Saliency Filters: Contrast Based Filtering for Salient Region Detection

- TEAM_DASH

So what is Saliency?

salience

/ˈseɪlɪəns/

noun

noun: **saliency**

the quality of being particularly noticeable or important; prominence.

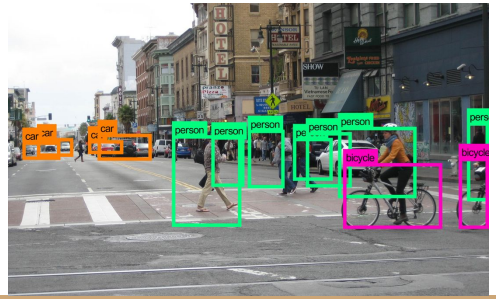
"the political salience of religion has a considerable impact"

Problem Statement

Various image features such as color variation, gradients, contrast etc., help catch attention of a human observer.

These features are operated on a pixel-by-pixel basis

This project is based on the observation that an image can be decomposed into basic, structurally representative elements that abstract away unnecessary details to perform contrast-based saliency.



Aim

Input

Output

Approach

Execution Pipeline

Abstraction

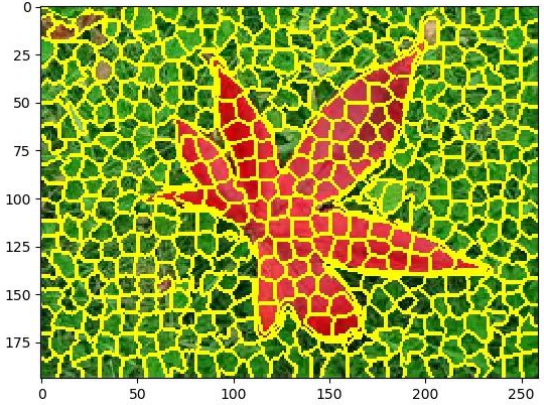
- Generates superpixels by clustering pixels based on their color similarity and proximity in the image plane.

- This is done in the five-dimensional [Labxy] space, where [L,a,b] is the pixel color vector in CIELAB color space, which is widely considered as perceptually uniform for small color distances, and x,y is the pixel position

SLIC Superpixels

- **S**imple **L**inear **I**terative **C**lustering
- One method from the various superpixel techniques
  - Ex: NC (Normalized Cuts), QS (Quick Shift)

Input



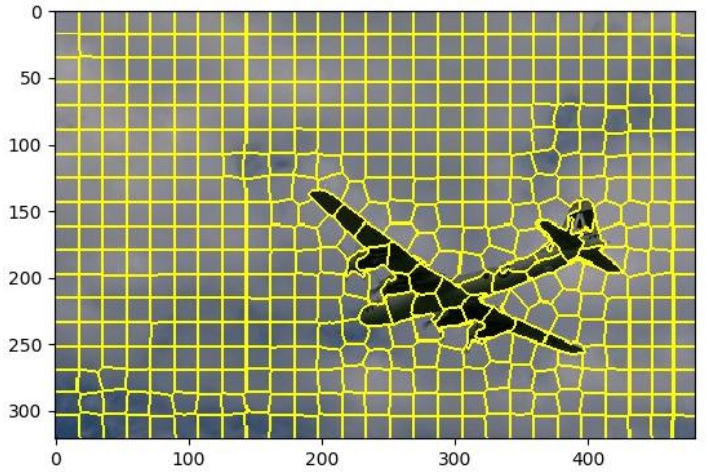
Output

- CIELAB color space is perceptually uniform for small color distances
- Lower m → more perceptually uniform
- Higher m →more compactness
- S → Grid Interval

$$d_{lab} = \sqrt{(l_k - l_i)^2 + (a_k - a_i)^2 + (b_k - b_i)^2}$$

$$d_{xy} = \sqrt{(x_k - x_i)^2 + (y_k - y_i)^2}$$

$$D_s = d_{lab} + \frac{m}{S} d_{xy} \ ,$$



Segmentation Result

Uniqueness

- This first contrast measure implements the fact that image regions, which stand out from other regions in certain aspects, catch our attention and hence should be labeled more salient.
- Essentially we are measuring the “rarity” of each element

$$U_i = \sum_{j=1}^{N} \|\mathbf{c}_i - \mathbf{c}_j\|^2 \cdot \underbrace{w(\mathbf{p}_i, \mathbf{p}_j)}_{w_{ij}^{(p)}}$$

Uniqueness Output

Input

Uniqueness Output

Distribution

- The idea is to render unique elements more salient when they are grouped in a particular image region rather than evenly distributed over the whole image
- Low variance indicates a spatially compact object which should be considered more salient than spatially widely distributed elements

$$D_i = \sum_{j=1}^{N} \|\mathbf{p}_j - \mu_i\|^2 w_{ij}^{(c)}$$

Distribution Output

Input

Distribution Output

Saliency Assignment

- Normalizing both uniqueness $\mathbf{U_i}$ and distribution $\mathbf{D_i}$ to the range [0::1].

