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Detection of Salient Region by Local Spatial Support & High Dimensional Color Transform

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ABSTRACT

Automatic salient object regions detection across images, without any prior information or knowledge of the contents of the corresponding images, enhances many computer vision and computer graphics applications. Our approach consists of global and local features, which complement each other to compute a saliency map. The proposed approach automatically detects salient regions in an image dataset. The first key idea of our work is to create a saliency map of an image by using a linear combination of colors in a high dimensional color space. This is based on an observation that salient regions often have distinctive colors compared with backgrounds in human perception, however human perception is complicated and highly nonlinear. By mapping the low dimensional red, green and blue color to a feature vector in a high dimensional color space, we will show that we can composite an accurate saliency map by finding the optimal linear combination of color coefficients in the high dimensional color space. To further improve the performance of our saliency estimation, our second key idea is to utilize relative location and color contrast between super pixels as features and to resolve the saliency estimation from a trimap via a learning based algorithm. The additional local features and learning based algorithm complement the global estimation from the high dimensional color transform based algorithm.

Keywords : Salient Region Detection, Super Pixel, Trimap, Color Channel, Histogram of Gradients, Random Forest

I. INTRODUCTION

The humans are experts at quickly and accurately identifying the most visually noticeable foreground object in the scene, known as salient objects, and adaptively focus our attention on such perceived important regions. Salient region detection is important in image understanding and analysis. Its goal is to detect salient regions in an image in terms of a saliency map, where the detected regions would draw humans' attention. Many previous studies have shown that salient region detection is useful, and it has been applied to many applications including segmentation, object recognition, image retargeting, photo rearrangement, image quality assessment, image thumb nailing, and video compression. The development of salient region detection has often been inspired by the concepts of human visual perception. One important concept is how "distinct to a certain extent" the salient region is compared to the other parts of an image. As color is a very important visual cue to human, many salient region detection techniques are built upon distinctive color detection from an image.

This approach uses the tree based classifier to estimate the location of salient region. This classifier classifies each super pixel as background, foreground and unknown region. These regions form the initial trimap. HDCT method separates the background and foreground region for saliency map. HDCT and local learning methods are proposed from the trimap. Global based HDCT method is to find color feature. This method joins many representative color spaces. Map the low dimensional color space into high dimensional color feature by using HDCT. Random forest method applied in local learning based method. This method performs the relative location and color contrast between super pixels. A random forest classifier to classifies the saliency of a super pixel by comparing the distance and color contrast of a super pixel to the K nearest foreground super pixels and the K nearest background super pixels. Join the saliency maps from the HDCT based method and the local learning based method by weighted combination.

II. LITERATURE REVIEW

Jiwhan Kim, Dongyoon Han, Yu-Wing Tai, and Junmo Kim, "*Salient Region Detection via High-Dimensional Color Transform and Local Spatial Support",* IEEE transactions on image processing, vol. 25, No. 1, January 2016.

In this paper, a novel approach to automatically detect salient regions in an image. It consists of global and local features, which complement each other to compute a saliency map. The first key idea is to create a saliency map of an image by using a linear combination of colors in a high dimensional color space. This is based on an observation that salient regions often have distinctive colors compared with backgrounds in human perception, however human perception is complicated and highly nonlinear. By mapping the low dimensional red, green, and blue color to a feature vector in a high dimensional color space, show that it can composite an accurate saliency map by finding the optimal linear combination of color coefficients in the high dimensional color space. To further improve the performance, second key idea is to utilize relative location and color contrast between super pixels as features and to resolve the saliency estimation from a tri map via a learning based algorithm. The additional local features and learning based algorithm complement the global estimation from the high dimensional color transform-based algorithm.

N. Kalaivani, S. Sanjuna, "*Salient region detection via super pixels, histogram of gradients",*International journal of electrical, electronics and data communication, ISSN: 2320-2084 Volume-5, March 2017.

In this paper, it considers feature based on global and local features, which complement each other to compute a saliency map. The proposed approach automatically detects salient regions in an image dataset. The proposed algorithm based on applies super pixel segmentation appearance model. To improve the performance of saliency map estimation, based on super pixels as features algorithm to resolve the saliency estimation from a tri map via a learning based algorithm. It introduces a novel technique to automatically detect salient regions of an image via high dimensional color transform. To represent a saliency map of an image as a linear combination of high dimensional color space where salient regions and backgrounds can be distinctively separated. This is based on an observation that salient regions often have distinctive colors compared to the background in human perception. By mapping a low dimensional RGB color to a feature vector in a high dimensional color space, it shows that it can linearly separate HDCT and local learning methods are proposed from the tri map. The salient regions from the background by finding an optimal linear combination of color coefficients in the high dimensional color space. High dimensional color space incorporates multiple color representations including RGB, CIELab, HSV and with gamma corrections to enrich its representative power.

