

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 1 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