IT472 : Project Assignment Evaluation (Final Presentation)

Ujjval Patel, Siddharth Pogul • 16.04.2019

SDSP: A novel saliency detection method by combining simple priors

Overview

Status

Completed

Recent progress

- Finished the coding phase.

Index

- Motivation
- Previous approaches
- 3 simple priors and method to stimulate them
- Main Method
- Experimental Results and Photos

Motivation

Human beings can routinely and effortlessly judge the importance of image regions, and focus their attention on important parts. Computationally detecting such salient image regions has vast applications including

1. object-of-interest image segmentation
2. object recognition
3. adaptive image compression
4. content-aware image editing

Previous Approaches

- The first influential and best known model in this field was proposed by Itti *et al*. Itti's model follows the Feature Integration Theory.
- Harel *et al*. proposed the graph-based visual saliency (GBVS) model by introducing a novel graph-based normalization/combination strategy.
- Klein and Frintrop modeled the center-surround contrast in an information-theoretic way.
- Bruce and Tsotsos modeled the image's saliency as the maximum information that can be sampled from it. In their method, saliency is computed as Shannon's self-information.

3 simple priors and method

to stimulate them

1) Frequency Prior

$$S_F(\mathbf{x}) = ((f_L^* g)^2 + (f_a^* g)^2 + (f_b^* g)^2)^{\frac{1}{2}}(\mathbf{x})$$

Characteristics

$$G(\mathbf{u}) = \exp\left(-\left(\log \frac{\|\mathbf{u}\|_2}{\omega_0}\right)^2 / 2\sigma_F^2\right)$$

- Inspired by Achanta *et al*'s work , this paper, also resorts to band-pass filtering for saliency detection.
- We can construct a log Gabor filter with an arbitrarily bandwidth and still having no DC component.
- The transfer function of the log-Gabor filter has an extended tail at the high-frequency end, which makes it more capable to encode natural images than other common band-pass filters.

2) Color Prior

$$S_c(\mathbf{x}) = 1 - \exp\left(-\frac{f_{an}^2(\mathbf{x}) + f_{bn}^2(\mathbf{x})}{\sigma_c^2}\right)$$

$$f_{an}(\mathbf{x}) = \frac{f_a(\mathbf{x}) - mina}{maxa - mina}, f_{bn}(\mathbf{x}) = \frac{f_b(\mathbf{x}) - minb}{maxb - minb}$$

Characteristics

- warm colors, such as red and yellow, are more pronounced to the human visual system than cold colors, such as green and blue
- the point (f_{an}=0,f_{bn}=0) is the "coldest" point and thus it is the "least salient" one. Therefore, we define the color saliency of a point $\mathbf{x}$ in a straightforward manner as $S_c(\mathbf{x})$

3) Location Prior

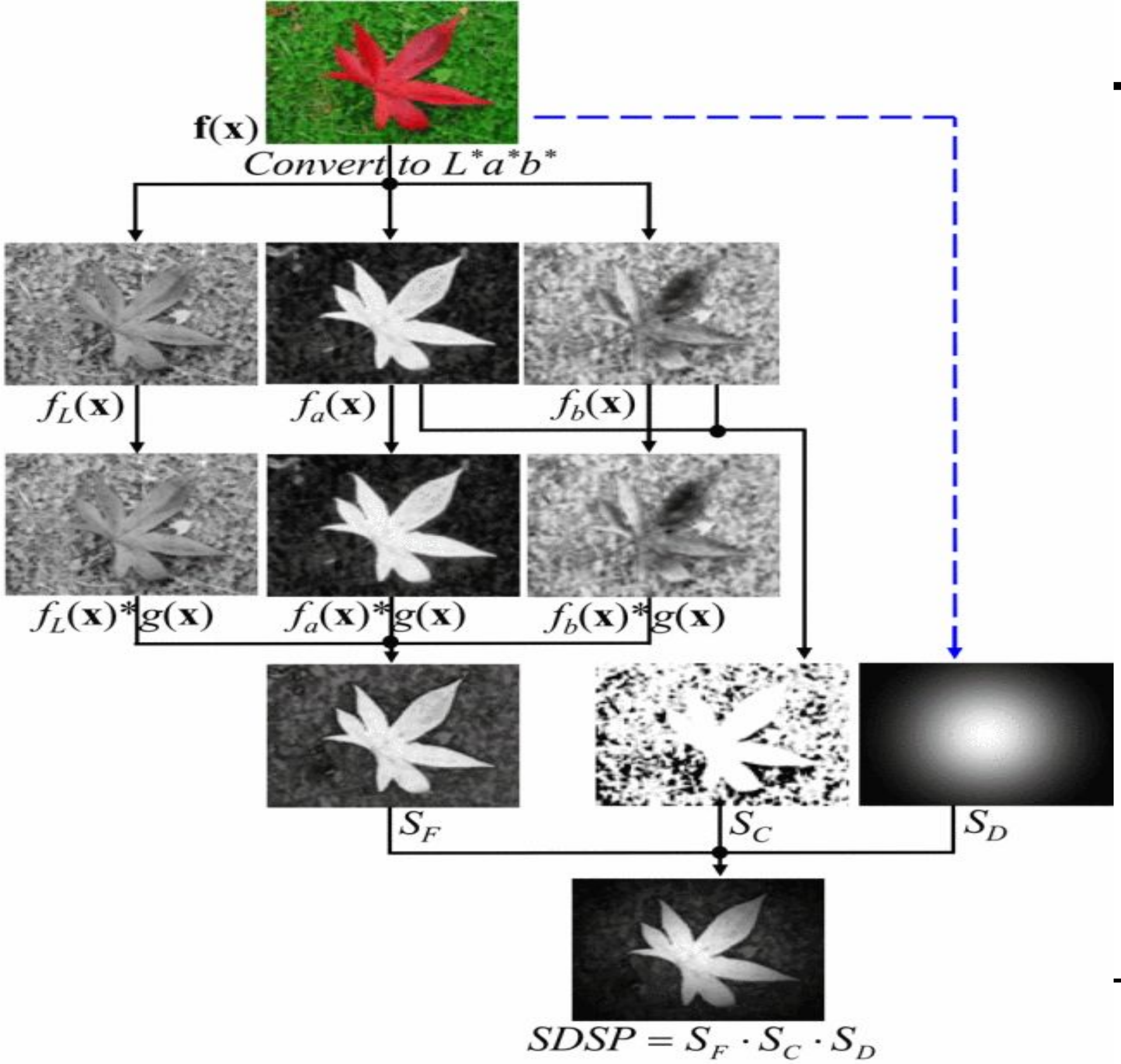
$$S_D(\mathbf{x}) = \exp\left(-\frac{\|\mathbf{x}-\mathbf{c}\|_2^2}{\sigma_D^2}\right)$$

