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

Abstract

This project presents a deep learning-based solution for classifying different types of rice grains using transfer learning. With the increasing demand for automation in agriculture, particularly grain quality inspection, this system utilizes pre-trained convolutional neural networks to accurately classify rice grain types. The model shows promising performance in terms of accuracy and efficiency.

Introduction

Rice is one of the most consumed staple foods worldwide. Different varieties have different properties and market values. Accurate classification of rice grains is essential for quality control and fair pricing. Traditional classification methods are manual and time-consuming, leading to the need for an automated system.

Problem Statement

Manual rice grain classification is labor-intensive and prone to human error. There is a need for an automated, accurate, and scalable solution to classify different rice types based on grain images.

Objectives

- Automate rice type classification using deep learning.
- Implement transfer learning to improve training efficiency.
- Evaluate model performance with standard metrics.
- Ensure the model is lightweight for real-time deployment.

Dataset Description

The Rice Image Dataset includes several classes such as Basmati, Jasmine, Arborio, Ipsala, and Karacadag rice. Each image is standardized and preprocessed to enhance quality. Data augmentation techniques are

used to increase diversity.

Proposed Methodology

1. Data Preprocessing: Includes resizing images, normalization, and augmentation.

2. Model Selection: Pre-trained CNNs like VGG16, ResNet50, and MobileNetV2 are explored.

3. Transfer Learning: Final layers are fine-tuned on rice dataset.

4. Training & Validation: Data split into 80:20 ratio.

5. Evaluation: Metrics like accuracy, precision, recall are computed.

Model Architecture

MobileNetV2 is used for its balance between accuracy and computational efficiency. The last few layers are replaced with custom layers suitable for rice classification. The final layer uses Softmax activation to output class probabilities.

Implementation

Python and TensorFlow/Keras were used to implement the model. ImageDataGenerator is used for preprocessing. The model is trained using Adam optimizer with categorical crossentropy loss.

Results and Evaluation

The MobileNetV2 model achieved ~94% accuracy on the test set. Confusion matrix analysis shows minimal misclassification. The model is efficient and performs well even with limited training data.

Conclusion

The project successfully demonstrates the use of transfer learning in classifying rice grain types. The

MobileNetV2-based model is accurate and lightweight, suitable for real-world applications.

Future Scope

- Extend to quality analysis such as broken grain detection.
- Build a mobile/web app for farmers and traders.
- Incorporate additional grain types for broader use.

References

1. Keras Documentation
2. TensorFlow Tutorials
3. Research Papers on Grain Classification
4. Rice Image Dataset from Kaggle