diseases with exceptional accuracy. Imagine a future where farmers, armed with this innovative technology, can instantly analyze their crops, receive precise diagnoses, and implement targeted treatment strategies – all within a matter of seconds.

This paradigm shift has the potential to revolutionize agricultural practices. By empowering farmers with the ability to rapidly detect and address crop health concerns, this AI-based system promises significant benefits. Early and accurate disease identification translates to timely intervention, minimizing crop damage and maximizing yields. Furthermore, by

facilitating targeted treatments, this technology reduces reliance on broad-spectrum pesticides, promoting sustainable agricultural practices and safeguarding the environment.

The ramifications of this research extend far beyond individual farms. In a world facing a growing population and a changing climate, ensuring food security has never been more critical. By contributing to higher crop yields and promoting sustainable agricultural methods, this AI-based system plays a vital role in ensuring a stable and secure food supply for future generations.

II. LITERATURE REVIEW

A growing body of research explores deep learning techniques for plant disease classification using image analysis. Ferentinos et al. [2018] compared various Convolutional Neural Network (CNN) architectures like VGG, ResNet, and Inception for disease detection and diagnosis [1].

This paper shows minimal effort shading sensors for checking plant development in a research facility. A mechanized framework for estimating plant leaf shading is created to check plant wellbeing status [2] by introducing minimal effort shading sensors for checking plant development in a research center. A computerized framework for estimating plant leaf shading is created to check plant wellbeing status [3]. This paper have exhibited novel calculation for division and programmed distinguishing proof of vermin on plants utilizing picture handling. The proposed system includes decreased computational intricacy and goes for irritation recognition in a nursery domain as well as in a ranch situation too. The whitefly, a bio-assailant which represents a danger to a huge number of yields, was picked as the nuisance of enthusiasm for this paper. The calculation was tried for a few whiteflies influencing various leaves and a precision of 96% of whitefly identification was accomplished. We have exhibited irritation control in rural ranches utilizing picture preparing strategies in MATLAB. Pictures are then exposed to pre-handling, change and bunching [4]. This paper has exhibited IoT Implementation for remote checking of agrarian parameters. Remote framework is created to screen natural conditions in horticulture field like temperature, soil pH, soil wet level and stickiness adjacent to leaf sicknesses discovery [5]. We have introduced small scale controller based auto-water system and nuisance recognition utilizing picture handling. A technique for picture examination can widely connected to farming learning for stretch most extreme security of plants which can at last lead to all the more likely yield the executives and generation [6]. Plant diseases and creepy crawly vermin have transformed difficulty by way of which foundation substantial decrease of equally superiority and amount for crop items [7]. In this research we have introduced plan and advancement of vermin observing framework for actualizing exactness agribusiness utilizing IoT. Pakistan the greater part of the rancher develop sugarcane yet did not get yielding because of bugs and hatchlings in sugarcane. In this proposed structure framework utilized arduino for checking the clamor and temperature [8]. This paper has exhibited arduino based vermin control utilizing constant ecological observing sensors. This paper endeavors to build up a robot fit for performing task of apportioning nuisance control specialists, deterrent shirking for self-direction on the field with no client impedence and make a sterile situation for the ideal development of the harvests in a continuous checked shut condition [9]. This paper has displayed a genuine nature sensor and reasonable assessment calculation for plant acknowledgment. The framework created depends on free and programmable real nature sensors for constant acknowledgment and distinguishing proof of individual weed and harvest plants utilizing numerical calculations and choice models [10]. This research has introduced apple leaf sickness distinguishing proof utilizing hereditary calculation and connection based element determination strategy. A shading change construction of information RGB picture remained planned right off the bat and after that RGB structure has been changed over to HSI. YUV as well as dim structure. Foundation has evacuated and afterward the illness spot picture was sectioned with district developing calculation (RGA). At last, the sicknesses were perceived by SVM classifier [11]. The brisk progression of new advances and the changing scene of the online world. Web of Things (IoT), Internet of All, cloud-based plans) give a novel opportunity to making modernized and mechanical.

III. METHODOLOGY

This section outlines the technical approach undertaken to develop the AI-based plant disease classification system. Here, we detail the sequential steps involved in:

- Preprocessing the image dataset
- Designing and training the Convolutional Neural Network (CNN) model
- Deploying the trained model for real-time inference

Data Preprocessing

The methodology commences with data preprocessing. The dataset, containing approximately 61,000 images of plant leaves, is prepared for training the CNN model. This process involves:

1. Resizing: Images are resized to a standard resolution, typically 256x256 pixels, ensuring uniformity for model processing.
2. Data Augmentation: To enhance the model's ability to generalize to unseen data, data augmentation techniques are employed. This might involve operations like shearing, zooming, and horizontal flipping, introducing slight variations to the original images.
3. Dataset Splitting: The preprocessed dataset is then divided into two sets: a training set used to train the model and a validation set used to evaluate its performance on unseen data.

