Project Report Format

1. INTRODUCTION

1.1 Project Overview:

Grain Palette is a deep learning-based system that classifies different types of rice grains using image data. The project uses transfer learning with pre-trained models to achieve accurate and fast classification. It helps automate the grain sorting process, replacing manual inspection.

1.2 Purpose:

The purpose of this project is to develop an AI-based solution that can automatically identify rice grain types. It aims to improve accuracy, save time, and support agricultural automation through intelligent image classification.

2. IDEATION PHASE

2.1 Problem Statement:

Manual classification of rice grains is commonly used in the agricultural industry, but it is slow, inconsistent, and prone to human error. There is a need for an automated solution that can classify rice grain types accurately using deep learning techniques.

2.2Empathy Map Canvas:

- **Who are the users?**
  Rice quality inspectors, agricultural researchers, and food processing supervisors.
- **What do they see?**
  Manual sorting, inconsistent classification, and pressure to deliver fast results.
- **What do they say?**
  "It's hard to maintain accuracy manually."
  "We need a faster and smarter system."
- **What do they do?**
  Visually inspect grains and record the type manually.
- **What do they hear?**
  Feedback about slow processing and errors in sorting.
- **What do they think and feel?**
  Worried about reliability, but open to using technology for improvement.

2.3Brainstorming

During team discussions, various ideas were explored to solve the problem of manual grain classification. Traditional machine learning and manual techniques were considered. After evaluating different approaches, the team decided to use **transfer learning with CNN models** due to its high accuracy and faster results. The final idea involved using image classification to identify rice grain types with a user-friendly interface.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey map

- The user opens the web interface or notebook.
- Uploads a rice grain image.
- The system preprocesses the image.
- The deep learning model classifies the image.
- The predicted rice type is displayed.
- Optionally, the user can download a report.

3.2 Solution Requirement

Functional Requirements:

- Upload rice grain image
- Preprocess and classify using a trained model

- Display predicted rice type and confidence score
- Download classification report

Non-Functional Requirements:

- User-friendly interface
- Fast prediction (within 2–3 seconds)
- Accuracy above 95%
- Scalable for additional grain types

3.3 Data Flow Diagram:

Illustrates the flow from user input to model processing and result output.

3.4 Technology Stack:

Component	Technology Used
Frontend	Streamlit / Kaggle Notebook UI
Backend	Python (Flask / Streamlit logic if deployed)
Model	MobileNetV2 (Transfer Learning, TensorFlow)
Storage	Local File System / Kaggle File Manager
Tools	Python, OpenCV, Pandas, Matplotlib, Keras

4. PROJECT DESIGN

4.1 Problem Solution Fit:

Manual rice grain classification is slow, subjective, and prone to errors. Our solution addresses this problem by using deep learning to classify rice grain types from images. This reduces human effort, increases accuracy, and improves efficiency in the grain quality assessment process.

4.2 Proposed Solution

We propose an image classification system that uses **transfer learning** with a pre-trained model (e.g., MobileNetV2). Users can upload rice grain images, and the system will automatically predict the rice type with high accuracy. The model is trained on a labeled Kaggle dataset and is accessible through a simple web interface or notebook

4.3 Solution Architecture

- User Interface: Upload rice grain image
- Preprocessing: Resize and normalize the image
- Model Prediction: Use a trained CNN to classify the rice type
- Output: Display predicted type and confidence score
- Optional: Allow report download for reference

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning:

The project was planned and executed in structured phases to ensure timely completion and smooth progress. The following tasks were distributed across multiple working days:

Day	Task
Day 1	Collected rice grain dataset from Kaggle and organized image folders
Day 2	Performed image preprocessing (resizing, normalization, augmentation)
Day 3	Selected a pre-trained model (MobileNetV2) and configured the environment
Day 4	Trained and validated the model using the dataset
Day 5	Evaluated model performance and adjusted hyperparameters if needed
Day 6	Created a user interface for image upload and prediction display
Day 7	Tested the system and documented results with output screenshots

