CV2015Spring—Assignment #1

Due: Thursday, Apr 9 10:00 AM

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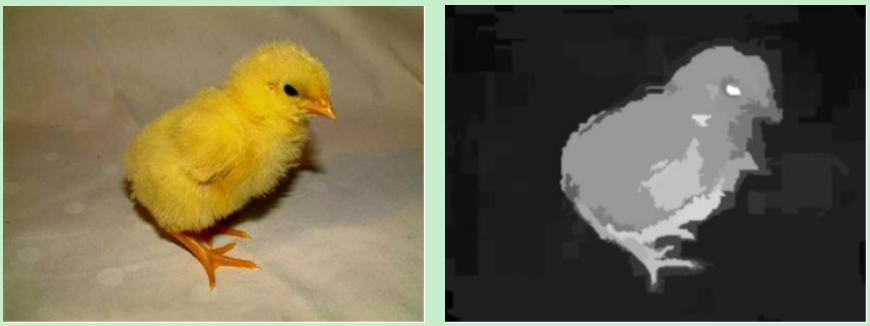
March 26, 2015

1. Assignment requirement

For this assignment, you will implement a version of the salient object detection technique. See Figure 1 for an example.



(a) (b)

Figure 1: Salient object detection.

Your method must be region-based, and at least one feature and one prior should be used. I will give you some tips for the implementation in the following sections.

2. Tips

The whole framework of the implementation for salient object detection is shown in Figure 2, it may serve as a reference for your assignment. Next, I will introduce the implementation and requirement of each part of the framework for you.

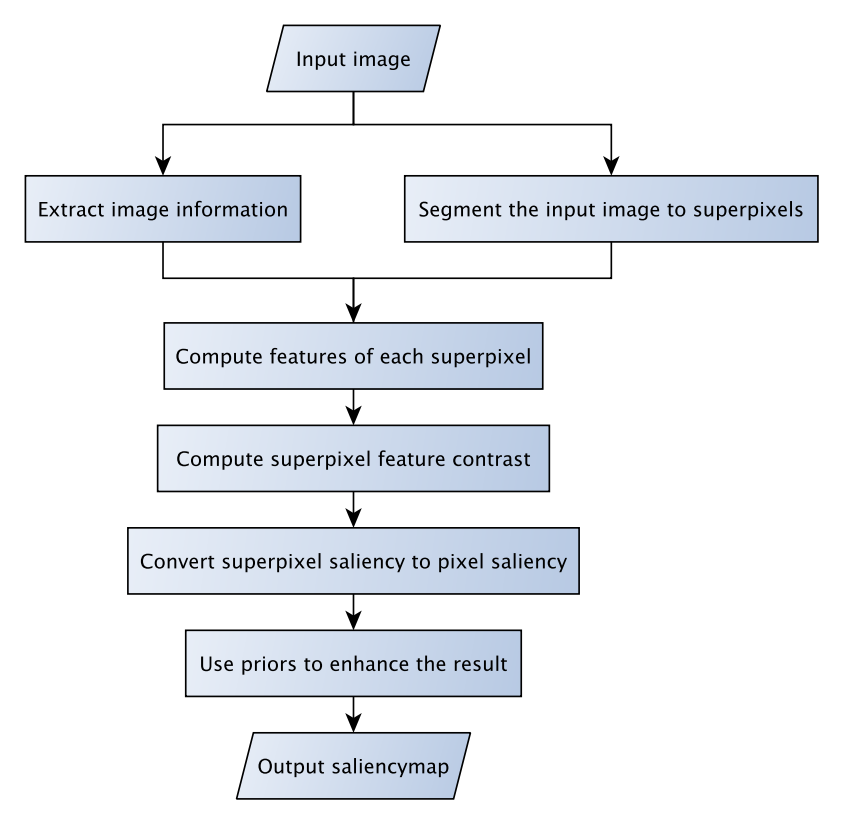


Figure 2: Framework of the implementation for salient object detection.

2.1 Input image

A simple dataset can be downloaded from the website[1]. Pick one or several images from the dataset randomly for test.

