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PISA: Pixelwise Image Saliency by Aggregating with Binarization

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Abstract— Driven by different applications such as image enhancement and image segmentation, computing pixel accurate saliency values beyond its early goal of mimicing human eye fixation. In this paper, we focus on highlighting salient foreground objects automatically from their background. This paper analyzed different salient detection methods. In this paper, we propose a unified framework called pixelwise image saliency aggregating (PISA). The propose method is divided into three stages such as Color-based contrast measure, Structure-based contrast measure, Fusion. First we have calculating color-based contrast measure, it detects homogeneous saliency regions is better. In this case, we have using kmeans cluster algorithms. A color extraction input is used to extract structure-based contrast measure, it detects structural saliency regions is better. In this case, we have using spectral residual approach, after the extraction we combine together in a pixelwise adaptive manner to measure the saliency. Extensive experiments we have using one application, i.e. Binarization. In addition, in this work we also create a threshold value and detecting foreground region. Finally, we discuss possible directions for the further work.

Keywords— Saliency, Visual saliency, Object detection, Feature extraction, Binarization, Spectral residual.

I. INTRODUCTION

Saliency is the quality of images with respect to the relative neighbours. Saliency improves to simple, easy to implement and reasonable outputs. There are different salient detection mechanisms. Main aims of saliency detection are to highlight salient foreground objects automatically from background (Fig. 1). It helps to study the attractiveness of visual attention. In recent application, we are assigning pixel accurate saliency values for detecting the salient features. In this case object detection is used. Object detection is related to computer vision and image processing. It detects instance of semantic objects in digital images and videos. It extracts an object from background. It also detect large salient region efficiently.

(a) (b) (c) (d)
Fig. 1 Saliency (a)(c) Input Images, (b)(d) Output Images.

In computer vision is in two parts: 1. image extraction and 2. Subsequent matching. Mainly two type approaches used to extracting an object from background i.e.; statistical approach and structural approach. To extract quantitative features are used for statistical approach. To extract morphological feature and their inter relationships are used for structural approach. It can be applicable to image browsing, cropping, compression, content-based image retrieval etc. This method used for extracting low-level features.

Salient object detection consists of two steps: 1. the computation of the saliency map, and 2. the output of the salient object. The saliency map is the saliency of each pixel in an image. It based on the saliency map, and applying various algorithms is used. It mainly focused on bottom up and low level saliency model. Identify remaining issues in existing model as follows:

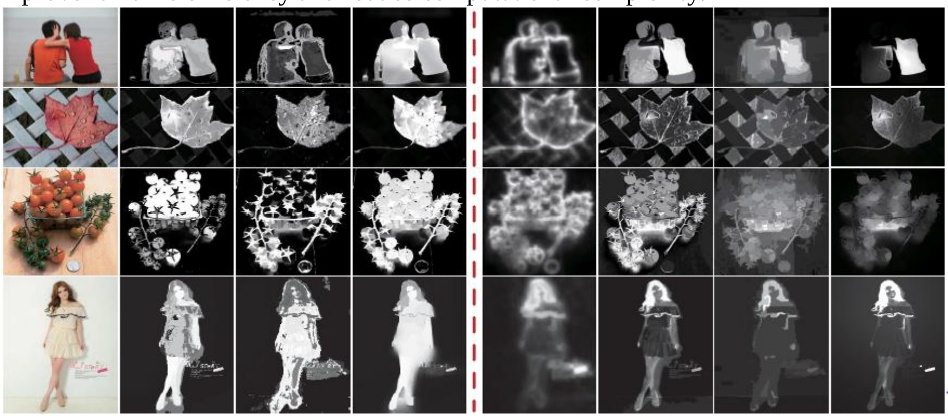
1. Consider a natural image from different patterns. Then applied to bottom-up feature extraction to salient objects. And also applied in image segmentation to build in similar colors distribute on both foreground and background objects. e.g., Fig. 2 (fourth row: f-h).

2. Assign the salience values used to over- segmentation of images, and exploit local filtering to smooth the saliency values. Image segmentation is introduced to local clustered textures. Compare with saliency values and object details by post-relaxation steps. e.g., Fig. 2 (first row: g-h).

These drawbacks will overcoming we proposed using a unified frame work i.e., PISA. It stands for Pixel wise Image Saliency Aggregating complimentary saliency cues. It generates detail-preserving, pixel- accurate, and fine-grained image saliency. Motivations of PISA as follows:

1. To measuring complimentary appearance of saliency.
2. Non-Parametric Feature Modelling.
3. Fine-Grained Saliency Assignment.