- We assume that both measures are independent, and hence we combine these terms as follows to compute a saliency value $\mathbf{S_i}$ for each element:

$$S_i = U_i \cdot \exp(-k \cdot D_i)$$

Saliency Assignment Output

Input

Saliency Output

Mean Absolute Error

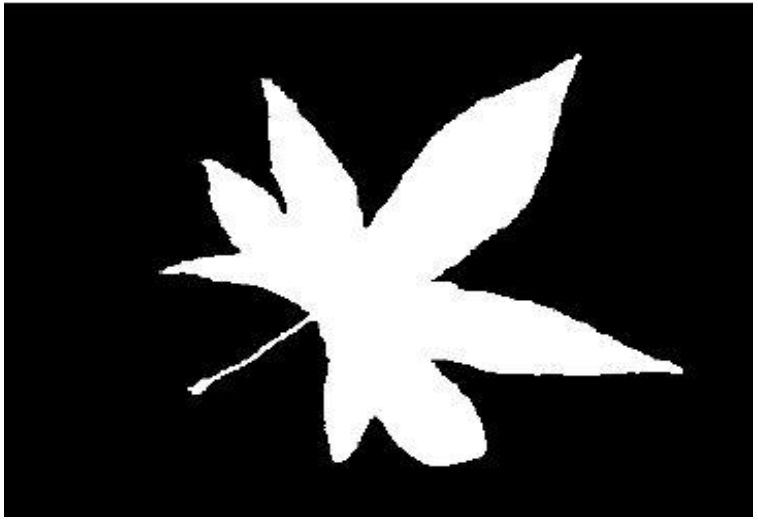
Mean absolute error (MAE) between the saliency map S and the binary ground truth GT is defined as:

$$MAE = \frac{1}{W \times H} \sum_{x=1}^{W} \sum_{y=1}^{H} |S(x,y) - GT(x,y)|$$

Input Test Image

MAE for Test Image

Saliency Output

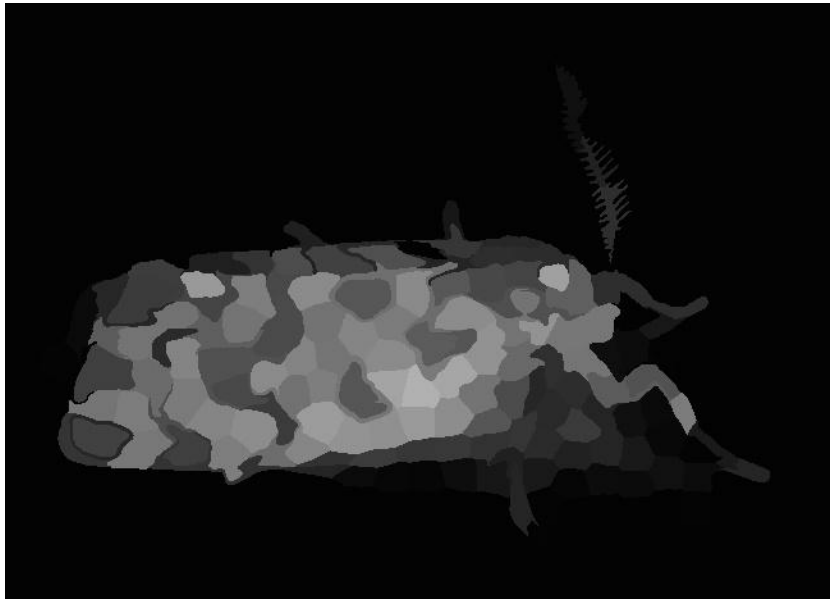


Ground Truth

MAE obtained is 0.41

Successful Results

Input



Output

Successful Results

Input

Output

Failure Results

Input

Output

Failure Results

Input

Output

GitHub Link

https://github.com/deepakksingh/Contrast-Based-Filtering-for-Salient-Region-Detection

Acknowledgement

1. Perazzi, F., Krahenbuhl, P., Pritch, Y., Hornung, A. (2012, June). Saliency filters: Contrast based filtering for salient region detection. In Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on (pp. 733-740). IEEE
2. The Berkeley Segmentation Dataset and Benchmark https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/bsds/
3. SLIC based Superpixel Segmentation (https://jayrambhia.com/blog/superpixels-slic)

Questions?

Thank you