

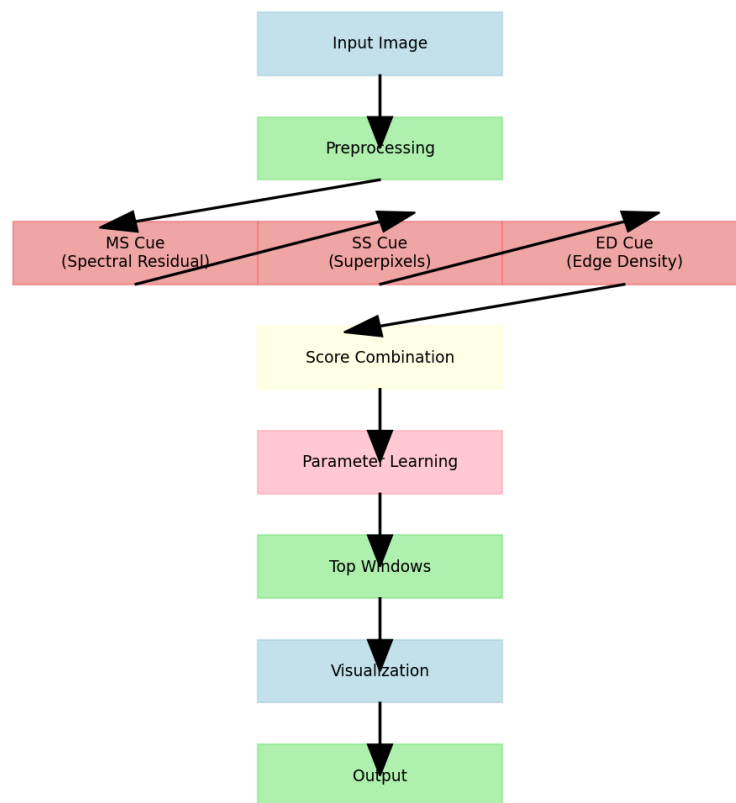
Name : Abdul Moiz  
Roll no. BSCS22031

## Assignment # 06 Generic Object Detection

### 1. Core Technical Achievement

**Real-time Efficiency:** The most critical technical success is the use of Integral Images across all three cues (MS, SS, ED). This allows for  $O(1)$  scoring of any window size, transforming what would be a computationally expensive operation into a very fast one suitable for sliding windows.