Characteristics

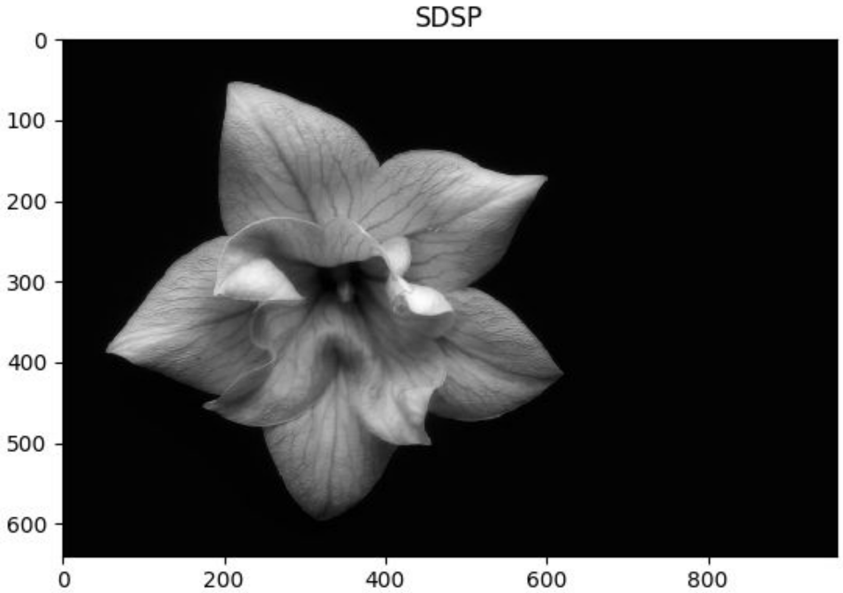
- Several previous studies have demonstrated that objects near the image center are more attractive to people.
- That implies locations near the center of the image will be more likely to be “salient” than the ones far away from the center.
- This prior can be simply and effectively modeled as a Gaussian map.