In this work focused on multiple labelling problems. In this paper, first we have to assigning salience levels and keeping the edges and boundary of salient objects. In this case we develop an F-PISA. It stands for Faster version of PISA. Using to improve run time efficiency and reduce computational complexity.



(a) (b) (c) (d) (e) (f) (g) (h)

Fig. 2 Saliency maps computed on (a) four example images by (d) the proposed PISA method and (e-h) a few competing bottom-up saliency detection methods [9], [10], [11]. The results generated by PISA with only color/structure contrast feature are shown in (b/c). (a) Original. (b) Color info. (c) Structure info. (d) PISA. (e) CA [11]. (f) HC [10]. (g) RC [10]. (h) SF [9].

This paper is categorized as follows: Section 2 describes related work. The proposed framework for saliency detection is presented in Section 3. Finally, conclusion is given in Section4.

II. RELATED WORKS

Various salience detections methods based on visual saliency. It consisting of two priors: i.e.; contrast priors and back-ground priors. These two priors used for contrast between foreground and background salient objects. Mainly two stages of visual processing are involved: bottom-up and top-down approaches. Bottom-up approach is task-free viewing cases and top-down approach is task-specific search. Salient region detection can be classified into contrast based method, learning based, rarity based method.

L. Itti, C. Koch, and E. Niebur, [2] proposed a rapid scene analysis. This model consists five Gaussian pyramids and four color channels from intensity images. Image is decomposed into a set of topographic feature maps. Each feature map is computed by a set of linear centre-surround operations, after computational we get normalized maps into three conspicuity maps.

This model is very robust to noise. It is simple and fast. This method is strong performance with complex natural scenes. The salience maps are generated by 1/256th the original image size based on low resolution. i.e., objects boundaries are not clear.

Y.-F. Ma and H. J. Zhang, [3] proposed fuzzy growing analysis. It is feasible and fast approach. This method is used to detection in images based on contrast analysis. Motivation of this method as follows:

1. Generating saliency map based on local contrast.
2. Extraction on images based on fuzzy growing methods.
3. Analyse image using framework.

It consisting of three levels i.e.; attended view extraction, attended area extraction, and attended point extraction. This framework is used to extracting attentions from images. These methods 1/100 of the image size object are not clearly isolated for large salient objects.

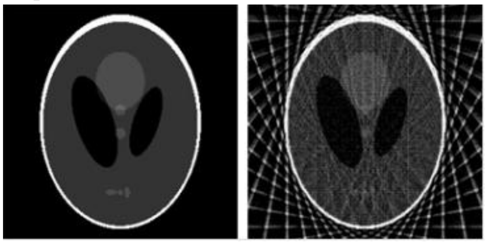
HYafeng Zheng and S. Susstrunk [4] proposed salient region detection based on automatic feature selection. Here, extract intensity, color, orientation features from weighted saliency point areas. First, we generate feature saliency map. Then each saliency transformation map into frequency domain, after the generation we applied to inverse FFT. Then compute weight of salient point areas, after the computation we find spatial distribution of salient points. These points are used for compute dynamic weight. These salient regions are extracting and integrated with saliency map, after that we detect multi-salient objects. In this method, the input size for image becomes 64*64 pixel.

Federico Perazz [5] proposed a Saliency Filters based on salient region detection. Here, consist four basic steps, as follows:

1. Divide homogeneous elements from image based on abstraction.
2. Compute measure contrast of these elements.
3. Derive saliency measure based on pixel accurate saliency map.
4. Separate foreground and background salient objects.

ChienChi Chen, Jian-Jiun Ding [6] proposed boundary information based on principle component analysis. This method used to create a saliency map. It consist four step procedures as follows:

1. Spatial variance of color.
2. Local and global contrast.
3. To measurement of border.
4. Multiplied by central distance map.



(a) (b)

Fig. 3 (a) Original image, (b) Reconstructed image.

In this method clearly defined boundaries that means it only applicable to centre of images. Because, fail to detecting salient object and multi-salient objects from centre of images.

The problem of boundary detection based on principle component analysis is that it can be applied only to the centre of images. To overcome this problem we used PISA framework.

