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Rice Leaf Diseases Detection Using Machine Learning

Introduction

Rice, scientifically known as Oryza sativa, is a vital crop globally, rice plays a crucial role as a staple food for a substantial segment of the global population. However, rice plants are susceptible to various diseases that primarily affect their leaves, posing significant threats to crop productivity and food security. Leaf diseases in rice, caused by pathogens like fungi, bacteria, viruses, manifest in the form of spots, lesions, discoloration, and deformities (Fig 1). Apart from visual damage, these diseases disrupt the plant's physiological processes, leading to reduced photosynthesis, weakened overall plant health, decreased yield, and compromised grain quality. Detecting and diagnosing these diseases in a timely manner is crucial for implementing effective disease management strategies, minimizing yield losses, and ensuring sustainable rice production [1]. The analysis of rice leaf diseases from images has emerged as a promising approach in plant pathology [2].

Fig 1. The dataset includes images brown spot of rice disease [4].

Advances in computer vision and machine learning techniques have enabled researchers to utilize image analysis for the diagnosis and classification of various rice diseases [3]. High-resolution images of diseased leaves can be captured and processed using sophisticated algorithms that extract pertinent features and patterns. In Fig. 2, the dataset showcases distinct rice leaf diseases, including rice blast, red blight, stripe blight, and sheath blight, along with their corresponding feature extraction images. These features encompass

characteristics such as size, shape, color variations, texture, and spatial distribution of lesions or symptoms on the leaves [4]. Machine learning models, such as Convolutional Neural Networks (CNNs), can be trained on labeled image datasets to learn the complex relationships between the extracted features and specific diseases [5]. Subsequently, these models can classify new, unseen leaf images, facilitating the accurate identification of diseases affecting rice plants [6]. This non-invasive and efficient method of disease analysis from leaf images holds immense potential for assisting farmers and plant pathologists in timely disease detection and management, ultimately leading to improved crop health, yield, and food security.

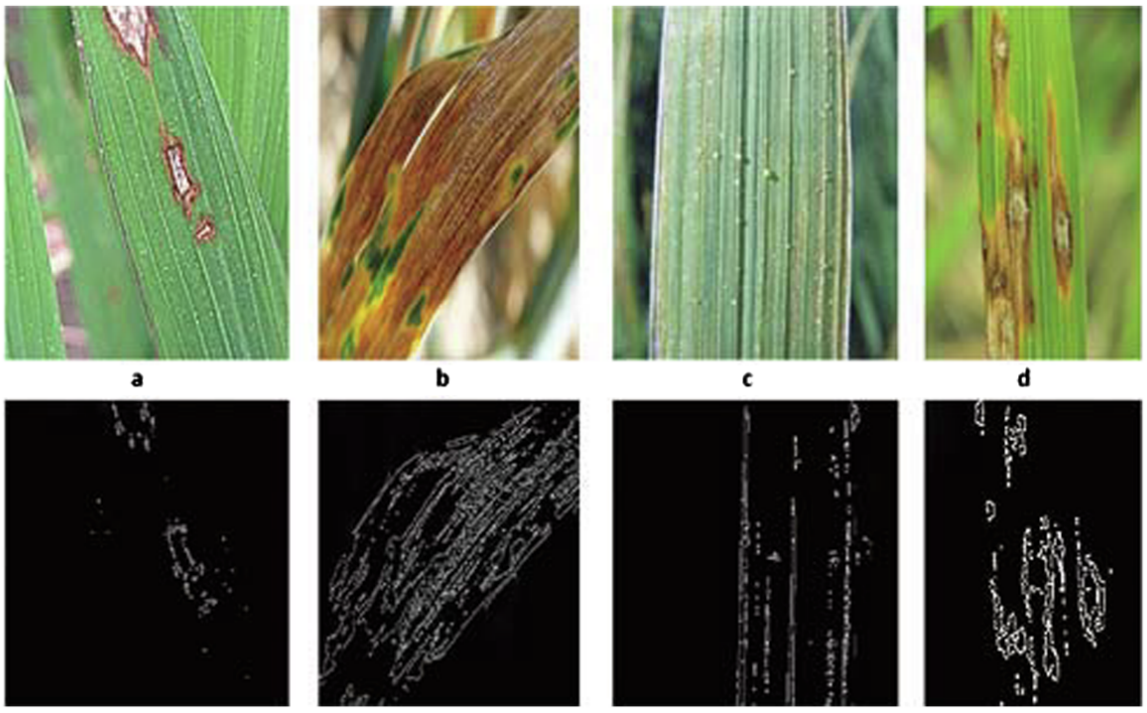

Fig 2. The dataset contains images of distinct rice leaf diseases (rice blast, red blight, stripe blight, and sheath blight), along with their corresponding feature extraction images [1].

