DETECTING PLANT LEAF DISEASE THROUGH THE APPLICATION OF DEEP LEARNING ALGORITHMS

Niranjan Murthy M[1], Swetha C S[2]

[1]*Student, Department of MCA, Bangalore Institute of Technology, Karnataka, India*

[2]*Professor, Department of MCA, Bangalore Institute of Technology, Karnataka, India*

ABSTRACT: The Plant Disease Detection System make use of deep learning techniques to provide an efficient and scalable solution to find and categorize plant diseases from leaf images. Utilizing a previously trained convolutional neural network (CNN) model, the system achieves high accuracy in identifying various plant diseases, thus aiding in early detection and management. This paper details the implementation process, including system architecture, data flow, and testing methodologies, make sure the system meets the specified functional and non-functional requirements. The outcome indicate the system robustness, usability, and scalability, make it as a important tool for farmers and agricultural experts. Future enhancements include expanding the disease database, real-time monitoring, mobile application development, and integration with agricultural management systems.

Key Words: Plant Disease Detection, Deep Learning, Convolutional Neural Network (CNN), Image Processing, Agricultural Technology, Disease Classification.

1. INTRODUCTION

Agriculture plays a pivotal role in the economy and sustenance of societies worldwide. However, plant diseases pose a significant threat to agricultural productivity, leading to substantial losses. Traditional methods of disease detection, which rely on manual inspection by experts, are often inadequate due to their labor-intensive and time-consuming nature. The advent of deep learning technology offers a promising alternative to automating the identify and classification of plant diseases. This paper presents the Plant Disease Detection System a web-based application that applies deep learning techniques to find plant diseases from leaf images, providing farmers and agricultural experts with an efficient tool for disease management.

2. LITERATURE SURVEY

Kusumo et al. (2018) marked machine learning techniques to automatic identification of corn plant diseases using image processing. They achieved promising results, indicating the potential of merging image processing with deep learning for disease detection[1].LeCun et al. (2015) gave a thorough explanation of deep learning methods and their uses, highlighting the revolutionary effects of deep neural networks in a number of industries, including plant disease detection[2].Lu et al. (2017) created a deep model of a network of convolutional neural networks (CNN) to identify rice illnesses. Their method showed notable accuracy gains over conventional approaches, highlighting the usefulness of deep learning for agricultural applications[3].Mohanty et al. (2016) used deep learning to the detction of plant diseases using images. Their research demonstrated the promise of deep learning models in practical settings by demonstrating that these models could diagnose a different of plant diseases with high accuracy[4].Srinivasan et al. (2023) focused on a CNN-based way to plant disease detection using multilabel images. They employed contextual regularization to enhance model performance, achieving high accuracy in detecting diseases from complex image datasets[5].Mokhtar et al. (2017) designed a support vector machine (SVM) to identify illnesses on tomato leaves. Although their method worked well, it brought to light

the shortcomings of conventional machine learning approaches in comparison to deep learning models[6].Kaur et al. (2019) conducted a examine on plant disease identification through leaf images, analyzing various deep learning models. Their findings indicated that CNNs and their variants consistently surpassed alternative models in terms of accuracy and robustness[7].Tiwari et al. (2020) examined the usage of deep learning to the diagnosis of potato leaf disease. Their method, which coupled CNNs with picture preprocessing, produced a significant level of precision and showed how deep learning may be used to find various illnesses in a variety of crops[8].Astani et al. (2022) offered a thorough analysis of many deep learning models towards the detection of plant diseases. They emphasized the use of real-time detection techniques and ensemble models in enhancing the accuracy and efficiency of illness diagnosis systems[9].Wang et al. (2022) optimized a lightweight YOLOv5 model for plant disease detection, focusing on real-time applications. Their study showed that the optimized model could effectively balance accuracy and computational efficiency, making it suitable for deployment in field conditions[10].Yu et al. (2021) developed a novel deep learning method using adaptive deep convolutional recurrent neural networks (ADCRNN) for corn leaf disease detection. Their approach significantly improved classification accuracy, demonstrating the effectiveness of merging CNNs with recurrent neural networks[11].Francis and Deisy (2019) explored the use of NASNet for plant disease recognition using leaf images. Their deep learning-based approach achieved high accuracy, showcasing the possible of advanced architectures like NASNet in agricultural applications[12].Too et al. (2019) We out a comparison research on deep learning model fine-tuning for plant disease detection. They emphasized the value of transfer learning techniques in improving model performance—particularly in the case of small datasets[13].