III. PROPOSED METHOD

In this section, we discussed implementation details of unified framework i.e., PISA. It helps to improve runtime efficiency and keep comparable performance. Here we have three stages such as Color-contrast measure, Structure-contrast measure, and fusion and also discussed about Binarization.

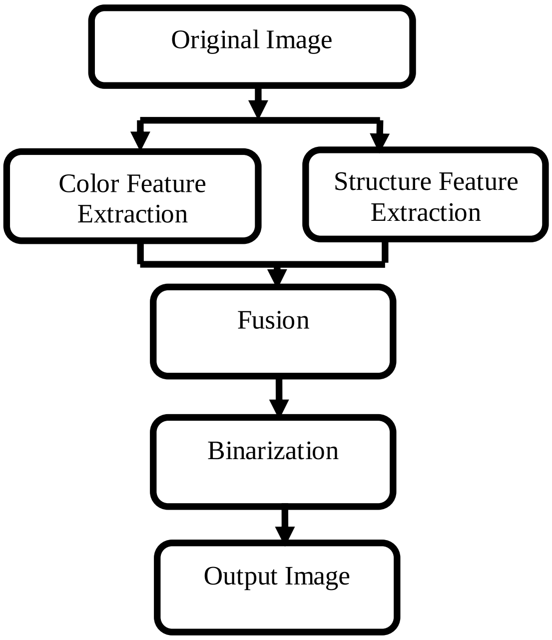


Fig. 4 The main flowchart of PISA.

A. Pixelwise Adaptive Observation

PISA calculated arbitrarily-shaped observation region in saliency. Main role of pixelwise observation is feature extraction and fine grained saliency [1]. Consider a pixel p which centered at square window (wp). Calculated color similarity of test pixel as follows:

$|I_c(q)-I_c(p)|\leq\tau$, $c \in \{R,G, B\}$, $q \in W_p$

Where, Ic intensity of color bands, τ is the confidence level of color similarity. The size of Wp is (2L+1)*(2L+1), L is the maximum arm length.

Here, horizontal H(p) and vertical V(p) arms of the pixel p connected to local observation window. After the connection we integrating multiple H(p) sliding along V(p) as follows:

$$\Omega_p = \bigcup_{q \in V(p)} H(q)$$

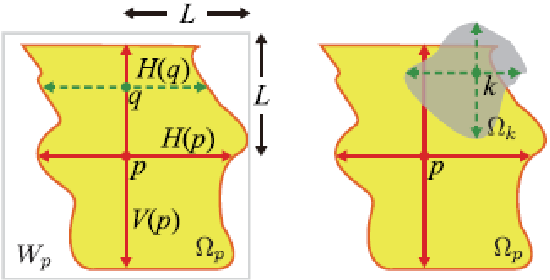


Fig. 5 The left subfigure shows the construction of the shape-adaptive observation window for pixel p, and the right subfigure shows the weighted aggregation of each k €Ωp

B. Color and Structure Saliency Measures

1) Color Based Contrast

Color contrast is a global image context. It is computationally expensive. Consider a number of pixel image I, complexity of image I is O(N2). In color contrast measure, we used Histogram based Contrast (HC) [1].

Consider pixel p is used for construct a local observation region (Fig. 7, Fig. 8). After construction we calculate color based contrast as follows:

$$U^c(p) = U^c(h^c(p)) = \sum_{i=1}^{k_c} \omega_i \left\| h^c(\phi_i), h^c(\phi_p) \right\|$$

Where, is the average color histogram of cluster and is the number of pixels belonging to the cluster.

In this case, color histogram quantized into different clusters. This problem focused on three terms as follows:

1. Improve color dissimilarity.
2. Adaptively used for histogram distribution.
3. Re-weight the salient values based on visual similarities.

In this case we have detecting homogeneous saliency regions is better. In this work we compute the color contrast based on a non-parametric distribution extracted from local homogeneous region.

