

## **CS 5330 CVPR Final Project Proposal Real-Time Garbage Classification Using Webcam**

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### **Problem Statement**

The objective of this project is to develop a lightweight real-time garbage classification system that uses a computer webcam to identify and label garbage types in video frames. The system will classify garbage into three categories—Recyclable, Wet, and Dry—and display the classification label on the video feed (e.g., “Class: Recyclable”). The input is a video stream from a webcam capturing a single piece of garbage (e.g., a plastic bottle or food scrap), and the desired output is the predicted garbage category overlaid on the video frame, helping users classify garbage efficiently.

### **Data Acquisition**

The project will utilize a small subset of the TrashNet dataset, a publicly available garbage classification dataset containing images of six garbage types (cardboard, glass, metal, paper, plastic, trash). We will select three categories—plastic (Recyclable), paper (Dry), and trash (Wet)—with 100 images per category, totaling 300 images (240 for training, 60 for testing). Images will be resized to 64x64 pixels to reduce computational load. No additional data collection or annotation is required, as the dataset is pre-labeled and sufficient for this lightweight application.

### **Model Source**

The model will be a simplified version of the MyNetwork architecture from Project 5, originally used for MNIST digit recognition. We will adapt it into a lightweight CNN with two convolutional layers (8 and 16 filters, 3x3 kernels) and two fully connected layers, tailored for 3-class garbage classification. The code for this model will be modified from our existing Project 5 implementation, ensuring compatibility with the new task.

### **Solution Design**

The solution consists of three components: (1) a training phase where the lightweight CNN is trained on the small garbage dataset with data augmentation (random flips, brightness adjustments) to improve robustness; (2) a real-time inference phase using OpenCV to capture webcam video, preprocess frames (grayscale, binarize, resize to 64x64), and classify garbage using the trained model; and (3) a display module that overlays the predicted label (e.g., “Recyclable”) on the video feed. The system aims to achieve real-time performance with minimal computational resources.

### **Computing Resources**

Training and inference will be performed on a standard CPU (e.g., Intel i5). The small dataset (300 images) and lightweight model ensure that training for 10 epochs will take approximately 1-2 minutes, and real-time inference will run at 15 FPS or higher. No additional hardware (e.g., GPU) is required, making the project accessible on ordinary computers.

### **Expected Outcome**

A successful outcome would be a real-time garbage classification system achieving at least 85% accuracy on the test set and correctly classifying common garbage items (e.g., plastic bottles, paper, food scraps) in real-time video at 15 FPS or higher. The system should display accurate labels on the video feed, providing a practical tool for users to classify garbage efficiently. Additionally, the project will produce a training accuracy plot to analyze model performance.