3. EXISTING SYSTEM

Many plant disease detection systems have been developed utilizing various machine learning methods, including Random Forest, Naive Bayes, and Artificial Neural Networks. While such systems have been very promoting, they experience several limitations in their own sense. The accuracy of such models often comes out to be pretty low, and usually, their applicability is also restricted to detecting diseases in a single species of plants. Such systems have therefore found limited adoption in farming areas like the state of Karnataka, where farmers still rely on conventional disease detection techniques such as visual identification. Manuals relying on mere observation are not only time-consuming but also more prone to errors due to the subjectivity involved in human perception. It also creates the requirement for a more reliable solution that can easily be adopted and applied with simplicity by farmers and other agricultural professionals.

4. PROBLEM STATEMENT

Plant diseases significantly impact agricultural productivity, leading to reduced crop yields and economic losses. Traditional methods of disease detection are labor-intensive, time-consuming, and prone to human error. There is a pressing demand for an automated, efficient, and scalable solution to detect plant diseases accurately and timely. This project aims to address this challenge by developing a Plant Disease Detection System using deep learning techniques, producing a reliable instrument for early disease detection and management.

To develop software for anomaly detection using Autoencoders which will detect the abnormalities in the high-dimensional input datasets, i.e., credit card transaction details, using a neural network and unsupervised deep learning algorithms.

Input: Credit card transaction details' dataset.

Output: Detection of anomalies in the given dataset.

5. PROPOSED SYSTEM

The goal of the suggested system is to develop an entirely automated picture classification system that can accurately find and categorize plant diseases in a different type of plant species. This study uses CNN, DenseNet, and ResNet—three cutting-edge deep learning algorithms—to obtain a high degree of illness diagnosis accuracy. Compared to current approaches, the suggested system has a number of benefits, such as the ability to process many photos more quickly, the availableness of cures for diseases detected, and the flexibility to access data

without the requirement for specialized agricultural knowledge at any time. The suggested system seeks to offer a scalable and affordable solution for real-time disease monitoring and control in agriculture by making use of deep learning capabilities.

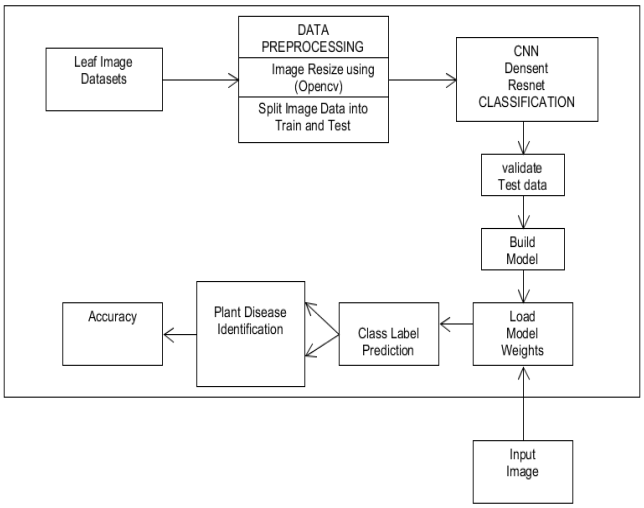

Fig -1: SYSTEM ARCHITECTURE

6. METHODOLOGY

The Plant Disease Detection System is designed to detect plant diseases from leaf images using a previously trained convolutional neural network (CNN) model. There are multiple steps in the methodology, which includes data collection, preprocessing, model training, and system integration.

