# Project Documentation - Garbage Image Classification

## 1. Code-level Documentation

- Inline comments explain data handling and model structure.

- Each function (if present) should include a docstring detailing input, output, and purpose.

- Implementation decisions (e.g., using MobileNetV2 for speed and performance) are noted in comments.

## 2. Design Document

This project utilizes a deep learning architecture based on MobileNetV2 to classify waste images into 7 categories. The pipeline consists of data loading, preprocessing, augmentation, model construction, training, and evaluation.

Challenges:

* - Dealing with class imbalance and diverse backgrounds in images.
* - Managing dataset directories and relabeling for consistency.

Solutions:

* - Random sampling and image augmentation.
* - Merging 'white-glass' into 'glass' class to reduce noise.

## 3. Implementation Notes

- Used MobileNetV2 as a base model due to its lightweight nature and strong performance.

- Used ImageDataGenerator for preprocessing and augmentation.

- Split dataset using sklearn's train\_test\_split with stratification.

Hyperparameters:

* - Optimizer: Adam
* - Loss: SparseCategoricalCrossentropy
* - Batch Size: 32

Future Work:

* - Implement Grad-CAM for interpretability.
* - Try other models like EfficientNet or ResNet.

## 4. Visual Documentation

Visual elements can include:

* - Pipeline diagrams showing steps from image input to prediction.
* - Before/after examples of augmented images.
* - Plots of training/validation accuracy and loss over epochs.

## 5. References Documentation (Required)

- Dataset: Garbage Classification Dataset from Kaggle.

- Model Reference: MobileNetV2, https://arxiv.org/abs/1801.04381

- Libraries used: TensorFlow, Keras, OpenCV, Pandas, Matplotlib.

- Techniques adapted from standard CNN and transfer learning practices.

All external sources are clearly cited. Original work is separated from pre-trained components.