

## **Part 2: Practical Implementation**

### **Task 1: Edge AI Project Report: Lightweight Recyclable Item Classifier**

#### **1. Introduction**

This project focuses on building a lightweight image classification model for recyclable item recognition. The goal is to demonstrate how Edge AI improves real-time decision-making by deploying models on low-resource devices.

#### **2. Dataset Summary**

- Total training images: 1000
- Validation images: 200
- Test images: 200
- Number of classes: 10 Classes were automatically detected from directory structure.

#### **3. Model Architecture**

A compact CNN model (Conv2D + MaxPool + Dense layers) was trained on 224x224 images. The model was optimized for small size suitable for Edge devices.

#### **4. Training Performance**

Final training accuracy: 0.6057

Validation accuracy: 0.4250

Test accuracy: 0.53

The model shows moderate generalization and can be improved with more training data.

## **5. TFLite Conversion**

The TensorFlow Lite model (recyclable\_model.tflite) was successfully exported. A prediction test was performed on a sample image.

## **6. Edge AI Benefits**

- Low latency: Decisions happen on-device, without sending data to cloud.
- Privacy: User data stays on the device.
- Offline capability: Model runs without internet.
- Energy efficiency: Optimized for low-power hardware like Raspberry Pi or mobile devices.

## **7. Deployment Steps**

- a. Load TFLite model using TensorFlow Lite Interpreter.
- b. Resize incoming images to 224x224.
- c. Normalize to 0–1 float.
- d. Run inference and pick the class with highest probability.
- e. Integrate into mobile/IoT pipeline.

## **8. Conclusion**

This project demonstrates the full workflow of training a compact image classifier, converting to TFLite, and understanding its application in Edge AI environments. Further improvements can be made using data augmentation, transfer learning, and quantization-aware training