1. Data Collection: High-quality pictures of plant leaves affected by different diseases are collected from public databases and field studies.
2. Preprocessing: The images are preprocessed to improve their ability and suitability for model training. Preprocessing steps include resizing, normalization, and noise reduction.
3. Model Training: A pre-trained CNN model is fine-tuned using the preprocessed images. The system is trained to classify various plant diseases based on the features extracted from the pictures.
4. System Integration: The trained model is merged into a web-based application developed using Flask. The application allows users to upload images, process them through the CNN model, and view the classification results.
5. Testing: Comprehensive testing is conducted, including unit testing, integration testing, system testing, user acceptance testing, performance testing, and security testing, to make sure the system's reliability and performance.

7. OUTPUT AND RESULTS

The Plant Disease Detection System demonstrates high efficiency in detecting variety plant diseases, with the CNN model achieving impressive results. The system's user-friendly interface allows easy image upload and result visualization, making it suitable for users with different levels of technical expertise. The scalability and durability of the model ensure it is capable of handling larger data loads and integrate new features in the future.

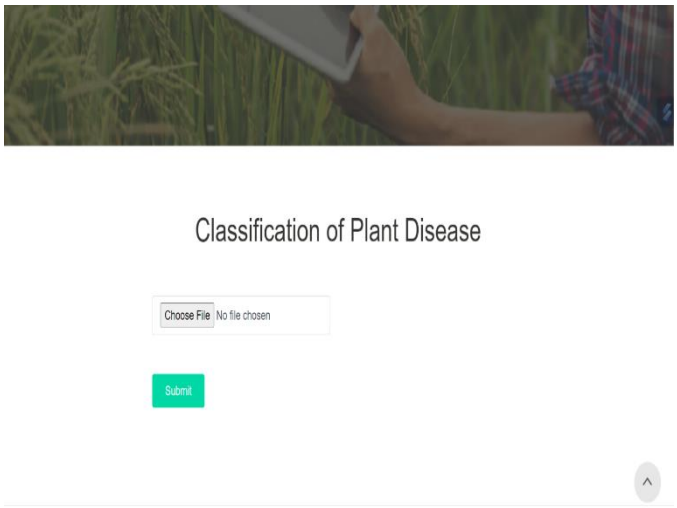

Fig -2: Prediction Page

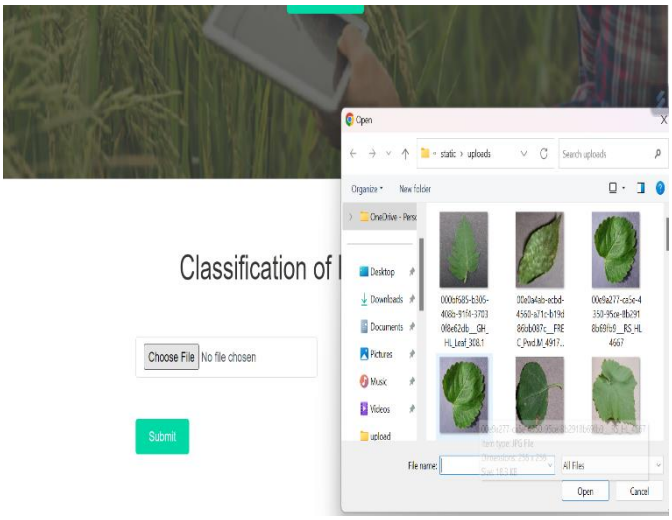

Fig -3: Uploading Page

Fig -4: Identifying Healthy leaf

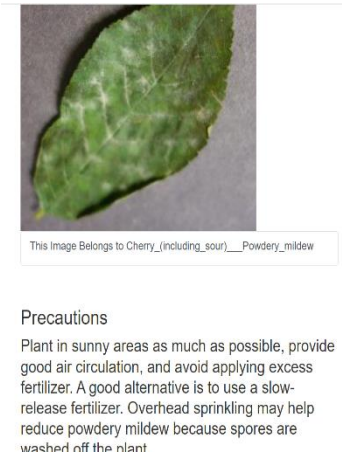

Fig -5: Identifying Diseased Leaf with Precaution

7. CONCLUSION

The Plant Disease Detection System represents a significant step forward in leveraging modern technology to address a critical challenge in agriculture. Through the merging of deep learning methods with a user-friendly web application, this system provides an efficient, reliable, and scalable solution for using leaf pictures to find and categorize plant diseases. The implementation process, which includes setting up the development environment, coding individual modules, integrating system components, and thorough testing, guarantees that the system satisfies the specified functional and non-functional requirements.

