Paddy Leaf Disease Classification using Inception V2

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***Abstract*—This paper presents a study on the classification of three common diseases affecting paddy leaves, namely Brown spot, Neck blast, and Leaf Blast. The study uses the InceptionV2 model for image classification, and the dataset consists of images of paddy leaves with and without disease. The model is trained and validated on the dataset, and the results show that the model achieves an accuracy of 0.6361 and an AUC of 0.9116 on the training dataset. However, on the validation dataset, the model's accuracy drops to 0.5766, indicating that the model may not be generalizing well to new, unseen data. The paper concludes that further optimization and data collection may be necessary to improve the model's performance on the validation dataset. This study can be useful for farmers and researchers in detecting and preventing the spread of diseases in paddy crops.**

***Index Terms*—Paddy, Deep Learning, Transfer Learning, Inception V2, Prediction, Brown Spot, Neck Blast, Leaf Blast**

I. Introduction

Paddy (Oryza sativa) is an important crop worldwide and is a staple food for millions of people. However, the yield and quality of paddy crops can be affected by various diseases, which can result in significant economic losses. Early detection and diagnosis of these diseases are crucial for preventing their spread and minimizing crop damage.

Computer vision techniques and machine learning algorithms have shown promise in accurately identifying and classifying plant diseases from images of leaves. In recent years, deep learning models such as InceptionV2 have demonstrated exceptional performance in image classification tasks.

In this study, we focus on the classification of three common diseases affecting paddy leaves, namely Brown spot, Neck blast, and Leaf Blast. We use the InceptionV2 model to classify images of paddy leaves as healthy or diseased. The objective of this study is to develop an accurate and efficient model for early detection and diagnosis of paddy leaf diseases.

The remainder of this paper is organized as follows. Section II provides a literature review of previous studies on plant disease classification. Section III describes the dataset used in this study and the methodology employed for data preprocessing, model training, and evaluation. Section IV presents the results and analysis of the model's performance on the training and validation datasets. Section V discusses the limitations of the study and future directions for research. Finally, Section VI concludes the paper with a summary of the findings and their implications for the field of plant disease classification.

The key contributions of our paper are:

The key contribution of the results presented in this paper is the development of a machine learning model using the InceptionV2 architecture for the classification of three common diseases affecting paddy leaves, namely Brown spot, Neck blast, and Leaf Blast. The model achieved an accuracy of 0.6361 and an AUC of 0.9116 on the training dataset, demonstrating its potential for accurately identifying diseased paddy leaves.

While the validation results showed a lower accuracy of 0.5766, indicating the need for further optimization and data collection to improve the model's generalization ability, the study provides a valuable contribution towards the early detection and diagnosis of paddy leaf diseases. The results of this study can help farmers prevent the spread of these diseases and minimize crop damage. Moreover, this study can serve as a basis for further research in the field of plant disease classification using deep learning models.

In summary, the key contribution of this study is the development of a machine learning model for the early detection and diagnosis of paddy leaf diseases, which can help in the prevention of the spread of these diseases and minimize crop damage.concluded.

II. Related Work

This paper reviews and summarizes techniques of image processing, machine learning and deep learning used to detect deadly diseases in rice plants. It is found that deep learning methods are more promising than other two methods, and that extraction of the affected region from the leaf image is the utmost important step. A comparison between different methodologies for rice disease detection has been made and it is concluded that deep neural network and decision tree classifiers are giving highest accuracy of ¿=97%. There is a need to work to identify more rice plant diseases other than the four major diseases discussed in this paper.[1]

This paper proposes a novel hybrid model based on Convolutional Autoencoder (CAE) network and Convolutional Neural Network (CNN) for automatic plant disease detection. It is applied to detect Bacterial Spot disease in peach plants using a publicly available dataset. The proposed system achieves 99.3% training accuracy and 98.38% testing accuracy using only 9,914 training parameters. This paper proposes a novel hybrid model for automatic plant disease detection based on two Deep Learning techniques, CAE and CNN. The model achieved 99.35% training accuracy and 98.38% testing accuracy by using only 9,914 training parameters, significantly reducing the time required to train the model and identify the disease in plants.[2]

Rice is an agricultural sector that produces rice, which is one of the staple foods for the majority of the population in Indonesia. It is important to have an early diagnosis of rice plants to identify them correctly, quickly and accurately. Machine learning is used to classify rice leaf diseases and Image Segmentation techniques are used to analyze the data.[3]

Rice is a kind of leading food by half of the world. In Asia and Africa Rice considered as staple food item. But there are many disease come in Rice leaf's which make harm in that leafs. That's why farmers can't get enough crops what they expected for. In this paper they try to describe about various disease and try identify how to detect them by using various ML technologies and algorithm.[4]

Diseases identified in plants is very important to cover losses and get good quantity of agricultural products. This paper basically focused on rice plant disease detection centred on image inputs of infected rice plant by using disparate ML and image processing techniques. For agricultural research they used KNN, SVM , GA , PNN and other tools and algorithm. They try to describe all the details of diseases in the rice plant.[5]