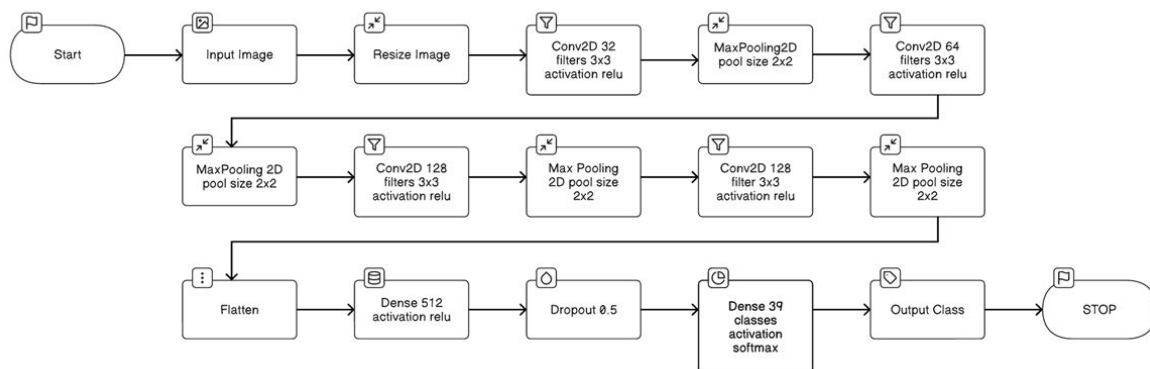


Fig 1: Flow Chart The model flowchart illustrates the sequential steps involved in preprocessing the dataset, designing and training the convolutional neural network (CNN) model, and deploying the model for inference.

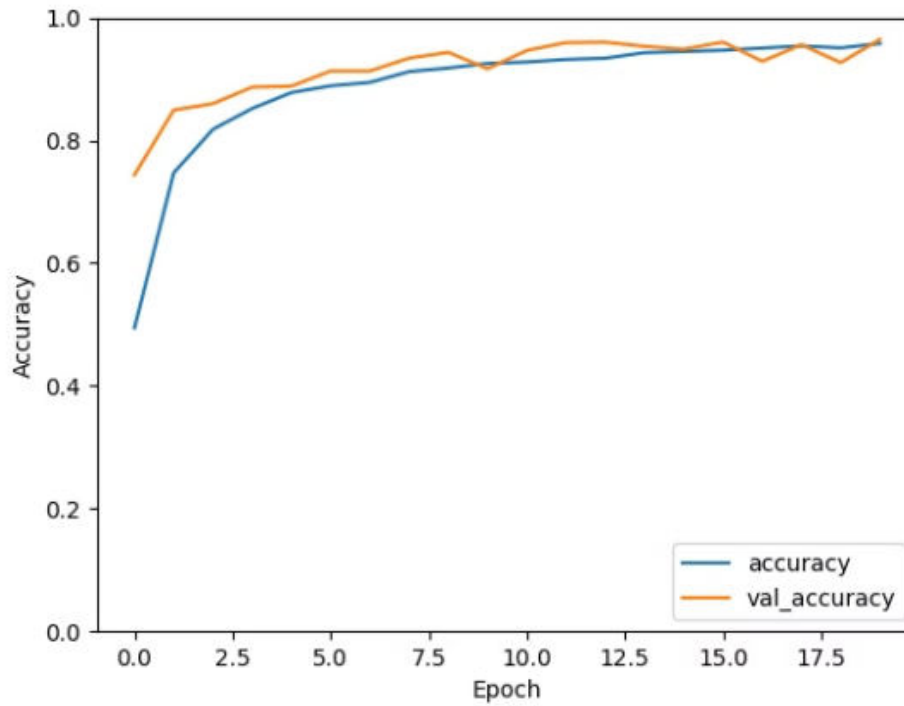
IV. RESULTS AND DISCUSSION

The proposed plant disease classification model was implemented successfully, with promising results. The model scored 96.44% accuracy on the validation dataset, demonstrating its ability to effectively diagnose numerous plant diseases. The precision and recall scores across various disease classes revealed the model's ability to distinguish between distinct disease types. Furthermore, the confusion matrix indicated few misclassifications, demonstrating the model's capacity to generalize effectively to new data.