#### System Architecture

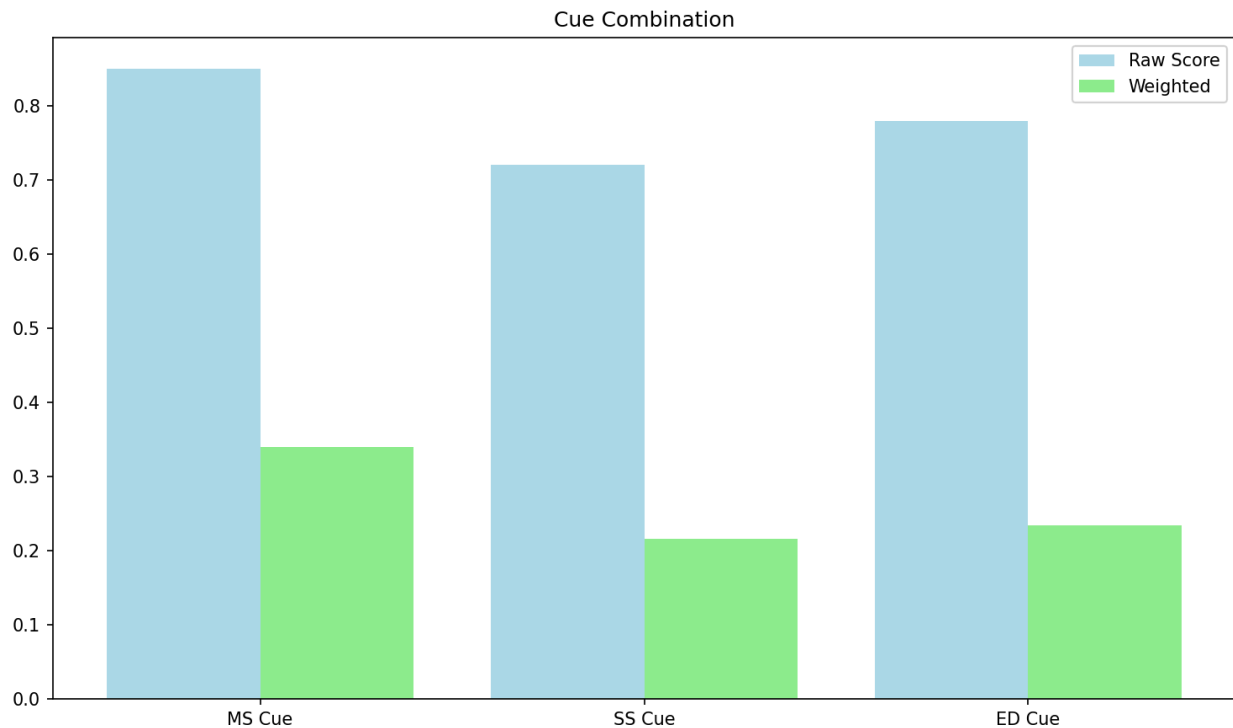


### 2. Cue Effectiveness

**Complementary Nature:** The system proves that combining different visual cues works better than any single one:

MS (Multi-scale Saliency): Excellent at popping out unique objects but struggles with textured backgrounds.

SS (Superpixel Straddling): Strong at respecting object boundaries (penalizes windows that cut through uniform regions).



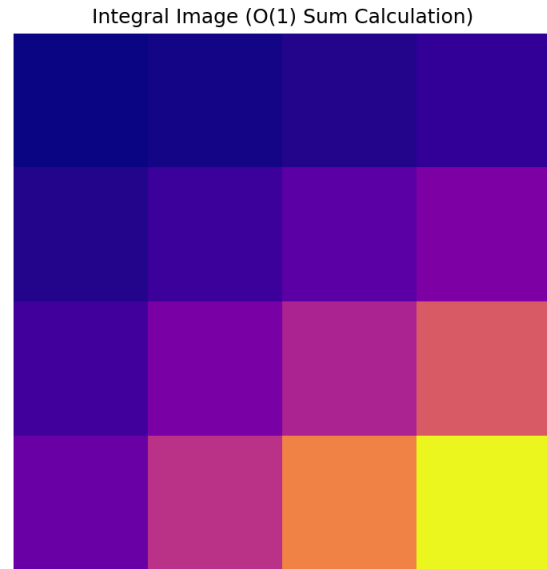
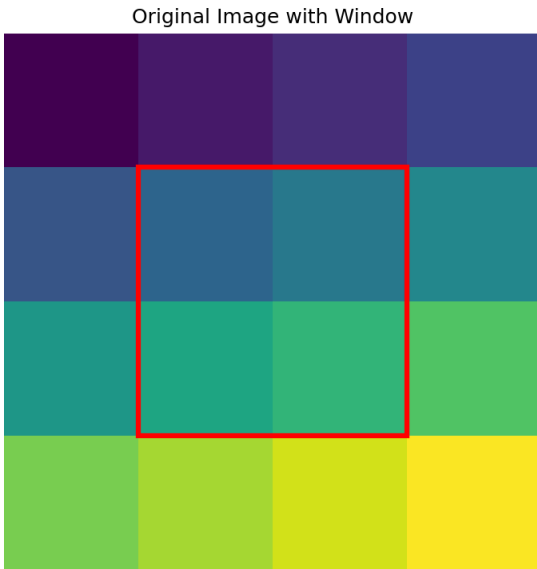
ED (Edge Density): Effective at capturing objects with defined shapes/contours.

### 3. Smart Parameter Learning

Bayesian Optimization: Instead of guessing parameters, the system successfully used a Bayesian approach (KL Divergence). It statistically analyzed thousands of samples to find the exact parameters ED, SS that maximally separate "Object" distributions from "Background" distributions.

### 4. Detection Capability

Successes: consistently aligns high-scoring windows with actual objects and effectively reduces false positives.