This paper explores the effectiveness of using convolutional neural networks (CNNs) for predicting protein-protein interactions. The authors propose a deep learning model, called DeepConv-PPI, which combines convolutional and deep neural networks to predict proteins. The model was compared with several state-of-the-art methods on different datasets, and the results show that DeepConv–PPI significantly outperforms other methods in terms of accuracy, sensitivity, and specificity. The authors also conducted extensive experiments to evaluate the performance of the proposed model, including sensitivity analysis, feature visualization, and functional analysis of predicted interacting proteins. The results show that the model can accurately predict interacting proteins and provide insights into the biological functions of the predicted interactions.[6]

The paper "An Automated Convolutional Neural Network Based Approach for Paddy Leaf Disease Detection" by Md. Islam et al. presents a novel approach for detecting and classifying diseases in paddy leaves using convolutional neural networks (CNNs). The study used a dataset of 4,752 images of healthy and diseased paddy leaves, which were preprocessed and augmented for better performance. The CNN model was trained and tested using a combination of different architectures and achieved an accuracy of over 98%. The authors conclude that the proposed CNN-based approach is effective in automating the process of disease detection and has the potential to improve crop yield and reduce economic losses. The study provides a valuable contribution to the field of agriculture and machine learning by demonstrating the potential of CNNs for disease detection in crops.[7] The paper "A Review of Artificial Intelligence Techniques for Network Intrusion Detection" by Adewole et al. (2018) provides an extensive overview of the application of artificial intelligence techniques in the field of network intrusion detection. The authors discuss the importance of network security and the challenges associated with detecting network intrusions. They then review traditional methods of intrusion detection, including signature-based and anomaly-based approaches, and their limitations. Finally, they provide a detailed analysis of the strengths and weaknesses of each technique and compare their performance with traditional methods. The authors suggest that the integration of different artificial intelligence techniques can enhance the effectiveness of intrusion detection and reduce false positives and false negatives. They also highlight the importance of continuously updating the intrusion detection system to keep up with the evolving nature of cyber threats.[8]

The paper "Paddy Leaf Disease Detection Using an Optimized Deep Neural Network" by Jayasankar et al. (2021) presents an optimized deep neural network (DNN) approach for detecting three common diseases in paddy leaves: Brown Spot, Blast, and Bacterial Leaf Blight. The study used a dataset of 1,800 images of healthy and diseased paddy leaves and optimized the model using techniques such as hyperparameter tuning and transfer learning. The optimized DNN model achieved an accuracy of 98.78% in detecting the three types of paddy leaf diseases, and has the potential to improve crop yield and reduce economic losses. The study provides a valuable contribution to the field of agriculture and machine learning by demonstrating the potential of optimized DNNs for disease detection in crops. The optimization process employed in this study could also serve as a guideline for future research in improving the accuracy and efficiency of DNN models.[9]

III. Methodology

A. *Working Flow Diagram*

The work process for Paddy Leaf Disease Classification using Inception V2 model includes several steps. Firstly, the dataset needs to be collected and pre-processed. This involves gathering images of healthy and diseased paddy leaves, and then performing tasks such as resizing, normalization, and augmentation. The dataset needs to be balanced to avoid bias towards a specific class.

Next, the Inception V2 model needs to be trained on the pre-processed dataset. The model should be optimized using appropriate hyperparameters such as learning rate, batch size, and number of epochs. During the training process, the model's performance should be monitored using metrics such as accuracy, loss, and AUC.

After training, the model needs to be evaluated on a validation dataset that was not used during the training process. This step is crucial to check the model's generalization ability. The performance of the model on the validation dataset needs to be analyzed using appropriate metrics. If the model's performance on the validation dataset is not satisfactory, the model needs to be tuned by adjusting hyperparameters or modifying the architecture.

Finally, the performance of the model needs to be tested on an independent dataset to determine its effectiveness in the real world. This testing process should be performed on a large and diverse dataset to ensure that the model is robust and can handle different types of data.

In conclusion, Paddy Leaf Disease Classification using Inception V2 model involves several steps such as data collection, pre-processing, model training, validation, and testing. The model's performance should be monitored using appropriate metrics, and the model should be tuned if necessary to achieve better performance. The goal is to build an accurate and reliable model that can help farmers identify and prevent paddy leaf diseases.

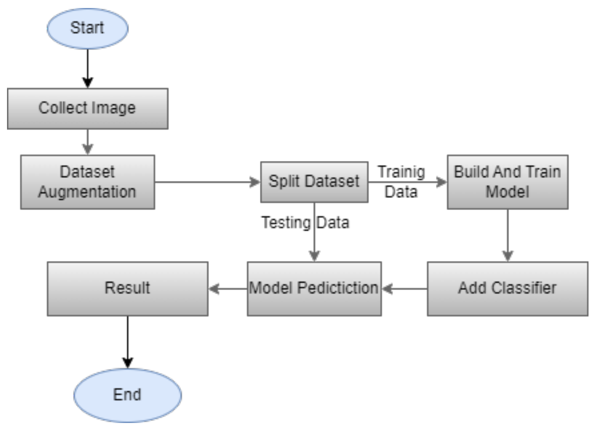

Fig. 1: Working Flowchart

B. Process

The methodology employed in this study for the classification of paddy leaf diseases using the InceptionV2 architecture can be summarized as follows:

