Learning patterns in rice leaf disease detection using deep learning architectures

***Abstract*—**

***Index Terms*—**

I. Introduction

II. Related Work

Many studies have studied the use of deep learning methods for detecting rice leaf diseases and learning about patterns in the diseases, including Blast, bacterial blast, tungro, and Brownspot. Alom, M., et al. (2018) discusses the evolution of deep learning methods post-Alexnet, covering key contributions in image classification, object recognition, and natural language processing. It discusses advancements in model architecture, optimization, and training techniques, focusing on CNNs like VGG, ResNet, and GoogleNet in their work [1]. Mishra, S., et al. (2020) introduces a real-time method for recognizing corn leaf diseases using a deep convolutional neural network (CNN). By tuning hyperparameters and adjusting pooling combinations on a GPU-accelerated system, the performance of the deep neural network is enhanced. The model achieves an accuracy of 88.46%, demonstrating the method's feasibility on standalone smart devices such as Raspberry Pi, smartphones, and drones [2].

A classification task using the Alexnet deep learning model and transfer learning by fine-tuning Alexnet pretrained on ImageNet results demonstrate that larger datasets lead to higher accuracy and lower loss, with accuracies of 90.7%, 86.6%, and 81.5% for datasets of 10,000, 5,000, and 1,000 respectively [3]. Confusion matrix analysis shows strong performance in distinguishing between different types of vegetables with minimal misclassifications. Additionally, the study highlights the computational efficiency of the fine-tuned model, reducing training time and resource requirements compared to training from scratch. These findings emphasize the practical utility of deep learning models like Alexnet for accurate and efficient vegetable classification, particularly beneficial for agricultural and food processing applications.

Another study by Hossain, et al. (2020) a CNN-based model is utilized for identifying diseases in rice leaves by minimizing the network parameters. This proposed model achieves impressive training and validation accuracies of 99.78% and 97.35%, respectively. Its effectiveness is evaluated on a separate set of rice leaf disease images, achieving a high accuracy of 97.82% with an AUC of 0.99. Furthermore, binary classification experiments were conducted, with recognition rates of 97%, 96%, 96%, 93%, and 95% for Blast, Brownspot, Bacterial Leaf Blight, Sheath Blight, and Tungro, respectively. Additionally, the model's efficiency in memory storage is notable due to its reduced number of network parameters [4]. Another deep CNN with a pre-trained ResNet-50 model and median filtering, followed by k-means clustering for segmentation is implied and achieves 97.3% accuracy across datasets [5]. Similarly, four pre-trained CNN models are developed: ResNet34, ResNet50, ResNet18 with self-attention, and ResNet34 with a self-attention layer between healthy and diseased rice leaves. Performance analysis reveals ResNet34 with Self-Attention as the top-performing model, achieving 98.54% accuracy, outperforming other models [6].
In this study, Maulana, et al. (2023) uses the InceptionV3 deep learning model to detect rice leaf diseases from images, utilizing transfer learning by fine-tuning InceptionV3 pretrained on ImageNet. Experimental results demonstrate accuracies ranging from 78.2% to 99.58% across various classification models. The study includes a detailed evaluation of the model's performance using metrics such as precision, recall and f1-score for each disease class achieving 99% precision, 93% recall, 96% f1-score for Bacterial Blight, 97% precision, 97% recall, 97% f1-score for Blast, 95% precision, 99% recall, 97% f1-score for Brownspot and 99% precision, 100% recall, 100% f1-score for Tungro. Evaluation calculation results of the InceptionV3 model using test data were - 97.47% for accuracy, 97.5% for precision and 97.46% for f1-score [7].

These studies collectively underscores the potential of deep learning methodologies in the domain of rice leaf disease detection. Through advancements in neural network architectures, transfer learning, multimodal imaging, data augmentation, and real-time monitoring systems, researchers aim to enhance the efficiency and accuracy of disease diagnosis in rice cultivation, contributing to improved crop yield and agricultural sustainability.

References

[1] M. Z. Alom, T. M. Taha, C. Yakopcic, S. Westberg, P. Sidike, M. S. Nasrin, B. C. V. Esesn, A. A. S. Awwal, and V. K. Asari, "The history began from alexnet: A comprehensive survey on deep learning approaches," 2018.

[2] S. Mishra, R. Sachan, and D. Rajpal, "Deep convolutional neural network based detection system for real-time corn plant disease recognition," *Procedia Computer Science*, vol. 167, pp. 2003–2010, 2020, international Conference on

Computational Intelligence and Data Science. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S187705092030702X

[3] L. Zhu, Z. Li, C. Li, J. Wu, and J. Yue, “High performance vegetable classification from images based on alexnet deep learning model,” *International Journal of Agricultural and Biological Engineering*, vol. 11, pp. 217–223, 01 2018.

[4] S. M. M. Hossain, M. M. M. Tanjil, M. A. B. Ali, M. Z. Islam, M. S. Islam, S. Mobassirin, I. H. Sarker, and S. M. R. Islam, “Rice leaf diseases recognition using convolutional neural networks,” in *Advanced Data Mining and Applications*, X. Yang, C.-D. Wang, M. S. Islam, and Z. Zhang, Eds. Cham: Springer International Publishing, 2020, pp. 299–314.

[5] P. A. S. Rani and N. Singh, “Paddy leaf symptom-based disease classification using deep cnn with resnet-50,” *International Journal of Advanced Science Computing and Engineering*, vol. 4, no. 2, p. 88–94, Aug. 2022. [Online]. Available: https://ijasce.org/index.php/IJASCE/article/view/83

[6] A. Stephen, A. Punitha, and A. Chandrasekar, “Designing self attention-based resnet architecture for rice leaf disease classification,” *Neural Computing and Applications*, vol. 35, no. 9, pp. 6737–6751, March 2023. [Online]. Available: https://doi.org/10.1007/s00521-022-07793-2

[7] A. Maulana, M. Asyhari, Y. Azhar, and V. Nastiti, “Disease detection on rice leaves through deep learning with inceptionv3 method,” *Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi)*, vol. 7, pp. 1147–1154, 10 2023.