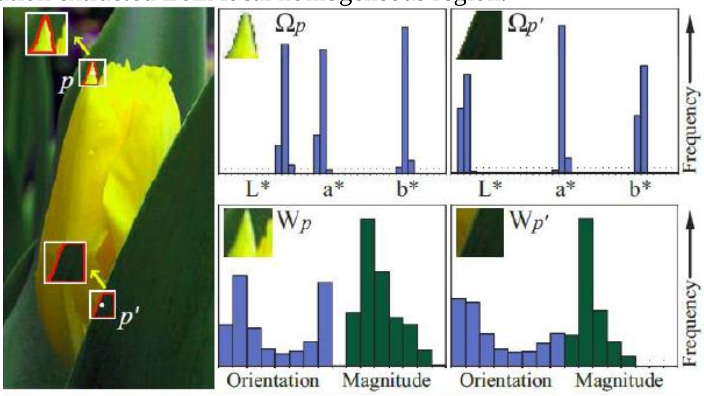


Fig. 6 The color descriptor is extracted from the shape-adaptive region Ωp/p (top) and the orientation-magnitude (OM) descriptor captures the structures within a local window Wp/p (bottom).

2) Structure-Based Contrast Measure

In this method detect only structural saliency regions is better. In this section we have using a spectral residual approach. This method is based on the log spectra representation of images. It is ability to detect proto-objects. Generality is the advantages of spectral residual approach. In this case saliency covers unknown features such as curve, density, intersection, inverse intersection, closure etc. To resolve the problem of weighting features from different channels such as shape, texture, orientations etc. Finally, this approach is compared with other detection algorithms. Computation of our method is extremely parsimonious [7].

C. Fusion of Saliency Map Generation

Saliency detection is subsequent processing. It can be used in an object detection or recognition. Saliency detection mainly focusing on three events [8]:

1. Detect both small and large saliency regions.
2. Detect saliency in cluttered scenes.
3. Inhibit repeating patterns.

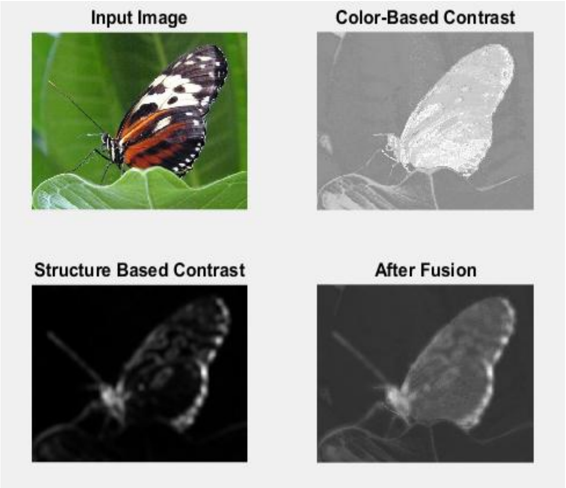


Fig.7: Fusion

In this case first we have to consider in a two processing channels yield with saliency maps. It detects Sg and S_l respectively. First we have to calculating in a color image. Then saliency map is computed for each channel. The final saliency map, S_f, is given by:

$S_f = Sg + k. S_l$, where k is a free parameter.

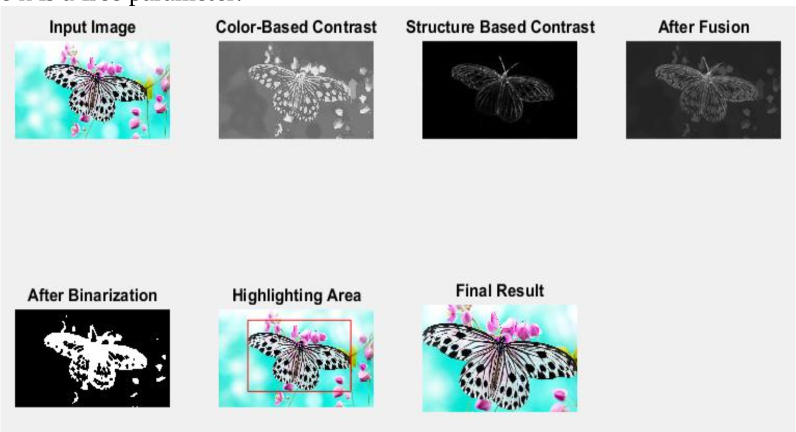


Fig. 8 Main flow of PISA

IV. CONCLUSIONS

Many applications applying different salient detection techniques are used. In our system, we have using in a unified framework called PISA. These frameworks are used to compute pixelwise saliency values and detect foreground details efficiently. In this method we have using in a Binarization. Binarization means to segment the given input image applying different threshold values. This method are utilizing emphasis on high frequency area and also detecting how many percentage cover in emphasis region. In this case we have detecting foreground region correctly. And also detecting on particular section will be rectangular region is formed. In this techniques are utilized in image segmentation and image enhancement purposes.

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