REFERENCES

[1] **Kusumo, B., Heryana, A., Mahendra, O., and Pardede, H.** 2018. Machine learning-based for automatic detection of corn-plant diseases using image processing. In: 2018 International Conference on Computer, Control, Informatics and its Applications (IC3INA). IEEE, pp. 93-97. doi:10.1109/IC3INA.2018.8629507.

[2] **LeCun, Y., Bengio, Y., and Hinton, G.,** 2015. Deep learning. Nature, 521(7553), pp. 436-444. doi:10.1038/nature14539.

[3] **Lu, Y., Yi, S., Zeng, N., Liu, Y., and Zhang, Y.,** 2017. Identification of rice diseases using deep convolutional neural networks. Neurocomputing, 267, pp. 378-384. doi:10.1016/j.neucom.2017.06.023.

[4] **Mohanty, S.P., Hughes, D.P., and Salathé, M.,** 2016. Using deep learning for image-based plant disease detection. Frontiers in Plant Science, 7(1419). doi:10.3389/fpls.2016.01419.

[5] **Srinivasan, R., Santhanakrishnan, C., Iniyan, S., Subash, R., and Sudhakaran, P.,** 2023. CNN-based plant disease identification in crops from multilabel images using contextual regularization. Journal of Survey in Fisheries Sciences, 10(2S), pp. 522-531.

[6] **Mokhtar, U., El-Bendary, N., Hassenian, A.E., Emary, E., Mahmoud, M.A.,** Hefny, H., and Tolba, M.F., 2017. SVM-based detection of tomato leaves diseases. In: 2017 International Conference on Advanced Technologies for Signal and Image Processing (ATSIP). IEEE. doi:10.1109/ATSIP.2017.8075524.

[7] **Kaur, S., Pandey, S., and Goel, S.,** 2019. Plants disease identification and classification through leaf images: A survey. Archives of Computational Methods in Engineering, 26, pp. 507-530. doi:10.1007/s11831-018-9255-6.

[8] **Tiwari, D., Ashish, M., Gangwar, N., Sharma, A., Patel, S.,** and Bhardwaj, S., 2020. Potato leaf diseases detection using deep learning. In: 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS). IEEE, pp. 461-466. doi:10.1109/ICICCS48265.2020.9121114.

[9] **Astani, M., Hasheminejad, M., and Vaghefi, M.,** 2022. A diverse ensemble classifier for tomato disease recognition. Computers and Electronics in Agriculture, 198, p. 107054. doi:10.1016/j.compag.2022.107054.

[10] **Wang, H., Shang, S., Wang, D., He, X., Feng, K., and Zhu, H.,** 2022. Plant disease detection and classification method based on the optimized lightweight YOLOv5 model. Agriculture, 12(7), p. 931. doi:10.3390/agriculture12070931.

[11] **Yu, H., et al.,** 2021. Corn leaf diseases diagnosis based on k-means clustering and deep learning. IEEE Access, 9, pp. 143824-143835. doi:10.1109/ACCESS.2021.3111994.

[12] **Francis, M., and Deisy, C.,** 2019. Deep learning based on NASNet for plant disease recognition using leave images. In: 2019 International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD). IEEE. doi:10.1109/ICABCD.2019.8851029.

[13] **Too, E.C., Yujian, L., Njuki, S., and Yingchun, L.,** 2019. A comparative study of fine-tuning deep learning models for plant disease identification. Computers and Electronics in Agriculture, 161, pp. 272-279. doi:10.1016/j.compag.2018.03.032.