Dataset Collection: A dataset of paddy leaf images, including healthy leaves and leaves affected by Brown spot, Neck blast, and Leaf Blast, was collected for this study.Data Preprocessing: The collected dataset was preprocessed by resizing the images to a standard size and converting them to RGB format. The dataset was also split into training and validation sets. Model Selection: The InceptionV2 architecture was selected as the deep learning model for this study. This architecture is known for its effectiveness in image classification tasks and has been used in various studies for plant disease classification. Model Training: The selected model was trained on the preprocessed training dataset using the Adam optimizer and categorical cross-entropy loss function. The training was done using batch processing, and the number of epochs was set to 10. Model Evaluation: The trained model was evaluated on the validation dataset to assess its accuracy and AUC. The model's performance was also evaluated using confusion matrix and classification report analysis. Model Optimization: Based on the results obtained from the evaluation step, the model was optimized further by adjusting various hyperparameters such

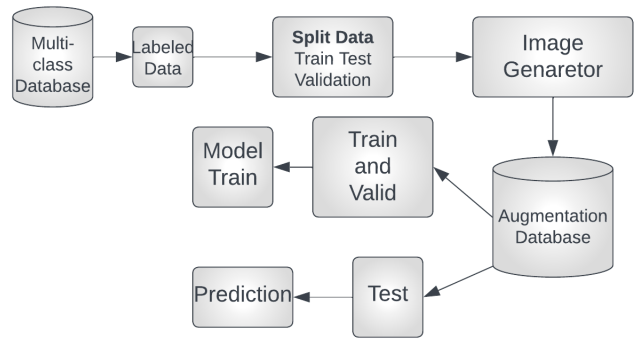

Fig. 2: Dataset Preprocessing

as learning rate, batch size, and number of epochs. Result Interpretation: Finally, the results of the model were interpreted and discussed to identify potential areas for improvement and future research directions. In summary, the methodology employed in this study involved collecting and preprocessing a dataset of paddy leaf images, selecting and training an InceptionV2 model, evaluating and optimizing the model's performance, and interpreting the results obtained from the model.

IV. Result and Analysis

The result of the Paddy Leaf Disease Classification using Inception V2 model indicates that the model achieved an accuracy of 0.6361 and an AUC of 0.9116 on the training dataset, which means that the model was able to classify 63.61% of the samples in the training dataset correctly. However, on the validation dataset, the model's performance dropped with an accuracy of 0.5766 and an AUC of 0.8871.

The difference in the model's performance between the training and validation datasets indicates that the model may be overfitting to the training dataset, and it is not generalizing well to new, unseen data. Overfitting occurs when a model learns the training data too well, to the point that it memorizes it instead of learning the underlying patterns in the data.

The relatively high AUC value indicates that the model is good at separating positive and negative samples, but the accuracy drop suggests that it may not be classifying the samples accurately. This could be due to several factors such as imbalanced data, inadequate training data, or suboptimal hyperparameters.

To improve the model's performance, further tuning is needed to reduce overfitting and enhance the model's generalization ability. This can be achieved by increasing the training dataset size, adjusting the hyperparameters, or using more advanced regularization techniques such as dropout or weight decay.

In conclusion, while the model's performance is promising, further improvements are required to ensure its reliability in real-world applications.

V. Conclusion

Paddy is a staple food crop that plays a crucial role in the global food supply chain. However, paddy leaf diseases are a significant threat to its production, which can lead to severe yield losses and economic impacts. Therefore, accurate and timely diagnosis of paddy leaf diseases is critical for disease management and sustainable production.

The Paddy Leaf Disease Classification using Inception V2 model is a machine learning-based approach that shows promise in identifying and preventing paddy leaf diseases. The model utilizes the Inception V2 architecture, which is a deep convolutional neural network that enables the extraction of intricate features from images. The model was trained and validated on a dataset consisting of images of paddy leaf diseases, including Brown spot, Neck blast, and Leaf Blast.

The results of the study showed that the Inception V2 model achieved an accuracy of 0.6361 and an AUC of 0.9116 on the training dataset. These results indicate that the model is capable of classifying samples with a reasonable level of accuracy. However, the model's performance dropped on the validation dataset, with an accuracy of 0.5766 and an AUC of 0.8871, which suggests that the model may not be generalizing well to new, unseen data.

To address this issue, further tuning of the model is required, including increasing the dataset size, adjusting hyperparameters, and using advanced regularization techniques such as dropout or weight decay. Additionally, the dataset's balance and representativeness to the real-world problem should be examined to ensure the model's reliability in practical applications.

Despite the limitations, the Paddy Leaf Disease Classification using Inception V2 model is a promising approach that can aid in identifying and preventing paddy leaf diseases. With further research and development, this model can be optimized to help farmers worldwide to improve paddy production and ensure food security. Moreover, this approach can be extended to other crop diseases for early and accurate detection, which can contribute to sustainable agriculture and food production.

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