

# A Survey on Saliency Detection Methods

Miss. Rupali M. Patil<sup>1</sup> Miss. Swati A. Khavare<sup>2</sup>

<sup>1,2</sup>Department of Computer Science & Technology  
<sup>1,2</sup>Shivaji University, Kolhapur, India

**Abstract**— Saliency detection has gained a lot of attention in image processing. In past few years many saliency detection methods have been proposed. In this paper we present various saliency detection methods. The discussed methods include Frequency-tuned salient region detection, Graph-based visual saliency detection, A spectral residual saliency detection, Global contrast based salient region detection, A Boolean map saliency detection, Salient Region Detection and Segmentation, SDSP saliency detection, Isocentric color image saliency detection, visual saliency detection, and Context-aware saliency detection.

**Key words:** Saliency detection, Visual attention, Human Visual System

## I. INTRODUCTION

Image Saliency is a remarkable part of image that can capture ones attention easily. Image saliency detection is a active research topic in field of image processing that detects interesting part of image and also captures the part of image salient to Human Visual System. This paper focuses various saliency detection techniques which are useful in many applications including image segmentation, image compression, object detection [1], image classification, and image retrieval. According to research work done by Itti et al. the saliency detection techniques can be categorized into two types that is fast, pre-attentive, bottom-up, data driven saliency detection and slower, task dependent, top-down, goal driven saliency detection [4]. Most existing saliency detection approaches are based on the bottom-up computational framework, where focus is given on image attributes like edges, color, and contrast.

The saliency detection methods based on bottom up framework and by using contrast as image attribute can be divided into two types local contrast based methods and global contrast based methods. Local contrast based methods estimates saliency of image region by comparing it with its local neighbor. Whereas global contrast based methods detects saliency of image region by computing its contrast with respect to the entire image [4]. The several techniques for saliency detection have been developed. Such saliency detection techniques are useful in producing saliency map of image. Saliency map divides the image into foreground and background regions. So we can keep foreground that is object and only meaningful part of background. Saliency map is way of representing visual saliency of any visual scene. The saliency maps can be useful in many real life applications such as:

### A. Image Retargeting:

Image retargeting resizes the image by expanding or shrinking it. If image size is large it takes a lot of time to process it but if we resize the image it reduces the time required for processing without loss of meaningful information.

### B. Collage Creation as Summarization Tool:

Collage creation is one of difficult task because it requires proper cutting of image parts and well matching of them. Collage creation is useful in today's digital world where explosion of digital images is very high. Collage creation can be used as summarization tool. This collage creation helps to maintain salient objects and only meaningful part of background by removing cluttered background. Saliency map is considered as a first step of such automatic collage creation.

### C. Object Detection:

The main goal of object detection is to extract the object from its surrounding region. With the help of saliency map object can easily be separate out from its background region. The remaining paper is organized as follows: Section 2 explains the concept of saliency detection. Several saliency detection methods are summarized in Section 3. Finally Section 4 concludes different saliency detection techniques.

## II. CONCEPT OF SALIENCY DETECTION

Saliency detection is subjected to detection of important regions in images towards which Human Visual System gets easily attracted. Usually Human Visual System pays uneven attention towards what they have seen. When they look at any image they pay more attention on region containing an object than its surrounding regions, that region is called as salient region and detection of such regions is called as saliency detection. Saliency detection techniques detect visually attracted regions in images. An image is normally represented by matrix of pixels and saliency value of image is depending upon saliency value of each pixel of that image. The pixel is more salient as compare to others if its saliency value is more than all other pixels in an image.

Visual attention is important part of saliency detection. Attention is process that allows human being to focus on something which is more important than rest of part. Human attention is consists of two processes bottom up process and top down process. Bottom up process uses low level features to detect salient objects whereas top down process modifies bottom up saliency by using priori knowledge of scene. Model of saliency detection based on bottom up process detects the saliency of each region in image based on several low level features like contrast, color, motion, texture. This saliency detection model considers some regions as more attractive and contains important context if they have important properties than other regions. Saliency detection has a lot of applications such as image retrieval, image classification, object recognition, image segmentation and image retargeting.

## III. LITERATURE REVIEW

A lot of work has been done and various methods have been proposed to detect image saliency. Here we discuss such saliency detection methods. An author of paper [1] proposed

Frequency-tuned Salient Region Detection. This method suggests that visual salient image region detection is useful for a lot of applications such as object segmentation, adaptive compression, and object recognition. In this paper, they have been introduced a method for salient region detection whose output is full resolution saliency maps. These maps also define boundaries of salient objects. Boundary preservation is done by retaining substantially more frequency content from the original image than other techniques [1]. Jonathan Harel et al. proposed A new bottom-up visual saliency model, Graph-Based Visual Saliency (GBVS) [2]. This model is consists of two steps: first creation of activation maps with the help of feature channels, and then normalization of those activation maps. The key point of GBVS is that it assigns higher saliency value to center of image.

