GrainPalette - A Deep Learning Odyssey In Rice Type Classification Through Transfer Learning

Abstract

Rice, being one of the most consumed staple foods worldwide, exists in numerous varieties. Accurate classification of rice types is crucial for quality control, supply chain management, and agricultural research. Traditional methods are manual, time-consuming, and error-prone. This project proposes an AI-powered approach using transfer learning-based deep learning models to automate rice type classification, ensuring accuracy, scalability, and efficiency.

1. Introduction

Rice plays a pivotal role in global food security. The classification of rice varieties is traditionally performed through manual inspection, which introduces subjectivity and inefficiency. Deep learning, particularly transfer learning, provides an effective alternative for automating this process. By leveraging pretrained models, we can achieve high performance with limited domain-specific data.

2. Problem Statement

The manual identification of rice varieties poses several challenges, such as: • Time-consuming and labor-intensive. • High probability of human errors. • Lack of scalability for large datasets. Thus, there is a strong need for an automated and intelligent rice type classification system.

3. Objectives

- Develop a deep learning model for rice type classification.
- Utilize transfer learning to enhance classification accuracy.
- Evaluate multiple pretrained models.
- Design a scalable and robust solution for real-world deployment.

4. Methodology

The methodology followed in this project involves: • Data Collection: Acquiring rice type images from open-source datasets. • Preprocessing: Image resizing, normalization, and augmentation. • Transfer Learning: Fine-tuning pretrained CNN architectures such as ResNet50, VGG16, InceptionV3, MobileNetV2, and EfficientNet. • Model Evaluation: Assessing performance using accuracy, precision, recall, and F1-score. • Deployment: Designing framework for practical use in agricultural applications.

5. Dataset

The dataset consists of multiple rice varieties collected from agricultural research centers and open-source repositories. The dataset was balanced to ensure fair classification and preprocessed through resizing, normalization, and data augmentation to improve generalization.

6. Transfer Learning Models

- ResNet50
- VGG16
- InceptionV3
- MobileNetV2
- EfficientNet

7. Results

The experimental results indicate that transfer learning models significantly improve rice type classification. Among the models tested, EfficientNet achieved the highest accuracy, followed by ResNet50 and InceptionV3. The use of pretrained models reduced training time and enhanced generalization performance.

8. Conclusion

This project demonstrates the effectiveness of transfer learning in rice type classification. The proposed system ensures accuracy, scalability, and robustness compared to manual methods. By automating rice classification, it reduces human errors and enhances agricultural productivity.

9. Future Work

Future extensions of this work include: • Expanding the dataset with more rice varieties. • Deployment of the system as a mobile and web application. • Incorporating explainable AI to enhance model transparency. • Collaborating with agricultural organizations for large-scale validation.