

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

Team Members: M.Kishor, Kambham Mahendra, K Hasmath, K Rechal

Faculty Mentor: Y. Amarnath

1. Introduction

GrainPalette is an intelligent rice grain classification assistant powered by deep learning and transfer learning. This project aims to accurately classify different rice types using image recognition techniques, facilitating automation in agriculture and food processing sectors. It offers a smart, fast, and reliable solution for grain quality assessment and variety identification through a web interface.

2. Tools & Technologies

- Pre-trained CNN Models (e.g., VGG16, ResNet50) via **Transfer Learning**
- **Python 3, TensorFlow / Keras**
- **Flask** (for backend integration)
- **HTML, CSS, JavaScript (AJAX)** (for frontend)
- **VS Code, Replit / Render** for deployment and testing

3. Technical Architecture

The system consists of a web-based frontend where the user uploads an image of a rice grain. The backend uses a Flask server that processes the image, runs it through a fine-tuned pre-trained CNN model (e.g., VGG16), and returns the predicted rice type. Results are shown in real time.

4. Modules Implemented

- **Model Selection and Architecture:** Pre-trained CNN model (e.g., VGG16) used with custom classifier layers
- **Core Functionality:** Image classification using transfer learning
- **Application Logic:** Flask-based server routes handle image input and prediction

- **UI Design:** Simple interface for uploading rice grain images
- **Deployment:** Web app deployable on platforms like Render or Replit

5. Sample Code Snippet

Backend logic to classify rice grain image:

python

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```
from tensorflow.keras.applications.vgg16 import VGG16
from tensorflow.keras.models import Model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.applications.vgg16 import preprocess_input
import numpy as np

# Load base model
base_model = VGG16(weights='imagenet', include_top=False, input_shape=(224, 224, 3))

# Add custom layers for rice classification
x = base_model.output
x = GlobalAveragePooling2D()(x)
x = Dense(256, activation='relu')(x)
predictions = Dense(num_classes, activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=predictions)

# Predict function
def predict_rice_type(img_path):
    img = image.load_img(img_path, target_size=(224, 224))
    x = image.img_to_array(img)
    x = np.expand_dims(x, axis=0)
    x = preprocess_input(x)
```

```
preds = model.predict(x)
return class_names[np.argmax(preds)]
```

6. Output (Demo)

Screenshot Placeholder:

(Insert screenshots of the web interface where users upload grain images and receive classification results.)

7. Conclusion

This project showcases how **Transfer Learning** can be leveraged to classify rice grain types efficiently. With real-time image classification capabilities and an intuitive interface, **GrainPalette** demonstrates practical AI implementation in agriculture. Future enhancements include dataset expansion, mobile app integration, and batch image processing support.