Project Title

Waste Classification System

Group 14 Members

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Idea Proposal by Group 14

1. Project Idea:

Problem: Improper waste disposal leads to environmental pollution, resource wastage, and health hazards. Manual waste sorting is labor-intensive and inconsistent.

Goal: Develop an automated computer vision-based classification system that categorizes waste into three hierarchical levels: (1) Recyclable vs. Non-recyclable, (2) Waste type (paper, plastic, metal, glass, organic, etc.), and (3) Hazardous waste classification. This system will improve waste management efficiency, promote recycling, and ensure proper hazardous waste handling.

2. Relevance to Sustainable Development Goals (SDGs):

SDG 3 (Good Health & Well-being): Prevents health hazards by properly isolating hazardous materials, **SDG 9 (Industry, Innovation, and Infrastructure) :** Aims to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation, **SDG 12 (Responsible Consumption & Production):** Reduces waste through improved sorting and recycling rates, **SDG 13 (Climate Action):** Decreases landfill methane emissions by promoting recycling and proper waste segregation, **SDG 11 (Sustainable Cities & Communities):** Enables efficient municipal waste management infrastructure.

3. Literature Examples:

Paper 1: *Trash Detection: Advanced Classification of Waste Materials Using ML Techniques (IEEE, 2024)* Developed a **CNN-based model** trained on five waste categories (paper, plastic, glass, metal, cardboard). Achieved **93.39% accuracy**, showing CNN's strong capability for automated waste classification and recycling efficiency improvement.

Paper 2: *An Automated Waste Classification System Using Deep Learning Techniques (Knowledge-Based Systems,2025)*: Proposed a **three-stage lightweight deep learning system** using a new large-scale dataset (TriCascade, 35,000+ images). Achieved up to **96% accuracy** and demonstrated real-time sorting with a hardware prototype, proving its industrial scalability and efficiency.

4. Describe Your Data:

The project will explore multiple **publicly available waste classification datasets** to identify the most suitable one:

- Waste Segregation Image Dataset – Kaggle Dataset
- Waste Classification Dataset – Kaggle Dataset
- Garbage Classification (12 classes) – Kaggle Dataset
- Roboflow Waste Datasets – Roboflow Universe

The data mainly consist of **waste images (JPEG/PNG format)** labeled into different classes. Preprocessing steps will include **image resizing, normalization, data augmentation, and label encoding** to ensure balanced classes and improve generalization.

5. Approach (Machine Learning or Deep Learning):

Deep Learning (Convolutional Neural Networks)

- Why Deep Learning: Waste images have high visual complexity with varying lighting, angles, and material textures. CNNs excel at feature extraction for image classification
- Model Architecture: Transfer learning with pre-trained models (MobileNetV2 for efficiency, ResNet50 for accuracy) fine-tuned on waste dataset
- Multi-task Learning: Implement three separate classification heads for hierarchical predictions, allowing the model to learn shared features while maintaining task-specific outputs