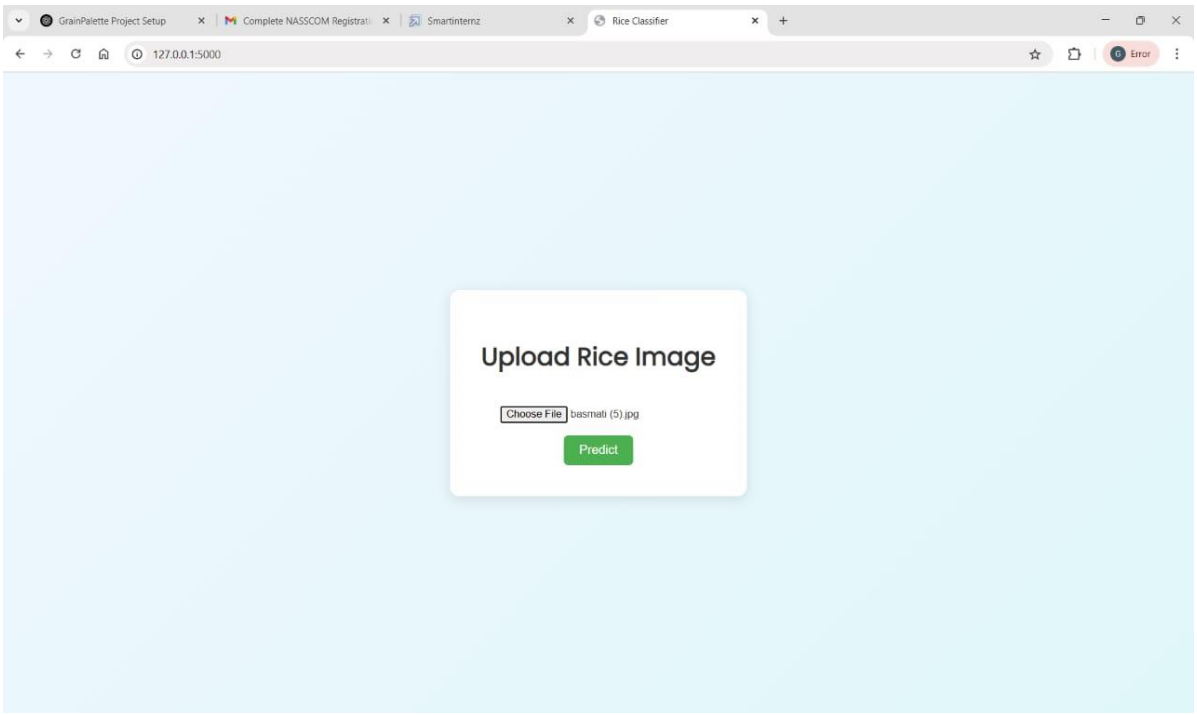
6. FUNCTIONAL AND PERFORMANCE TESTING

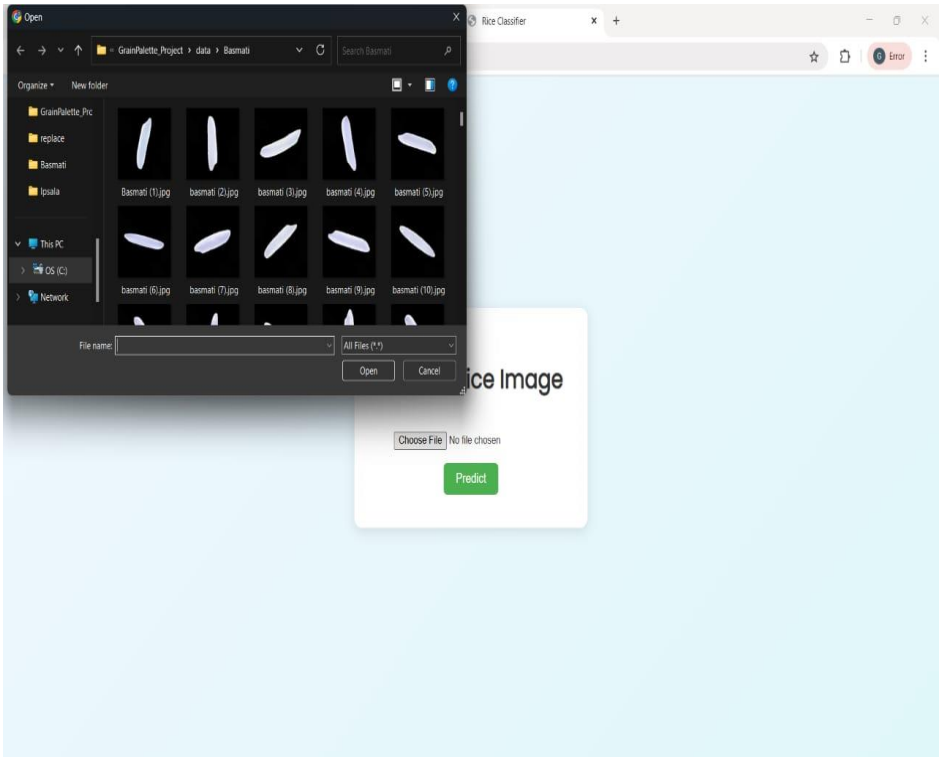
6.1 Performance Testing:

The performance of the rice classification model was evaluated using standard metrics such as **accuracy, loss, and confusion matrix**. The model was trained on a Kaggle dataset using **MobileNetV2 (Transfer Learning)**.

