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Finding Visual Attention in an Image: Learning through Hierarchal Inheritance Approach

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Abstract

Finding visually attractive region in an image is one of the interesting research area due to its real time applications. Generally we take the images to capture objects (visually attractive region). In this paper the proposed approach regards the important object detection in an image. The proposed algorithm contains multiple phases: preparing the super-pixel using ensemble decision trees to estimate the adjacency probability between the regions, and forming the saliency vector (visually attractive region) using the learned weights through hierarchal inheritance approach. The proposed approach is tested on several popular benchmark data-sets and performed well among the present approaches. The results were compared and shown in section 6.

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Keywords: Saliency Vector; Salient Object; Superpixel; Visually Attractive Object; Visually Attractive Region.

1. Introduction

Eye fixation has been a basic problem in cognitive sciences, neuroscience, visual saliency and computer vision and image processing for a long time[1,2]. Eye fixation has been identified as the problem of identifying the important region[3] (visually attractive region) in the given image. There are variant real time applications of salient object detection for instance object recognition[4,5], image compression[6], image cropping[7], photo collage[8], dominant color detection[9] and so on.

According to the study of cognitive science the visually attractive region is the uniqueness, rarity and surprise of an image. The characteristics of the visual attention is based on the variety of features for instance position, color, appearance, contrast[10,11] (local and global perspective), and so on.

Detecting the important object in an image by humans is a trivial task but it is not for the systems. In this paper the proposed algorithm deals how to find out the visual attention in an image by using learned weights (generated by hierarchal segmentation approach). The visually attractive region detection is the regression problem and the supervised (random forest regressor) learning technique is used to assign the saliency values to the regions of segmented image and these values are used to find the saliency vector (visually attractive region).

The key assets of this paper are 1) formation of super-pixels used for primary segmentation (acts as regions) in a given image 2) choosing the appropriate features for finding out the visually attractive region 3) providing the

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values to the regions based on the ensemble (random forest regressor) technique[1,33] 4) weights (W), generated by hierarchal inheritance approach, provide the visually attractive object without regressive search on complete image. In the proposed approach the feature vectors are compared between the regions locally and globally[2,12]. The background removal also plays a vital role in finding out the visually attractive object, the proposed approach handles it effectively.

2. Related Work

The following gives review of how the research is going on towards the salient object detection. A comprehensive study on salient object detection be available[13]. The review on visual saliency, eye fixation and also included analysis on salient object detection.

Most of the important object detection algorithms are based on the feature combining theory[14] which integrates the several features for the prediction of important object detection. The biologically-plausible architecture was proposed[15] which is certainly depends on the studies concerning the detection, localization, and recognition of objects in visual fields.

In the recent past very intensive research is going on, to specify what are the effective feature vectors to find out the salient object detection. The variant centre-surround hypothesis is analyzed[16]. Centre-surround differences are generally calculated based on the color histograms. A strong mathematical formulation was proposed[17].

Centre-surround difference acts as one of the feature vector in salient object detection. The difference between the neighbouring regions will be useful to calculate the saliency values of the regions[18]. The global and regional contrast differences are computed to calculate the salient features. The global contrast differences are computed between the regions and the regional contrast differences are calculated within the region[19].

Different approaches have been proposed to find out the salient object detection. Usually the salient object will be present in the middle of the image, by the majority cases, this is known as centre-bias[18]. The related concepts such as auto-context cue[20]. A graphical based approach was used to generate the salient object[3]. A matrix formation scheme is proposed to detect the important objects[21].

Besides to the above approaches, several approaches have been proposed to detect the important regions in a given image. By combining the image cues are used to find out generic objectness measurement[23]. Checks whether by decomposing the neighbouring regions will form the salient object[24].

Visual saliency is another important area used for the salient object detection. In the recent past developments includesthe isocentric curvedness and colorness[25], image histograms[26], utilization of depth cues[27], top-down and bottom-up feature specification[28], and etc. There are many other saliency definitions aiming to detect the visual attention in a given image.

The proposed approach differs from the existing approaches in feature integration and learning to combine the segmented regions in a given image. The advantage of learned through hierarchal inheritance approach is that the regressive search on complete image for finding the visually attractive regions is not required. The proposed approach learns to automatically assign the values to the regions[2]. In most of the existing algorithms the saliency vector generation is done by combining the different types of feature vectors[3,23]. In the proposed approach the random forest regressor (Ensemble learning) is used to provide the appropriate saliency values to the segmented regions rather than simply combining or integrating the features of the given image. In the proposed approach both regional and global feature differences are used. The recent learning approach[3] aims to find out the eye fixation.

3. Visually Attractive Region Computation

The process of finding the visually attractive region in the given image contains various phases: segmenting the image in to different regions based on the features (color, background, contrast, properties and so on), providing the values to the regions based on the learned ensemble (random forest regressor) technique, and weights (W), learned by hierarchal inheritance approach, and mapping the saliency vector (svector).