Related work

Several notable studies have been conducted on the classification of rice leaf diseases using deep learning techniques. Jiang et al. (2020) proposed a model that combines image preprocessing, feature extraction, and a combination of Convolutional Neural Networks (CNNs) and Support Vector Machine (SVM) for accurate disease identification [1]. Their model achieved an impressive accuracy of 96.80% in classifying four major rice leaf diseases. In 2020, Bhattacharyya, Mitra, and Dutta edited a book titled "Intelligence Enabled Research: DoSIER 2019," which features research in various domains, including agricultural intelligence. The book provides valuable insights into the application of intelligent systems and computing in research and development. While not specific to rice leaf disease classification, it serves as a comprehensive resource for understanding the broader context of intelligence-enabled research [2].

Ghosal and Sarkar (2020) developed an automated system for rice leaf disease classification using CNNs and transfer learning techniques [3]. Their model achieved an impressive test accuracy of 92.40% and exhibited the potential for detecting other plant leaf diseases as well. In a separate study, Mekha and Teeyasuksaet (2021) investigated the effectiveness of the random forest algorithm in classifying rice leaf diseases [4]. Their comparative analysis revealed that the random forest algorithm achieved the highest accuracy of 69.44% among the tested methods. These studies contribute valuable insights into the field of agricultural disease detection and provide a foundation for further research in this domain.

Lu, Lin, Zhang, Liu, and Guan (2023) published a study titled "New method for rice disease identification based on improved deep residual shrinkage network" [5]. Their research proposed an improved model called ICDRSN for accurate rice leaf disease recognition. The model incorporated sparse neural network modules, CBAM modules, and ELU and Focal loss functions to enhance disease identification. The ICDRSN achieved a mean accuracy of 98.65% and outperformed classical models in convergence speed and robustness. Aggarwal et al. (2023) focused on improving the classification of rice leaf diseases through the integration of pre-trained deep learning models and ensemble learning techniques [6]. Their proposed model showcased higher accuracy rates on both normal and segmented datasets, leveraging the power of pre-trained neural networks and image processing.

These studies from 2020 to 2023 highlight the significance of accurate disease identification in rice crops. They showcase the effectiveness of deep learning methods, including Convolutional Neural Networks (CNNs), transfer learning, and pre-trained models, for addressing rice leaf disease classification challenges. Future research directions include expanding datasets, exploring alternative architectures, and optimizing models for real-world field conditions.

References

[1] F. Jiang, Y. Lu, Y. Chen, D. Cai, and G. Li, “Image recognition of four rice leaf diseases based on deep learning and support vector machine,” *Computers and Electronics in Agriculture*, vol. 179, p. 105824, Dec. 2020, doi: 10.1016/j.compag.2020.105824.

[2] S. Bhattacharyya, S. Mitra, and P. Dutta, Eds., *Intelligence Enabled Research: DoSIER 2019*, vol. 1109. in Advances in Intelligent Systems and Computing, vol. 1109. Singapore: Springer Singapore, 2020, doi: 10.1007/978-981-15-2021-1.

[3] S. Ghosal and K. Sarkar, “Rice Leaf Diseases Classification Using CNN With Transfer Learning,” in *2020 IEEE Calcutta Conference (CALCON)*, Kolkata, India: IEEE, Feb. 2020, pp. 230–236, doi: 10.1109/CALCON49167.2020.9106423.

[4] P. Mekha and N. Teeyasuksaet, “Image Classification of Rice Leaf Diseases Using Random Forest Algorithm,” in *2021 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunication Engineering*, Cha-am, Thailand: IEEE, Mar. 2021, pp. 165–169, doi: 10.1109/ECTIDAMTNCON51128.2021.9425696.

[5] Y. Lu, L. Lin, X. Zhang, W. Liu, and C. Guan, “New method for rice disease identification based on improved deep residual shrinkage network,” *Systems Science & Control Engineering*, vol. 11, no. 1, p. 2177770, Feb. 2023, doi: 10.1080/21642583.2023.2177770.

[6] M. Aggarwal *et al.*, “Pre-Trained Deep Neural Network-Based Features Selection Supported Machine Learning for Rice Leaf Disease Classification,” *Agriculture*, vol. 13, no. 5, p. 936, Apr. 2023, doi: 10.3390/agriculture13050936.