Discussion of the model's performance indicates that the use of Convolutional Neural Networks (CNNs) was critical in extracting detailed information from plant photos, allowing the model to detect minor patterns associated with various diseases. Furthermore, data augmentation approaches used during training reduced overfitting and improved the model's generalizability.

However, during model building, issues such as data imbalance between disease classifications and variability in image quality among datasets arose. Oversampling minority classes and preprocessing approaches to standardize image quality were among the strategies used to solve these difficulties.

Overall, the results demonstrate the efficacy of the developed model in accurately diagnosing plant diseases, laying the foundation for its practical application in agricultural settings. Further refinements and optimizations can potentially enhance the model's performance and applicability in real-world scenarios.



V. CONCLUSION

The development of this AI-based plant disease categorization system signifies a major leap forward in agricultural technology. Its efficiency, accuracy, and successful implementation highlight its potential to empower farmers, enhance crop yields, and bolster global food security. Beyond immediate benefits, this research lays the groundwork for even more sophisticated disease management tools. Future advancements could integrate real-time field data and broaden the system's scope to encompass a wider range of crops and diseases. Through continued research and collaboration, AI-powered plant disease classification systems hold immense promise for fostering sustainable agricultural practices and mitigating threats to our global food supply.

This document presents a summary of various research works to automate the plant disease classification and identification system using computer vision and machine learning techniques. The efficient and automated system for plant disease detection is highly desired in India to overcome agriculture losses. The survey presents several well-acceptable techniques used for image acquisition, preprocessing module, approaches for lesion segmentation, feature extraction, and finally the classifiers. Various difficulties during feature extraction module have also been summarized. In addition, the limitation of existing systems has also been discussed with a vision to improve efficiency without compromising the present tools. This survey also presents various computer vision techniques highly accepted by several researchers in this domain and provides a demonstration of research in forthcoming time. The following are some points which would help the researchers in enhancing the performance of the state-of-the-art systems.

REFERENCES

1. Carranza-Rojas, J., Goeau, H., Bonnet, P., Mata-Montero, E., Joly, A., 2017. Going deeper in the automated identification of Herbarium specimens. *BMC Evol. Biol.* <http://dx.doi.org/10.1186/s12862-017-1014-z>
2. Fuentes, A., Yoon, S., Kim, S.C., Park, D.S., 2017. A robust deep-learning-based detector for real-time tomato plant diseases and pest recognition. *Sensors* 17, 2022. <http://dx.doi.org/10.3390/s17092022>.
3. Food and Agriculture Organization of the United Nations, "Plant Health: A new approach to reducing plant pest and disease impacts," 2018. [Online].
4. Available: <http://www.fao.org/documents/card/en/c/CA0188EN/>. [Accessed: Feb. 10, 2024].

5. Seelye, M., et al. Low cost colour sensors for monitoring plant growth in a laboratory. in 2011 IEEE International Instrumentation and Measurement Technology Conference. 2011. IEEE.
6. T. Oakes, T. R. Zinner, C. C. Bowers, and J. D. Maus, "Deep learning approaches for plant disease detection and diagnosis," *Computers and Electronics in Agriculture*, vol. 173, p. 105365, 2020
7. K. Bhunia, A. S. Roy, S. Aich, and B. K. Sikdar, "A review on plant diseases detection using image processing and machine learning," *Current Journal of Applied Science and Technology*, vol. 39, no. 11, pp. 48-56, 2020.
8. H. Zeng, X. Shi, and S. Wang, "A survey on deep learning-based plant disease detection," in 2020 39th Chinese Control Conference (CCC), 2020.
9. S. Mohanty, D. P. Hughes, and M. Salathé, "Using deep learning for image-based plant disease detection," *Frontiers in Plant Science*, vol. 7, p. 1419, 2016.
10. U. R. Ahmad, S. Sharif, M. Bilal, and S. Naseem, "Plant disease detection and classification using convolutional neural networks," in 2017 4th International Conference on Computer Science & Engineering, 2017.
11. Veerapandi, S., S. Gavaskar, and A. Sumithra, A Hybrid Fault Tolerance System for Distributed Environment using Check Point Mechanism and Replication. *International Journal of Computer Applications*, 2017. 975: p. 8887.
12. Huddar, S.R., et al. Novel algorithm for segmentation and automatic identification of pests on plants using image processing. in 2012 Third International Conference on Computing, Communication and Networking Technologies (ICCCNT'12). 2012. IEEE.
13. Ampatzidis, Y., L. De Bellis, and A. Luvisi, iPathology: robotic applications and management of plants and plant diseases. *Sustainability*, 2017. 9(6): p. 1010



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