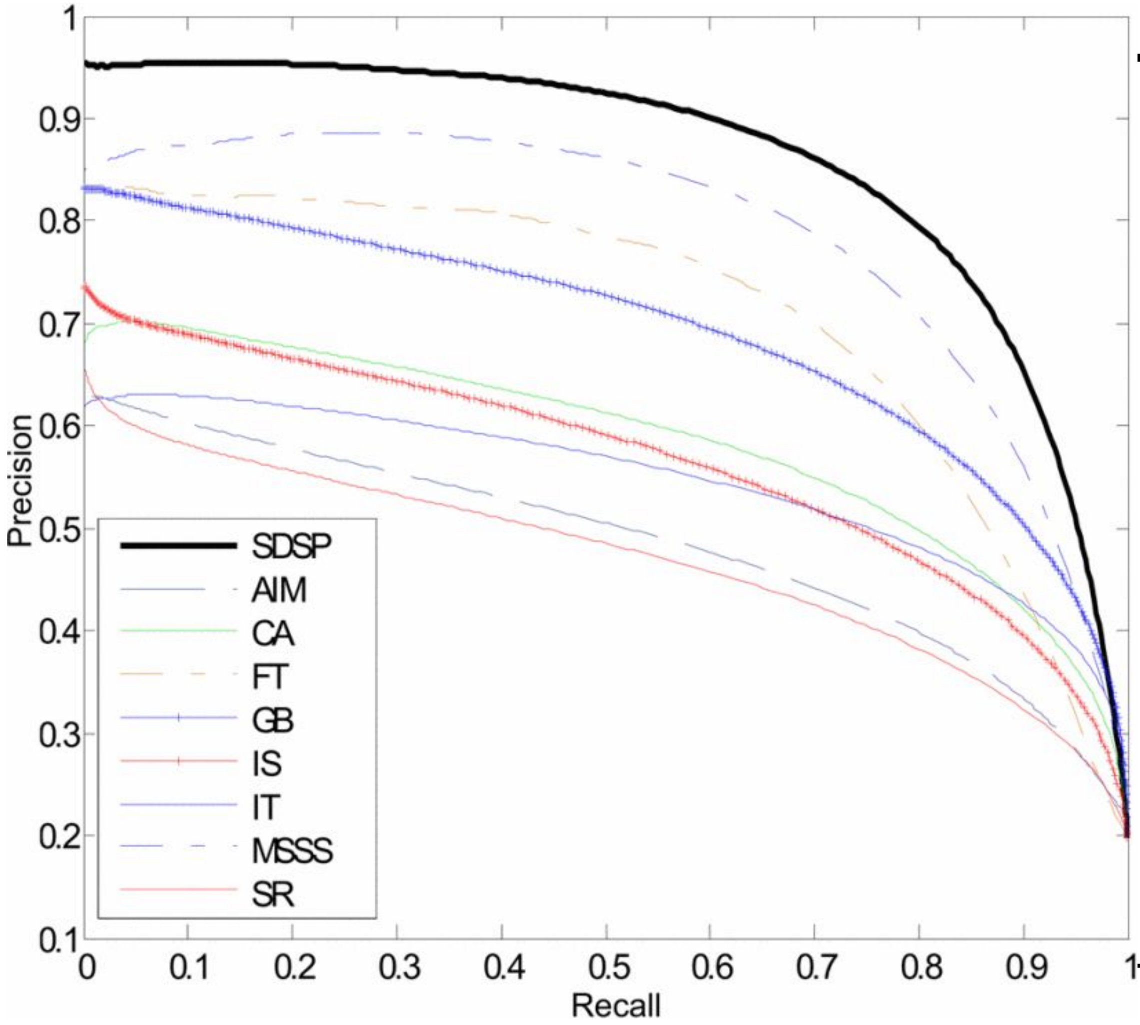
Main Method

$$SDSP(\mathbf{x}) = S_F(\mathbf{x}) \cdot S_D(\mathbf{x}) \cdot S_c(\mathbf{x})$$


$\mathbf{f}(\mathbf{x})$
$Convert\ to\ L^*a^*b^*$
$f_L(\mathbf{x})$
$f_a(\mathbf{x})$
$f_b(\mathbf{x})$
$f_L(\mathbf{x})*g(\mathbf{x})$
$f_a(\mathbf{x})*g(\mathbf{x})$
$f_b(\mathbf{x})*g(\mathbf{x})$
S_F
S_C
S_D
$SDSP = S_F \cdot S_C \cdot S_D$

Experimental results
And Photos


SDSP
0
100
200
300
400
500
600
0
200
400
600
800



Precision-recall curves obtained by using various saliency detection methods on the benchmark dataset.

Computational Cost

Method	Time (seconds)
AIM [9]	5.118
CA [15]	33.662
FT [12]	0.045
GB [7]	0.464
IS [11]	0.022
IT [5]	0.134
MSSS [13]	0.784
SR [10]	0.013
SDSP	0.039

Time cost of each method

References

Research paper :- **SDSP: A novel saliency detection method by combining simple priors**

1. B.C. Ho and J. Nam, "Object-of-interest image segmentation based on human attention and semantic region clustering," J. Opt. Soc. Am. A, vol. 23, pp. 2462-2470, 2006

2. U. Rutishauser, D. Walther, C. Koch, and P. Perona, "Is bottom-up attention useful for object recognition," CVPR'04, pp. 37-44, 2004

3. C. Christopoulos, A. Skodras, and T. Ebrahimi, "The JPEG2000 still image coding system: An overview," IEEE Trans. Consumer Elec., vol. 46, pp. 1103-1127, 2002

4. Y. Wang, C. Tai, O. Sorkine, and T. Lee, "Optimized scaleand-stretch for image resizing," ACM Trans. Graph., vol. 27, pp. 118.1-8, 2008

5. L. Itti, C. Koch, and E. Niebur, "A model of saliencybased visual attention for rapid scene analysis," IEEE Trans. PAMI, vol. 20, pp. 1254-1259, 1998

Thank you