

# PET Perplexity – An Automated Polymer Segregator

---

**Domain:** Computer Vision (CV), Image Processing, Artificial Intelligence (AI) & Deep Learning, Data Analytics & Visualization

## Business Context

PET bottle recycling facilities process thousands of compressed bottles daily from untied bales on conveyor belts. Manual sorting is labor-intensive, error-prone, and cannot provide real-time analytics for inventory and pricing. Develop an AI-powered image analysis system that can automatically identify and classify PET bottles by color, material type, size, brand, and estimated weight to optimize the recycling process and improve material grading.

### PET Bottle Recycling Process:

- Compressed bottles arrive in bales from collection centers
  - Bottles need sorting by: color (clear/transparent, green, blue, mixed), material purity, size, and contamination
  - Pricing varies: Clear PET fetches highest price (₹40-50/kg), colored PET is lower value (₹25-38/kg)
  - Mixed or non-PET contamination reduces entire batch value
-



## MVP Requirements -

### 1. Color Code Identification

Detect and classify bottle color into categories:

- Clear/Transparent (colorless)
- Light Blue (common for packaged water)
- Green (soft drinks, beer)
- Brown/Amber (beverages)
- Mixed/Other colors

### 2. Material Type Detection (PET vs Non-PET)

Identify PET bottles using visual cues:

- **PET characteristics:** Recycling code ♻ or '1' or 'PET' or 'PETE', typical glossy appearance, transparent/translucent nature
- **Non-PET contaminants:** HDPE (opaque, code 2), PP (code 5), PVC (code 3)
- Flag non-PET bottles for rejection with confidence score

### 3. Bottle Size Classification

Identify approximate bottle capacity:

- 200-300ml (small single-serve)
- 500-600ml (standard single-serve)
- 1000ml / 1 Liter (large single-serve)
- 1500-2000ml / 1.5-2 Liter (family pack)
- Ø 2 Liter (bulk)

### 4. Brand Identification

Identify brands using logo detection, bottle shape, cap color combinations, and label colors/patterns. Common brands to detect: Bisleri, Kinley, Aquafina (water); Coca-Cola, Pepsi, Sprite, Fanta (soft drinks); Minute Maid, Tropicana (juice); Generic/unbranded.

### 5. Weight Estimation

Estimate bottle weight based on size category and bottle thickness:



Size	Typical Weight	Height	Diameter
200ml	10-12g	120-140mm	50-55mm
500ml	18-25g	180-210mm	60-70mm
1L	35-45g	250-280mm	80-90mm
2L	55-70g	320-350mm	95-105mm

## 6. Analytics Dashboard

Summary statistics for uploaded batch (suggested):

- Total bottles detected
  - Color distribution (pie chart)
  - PET vs Non-PET ratio
  - Size distribution (bar chart)
  - Brand-wise count
  - Total estimated weight
  - Quality grade (% of clear PET)
  - Export report as PDF/Excel
-



## Evaluation Criteria (Total: 100%)

Criteria	Points	Details
Detection Accuracy	20%	Correct bottle count (10), Segmentation quality (10)
Color Classification	20%	Accurate color identification (15), Handling transparent bottles (5)
Material Type Detection	15%	PET vs Non-PET accuracy (10), Confidence scoring (5)
Size & Brand Recognition	20%	Size classification accuracy (10), Brand identification (10)
Weight Estimation	15%	Reasonable weight estimates (10)
Analytics & Visualization	10%	Clear dashboard/reports (10)



## Success Metrics

- **Bronze Level:** Detect 50%+ bottles, basic color classification (2-3 categories), simple size estimation, count statistics
  - **Silver Level:** Detect 70%+ bottles, accurate color classification (4+ categories), material type detection with 70%+ accuracy, size and weight estimation, basic brand recognition (3+ brands), dashboard with charts
  - **Gold Level:** Detect 85%+ bottles, high accuracy color & material classification (80%+), handles compressed bottles well, recognizes 5+ brands reliably, comprehensive analytics dashboard, export functionality, handles edge cases, professional UI/UX
- 

## Real-World Application Value

**Automated grading:** Eliminate manual sorting errors

**Real-time inventory:** Know exact composition of incoming material

**Better pricing:** Accurate color segregation improves sale value

**Quality control:** Reject non-PET contaminants early

**EPR Compliance:** Brand-wise tracking for Extended Producer Responsibility