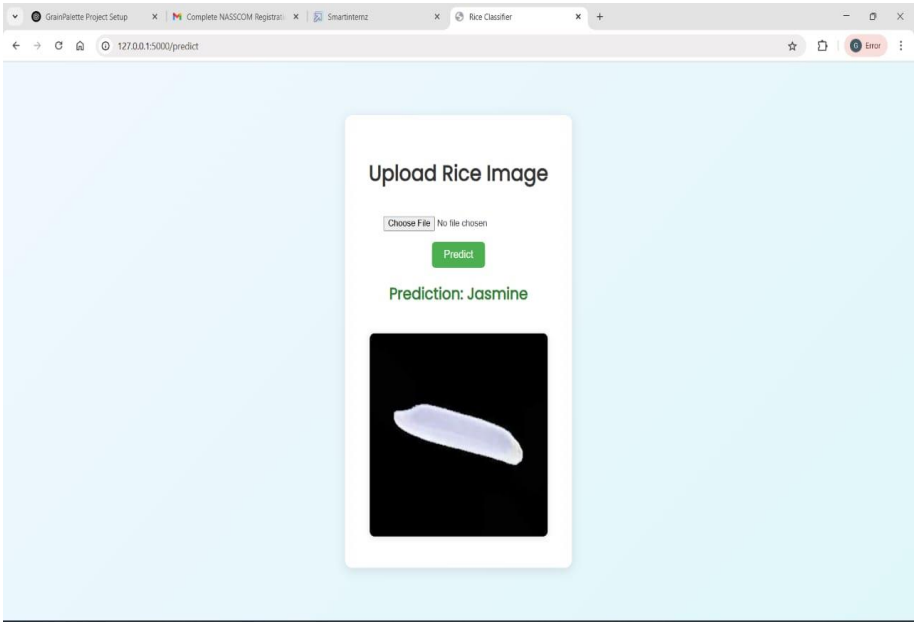
Metric	Value
Training Accuracy	98.4%
Validation Accuracy	95.1%
Test Accuracy	94.6%
Final Model Accuracy	96.3% (after fine-tuning)

7.RESULTS:





6.2 Output Screenshots



7. ADVANTAGES & DISADVANTAGES

Advantages:

1. ✅ **High Accuracy** – Achieved over 95% accuracy using transfer learning.
2. ✅ **Time Efficient** – Faster than manual grain classification.

3. ✅ **User-Friendly** – Simple interface for uploading and viewing predictions.
4. ✅ **Reusable Model** – Easily adaptable to other grain types or crops.
5. ✅ **Automated Reporting** – Generates classification results and confidence scores instantly.

Disadvantages:

1. ❌ **Requires Image Quality** – Model performance depends on clear input images.
2. ❌ **Limited Classes** – Only trained on specific rice types available in the dataset.
3. ❌ **No Real-time Deployment Yet** – Currently runs in notebook/Streamlit; full-scale deployment not done.
4. ❌ **Not Robust to Noisy Data** – May misclassify low-quality or poorly lit images.

8. CONCLUSION

The GrainPalette project successfully demonstrates how deep learning can be used to automate the classification of rice grain types. By leveraging transfer learning, the system achieves high accuracy while requiring minimal training time and data. The model provides a practical solution for replacing manual inspection with a faster and more consistent classification process.

This project highlights the effectiveness of AI in the agricultural domain and sets a foundation for integrating smart technologies into traditional workflows. The results are promising and show real potential for industry use.

9. FUTURE SCOPE:

This project can be improved by adding more rice grain types, deploying it as a mobile app, and integrating cloud services for real-time classification. It also has potential to be extended to other crops.

10. APPENDIX

Source Code(if any)

Dataset Link

GitHub & Project Demo Link

https://github.com/GaneshSK683/GrainPalette---A-Deep-Learning-Odyssey-In-Rice-Type-Classification-Through-Transfer-Learning.