2.2 Step 1-1: Extract image information (15 points)

Input The input color image ($m \times n \times 3$ matrix), m is the width of the input image, n is the height of the input image.

Output $m \times n$ matrix.

Implementation This step determines the regional feature you want to use in step 2, and you have two choices (choose at least one feature for this assignment):

- Color information

[1] http://research.microsoft.com/en-us/um/people/jiansun/SalientObject/salient_object.htm

- You should quantize each color channel (RGB) to reduce the number of colors (such as from 256 to 16), then the number of color is reduced to $16 \times 16 \times 16 = 4096$. In order to create a bin for each color, you can use a number ($1 \sim 4096$) instead of (R, G, B) values to represent a color uniquely.

- Texture information
  - You should compute the LBP value of each pixel here.

Hint The extraction of color/texture information can refer to the matlab code from the website[2], which also contains the computation of color histogram and texture histogram of superpixels in step 2 and the conversion of superpixel saliency to pixel saliency in step 4.

2.3 Step 1-2: Segment the input image to superpixels (20 points)

Input The input color image ($m \times n \times 3$ matrix), m is the width of the input image, n is the length of the input image.

Output Superpixel segmentation matrix ($m \times n$ matrix), the value of the pixel in this matrix is just a label to indicate the superpixel it belongs to, and pixels of the same superpixel are labeled the same value.

Hint There are a lot of superpixel segmentation algorithms, I recommend you to use SLIC[3], which is fast and easy to implement.

2.4 Step 2: Compute features of each superpixel (15 points)

Input Image information matrix, superpixel segmentation matrix.

Output h histograms, h is the number of superpixels after segmentation.

Implementation The feature you choose here is based on the information you extracted in step 1-1:

- Compute color histogram feature of each superpixel, which means counting number of pixels for each color and store it in histogram's bins.
- Compute texture histogram feature of each superpixel

Hint Useful function in matlab for histogram computation: *hist*.

[2] http://jianghz.com/projects/saliency_drfi/index.html
[3] http://www.vlfeat.org

2.5 Step 3: Compute superpixel feature contrast (20 points)

Input h histograms.

Output h values, each value indicates the global feature contrast of a superpixel.

Instructions Saliency can be defined as uniqueness in terms of local or global regional contrast. For simplicity, I recommend you to compute global regional contrast, which means that the saliency of a superpixel should be computed as its feature contrast of all the other superpixels in the image.

Theory The formulation for histogram distance is as follows:

$$\chi^2(\mathbf{h}_1, \mathbf{h}_2) = \sum_{i=1}^{b} \frac{2(h_{1i} - h_{2i})^2}{h_{1i} + h_{2i}} \tag{1}$$

where $\mathbf{h}_1$ and $\mathbf{h}_2$ are color histograms of two distinct regions, h_{1i} and h_{2i} are the ith component of $\mathbf{h}_1$ and $\mathbf{h}_2$ respectively, b is the number of histogram bins. Moreover, both histograms are normalized, i.e. their entries sum up to one.

2.6 Step 4: Convert superpixel saliency to pixel saliency (15 points)

Input h values, superpixel segmentation matrix.

Output An initial saliency map ($m \times n$ matrix).

Implementation Assign all the pixels of the same superpixel the same saliency value.

2.7 Step 5: Use priors to enhance the result (15 points)

Input Initial saliency map,.

Output Final saliency map.

Implementation Here you have two choices (choose at least one prior for this assignment):

- Center prior
- Color prior

Multiply the initial saliency map with the prior you choose, you can obtain the final saliency map.

Hint You can download the source code from this website[4] for reference.

3. Submission instructions

3.1 What to hand in?

- Your matlab code (Show your medial result in your code)
- A report containing the following:
  - Your name at the top
  - A brief explanation of your implementation strategy (in English)

3.2 Where to hand in?

Submit to Piazza in form of a followup below my assignment note.

[4] http://sse.tongji.edu.cn/linzhang/va/SDSP/SDSP.htm