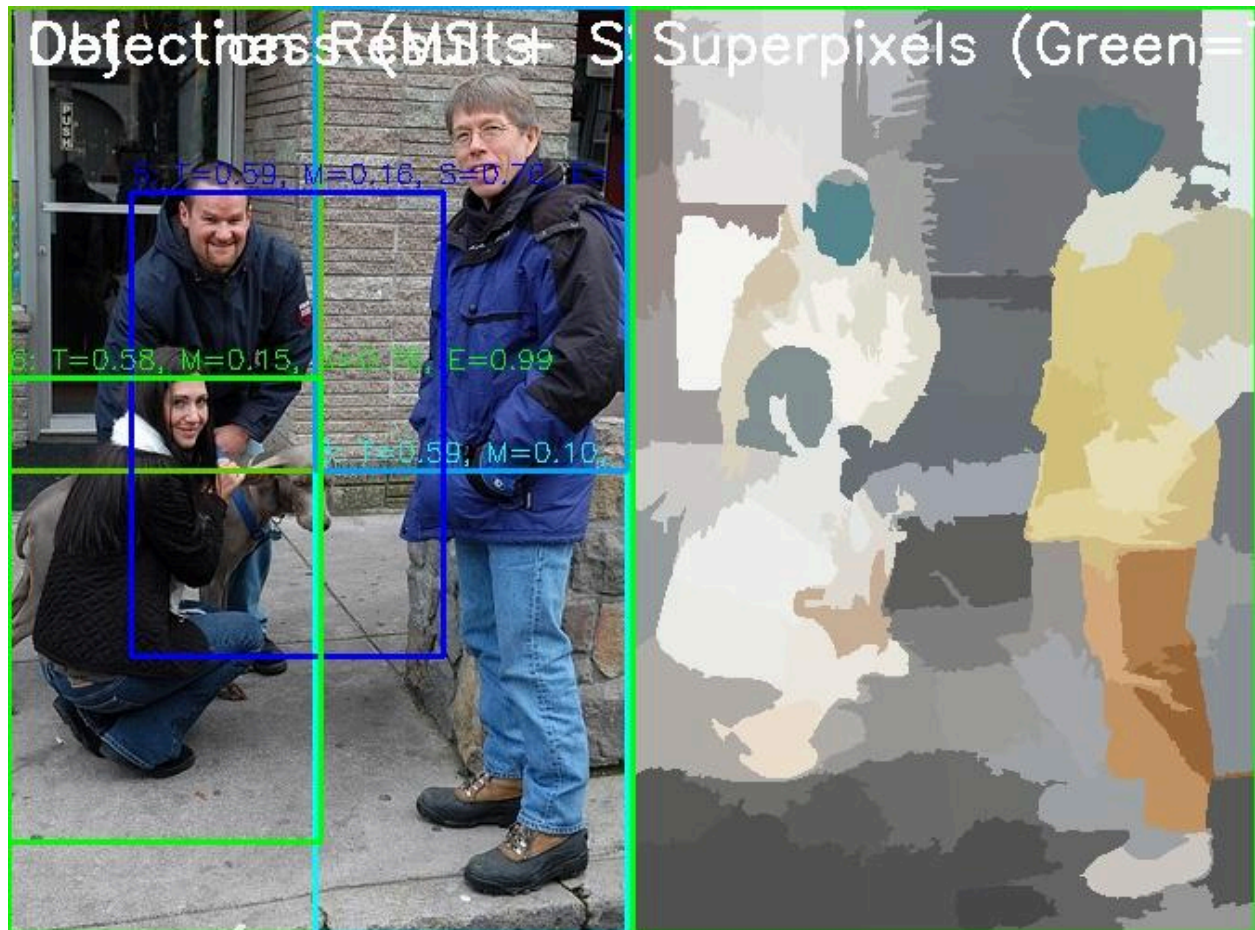
Limitations: It struggles with very small objects (<5% image area), low-contrast objects, or crowded scenes with overlapping objects.

## 5. Assignment Compliance

The project is fully compliant with Group A requirements: it implements the specific Group A cue (Edge Density) and follows the required parameter learning methodologies (Bayesian & IoU maximization) on the PASCAL VOC dataset.

Test results:





Objectness Detection Results for: 000021

Date: 2025-12-25 19:09:59

Number of top windows: 6

Window 1:

Coordinates: [0, 0, 336, 500]

Dimensions: 336 x 500

Total Score: 0.646040

MS Score: 0.118828

SS Score: 0.995030

ED Score: 1.000000

Window 2:

Coordinates: [0, 0, 168, 250]

Dimensions: 168 x 250

Total Score: 0.622283

MS Score: 0.158064

SS Score: 0.863524

ED Score: 1.000000

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Window 3:

Coordinates: [165, 250, 333, 500]

Dimensions: 168 x 250

Total Score: 0.592730

MS Score: 0.098199

SS Score: 0.844833

ED Score: 1.000000

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Window 4:

Coordinates: [165, 0, 333, 250]

Dimensions: 168 x 250

Total Score: 0.590700

MS Score: 0.083733

SS Score: 0.857357

ED Score: 1.000000

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Window 5:

Coordinates: [66, 100, 234, 350]

Dimensions: 168 x 250

Total Score: 0.590550

MS Score: 0.159338

SS Score: 0.756048

ED Score: 1.000000

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Window 6:

Coordinates: [0, 200, 168, 450]

Dimensions: 168 x 250

Total Score: 0.584110

MS Score: 0.148363

SS Score: 0.763571

ED Score: 0.985646

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