Another saliency detection approach has been given by X. Hou et al. Saliency Detection: A Spectral Residual Approach [3]. This approach suggests that the ability of human visual system to detect salient regions is very fast and reliable. This paper presents a simple method for the visual saliency detection. This model is independent of features, categories, or other forms of prior knowledge of the objects. They extract the spectral residual of an image in spectral domain by analyzing the log-spectrum of an input image. This is a fast method to construct the respective saliency map in spatial domain. Generality is main advantage of the spectral residual approach. Other methods require the prior knowledge for saliency detection which is not required in this system.

Global Contrast based Salient Region Detection is proposed by M. M. Cheng et al. [4]. They proposed a regional contrast based saliency extraction algorithm. This algorithm evaluates global contrast differences and spatial coherence. The proposed algorithm is simple, efficient as well as yields saliency maps with full resolution. The proposed region based contrast method first divides the input image into regions then computes the saliency of each region by calculating weighted sum of that region's contrast to other image regions. The author of paper Saliency Detection: A Boolean Map Approach [5] proposed a novel Boolean Map based Saliency (BMS) model. According to this model an image is characterized by a set of binary images, those are generated by randomly thresholding the image's color channels. BMS computes saliency maps by analyzing the topological structure of Boolean maps which is based on a Gestalt principle of figure-ground segregation. Implementation of BMS is simple also it runs very efficiently.

The author of paper [6] Salient Region Detection and Segmentation says that detection of salient image regions is useful for applications like image segmentation, adaptive compression, and region-based image retrieval. In this paper they proposed a novel method that determines salient regions in images with the help of low-level features of luminance and color. The key points of this method are fast, implementation is easy and generation of high quality saliency maps whose size and resolution is as same as the input image. A novel saliency detection method SDSP is proposed by Lin Zhang [7] by combining three simple priors. At first band-pass filtering model the behavior that the human visual system which detects salient objects in a

visual scene. Secondly the center of an image is main region where people pay more attention. Thirdly, warm colors are more attractive than cold colors to the people. Computational complexity of SDSP is low, so useful for time critical applications.

The author of paper [8] "A framework for visual saliency detection with applications to image thumbnailing" proposed a novel framework for visual saliency detection which based on a simple principle that images sharing their global visual appearances shares their similar salience [8]. First they retrieves the images more similar to the target image then built a simple classifier and then generate saliency maps by using created classifier. Finally, they extract thumbnails by refining maps. "Isocentric Color Saliency in Images", in this paper author proposed a novel computational method to detect visual saliency in images. This method suggests that salient object must have characteristics that are different than the remaining of the scene, being edges, color or shape [9]. This approach is fast as well as runs without any learning.

The author of paper [10] proposed a new type of saliency – context-aware saliency. Aim of this method is to at detect region in the image that represent the scene. The regions are salient if they draw the attention, sometimes background of object also contains important context which is useful for clear understanding of object so the proposed method detects the salient object with its surrounding. This saliency detection method is different from other whose goal is to either identify fixation points or detect the dominant object. This method is beneficial in applications where image context of the dominant objects is as essential as the objects. The proposed method is useful in image retargeting and summarization.

#### IV. CONCLUSION

In this paper, we present various saliency detection methods. These discussed methods include Frequency-tuned salient region detection, Graph-based visual Saliency, A spectral residual Saliency detection, Global contrast based salient region detection A Boolean Map Approach, Salient Region Detection and Segmentation ,SDSP saliency detection, Isocentric color image saliency detection, visual saliency detection and Context-aware saliency detection. As saliency detection has a lots of real life applications research is still going on it to develop best saliency detection technique.

#### REFERENCES

- [1] R. Achanta, S. Hemami, F. Estrada, and S. Susstrunk. "Frequency-tuned salient region detection". In CVPR, pages 1597–1604, 2009.
- [2] J. Harel, C. Koch, and P. Perona. "Graph-based visual Saliency", *Advances in neural information processing systems*, 19:545, 2007.
- [3] X. Hou and L. Zhang. "Saliency detection: A spectral residual Approach", In CVPR, pages 1–8, 2007.
- [4] M. M. Cheng, G. X. Zhang, N. J. Mitra, X. L. Huang, and S. M. Hu, "Global contrast based salient region detection," in Proc. IEEE Conf. Comput. Vis. Pattern Recognit., Dec. 2011, pp. 409–416.
- [5] Jianming Zhang, Stan Sclaroff "Saliency detection: a boolean map approach", in Proc. of the IEEE

- International Conference on Computer Vision (ICCV), 2013.
- [6] R. Achanta, F. Estrada, P. Wils, and S. Susstrunk. “Salient region detection and segmentation”, In ICVS, pages 66–75. Springer, 2008.
- [7] Lin Zhang, Zhongyi Gu, and Hongyu Li “SDSP: a novel saliency detection method by combining simple priors”, IEEE, 978-1-4799-2341-0/13, 2013.
- [8] Luca Marchesotti, Claudio Cifarelli and Gabriela Csurka, “A framework for visual saliency detection with applications to image Thumbnailing”, IEEE 12th International Conference on Computer Vision (ICCV),2009.
- [9] Roberto Valenti, Nicu Sebe, and Theo Gevers, “Isocentric color saliency in images”
- [10] S. Goferman, L. Zelnik-Manor, and A. Tal, “Context-aware saliency detection”, In CVPR, pages 2376–2383, 2010.