T. Jeyapriya, G. Rajasekaran, "*Detection of Global Salient Region via High Dimensional Color Transform and Local Spatial Support*", International Conference on Innovations in Engineering and Technology (ICIET) - 2016

This approach uses the tree based classifier to estimate the location of salient region. This classifier classifies each super pixel as background, foreground and unknown region. These regions form the initial tri map. HDCT method separates the background and foreground region for saliency map. Global based HDCT method is to find color feature. This method joins many representative color spaces. Map the low dimensional color space into high dimensional color feature by using HDCT. Random forest method applied in local learning based method. This method performs the relative location and color contrast between super pixels. A random forest classifier to classifies the saliency of a super pixel by comparing the distance and color contrast of a super pixel to the K nearest foreground super pixels and the K nearest background super pixels. Join the saliency maps from the HDCT based method and the local learning based method by weighted combination. Representative works in salient region detection are reviewed in this section. We refer readers to for a more extensive comparative study of state of the art salient region detection techniques.

Lalkot Farha Naaz A. Rahim, V.S.Kolkure "A High Dimensional Color Transform and Learning Based Approach for Dominant Area Detection" International Journal of Engineering Science and Computing, April 2017.

An approach is described that significantly detect dominant region in an image. This approach considers global and local features, which is used to compute a dominancy map. First a dominancy map of an image is created by using a linear combination of colors in a high dimensional color space. This is based on observation that dominant regions have distinguishing colors compared to backgrounds in human vision. The small-dimensional red, green, and blue color are mapped to a feature vector in a high dimensional color space, an detailed dominancy map is composite by finding the excellent linear combination of color coefficients in the high dimensional color space. Secondly, the performance of dominancy estimation is raised by applying relative location and color contrast between super pixels to from a trimap via regression algorithm. The test results of two benchmark datasets found to be effective.

The proposed method of dominant region detection estimates the foreground regions from an initial dominancy trimap using two different methods first is global dominancy estimation via global High Dimensional Color Transform (HDCT) method and second is local dominancy estimation via local learning based (LLB) method. High Dimensional Color Transform (HDCT) detection uses HDCT algorithm and local learning based (LLB) detection uses regression algorithm.LLB method has low computational complexity and is an excellent complement for HDCT method. The trimap-based robust estimation overcomes the limitations of inaccurate initial dominancy classification. There is use of some most effective features that can be calculated rapidly, such as color, contrast and location features. So, the dominant region can be found accurately using even a smaller number of features. Computations are performed in super pixel level. As a result, this proposed approach achieves good performance and is computationally efficient.

Anchal A. Khadse, Renu G. Dhokte, Mr. M. H. Nerkar "A Review on Implementation of High Dimension Colour Transform In Domain Of Image Processing" International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 06 June - 2017

Extraction of salient region from colour image is very useful nowadays so this topic deals with the study of salient region detection in an image with the help of high dimension colour transform algorithm. To extract salient region from the image it is necessary to design saliency map. For computation of saliency map, global and local features of the image are needed to find out. The creation of saliency map is a first approach of this work, and it is a linear combination of colours in high dimensional colour space. By mapping the low-dimensional red, green, and blue colour to a feature vector in a high-dimensional colour space, we show that we can composite an accurate saliency map by finding the optimal linear combination of colour coefficients in the high-dimensional colour space. The performance of our saliency estimation is improved by our second approach which is used to utilize relative location and colour contrast between super pixels as features and to resolve the saliency estimation from a trimap via a learning-based algorithm. We here used number of images as a trained dataset for analysis of different parameters in colour images.

Object detection is necessity of picture handling process in image processing. In this paper we survey the current systems of salient object detection. Salient region detection is a challenging problem and an important topic in computer vision. The single visual cue based salient region detection methods have their own limitation. Implementation of HDCT method deals with salient region detection that estimates the foreground regions from a trimap using two different methods:

global saliency estimation via HDCT and local saliency estimation via regression. The trimap-based robust estimation overcomes the limitations of inaccurate initial saliency classification. As a result, this method achieves good performance and is computationally efficient in comparison to the state-of-the art methods

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Jiwhan Kim Dongyoon Han Yu-Wing Tai Junmo Kim "Salient Region Detection via High-Dimensional Color Transform" IEEE xplore CVPR 2014.

In this paper, we introduce a novel technique to automatically detect salient regions of an image via high dimensional color transform. Our main idea is to represent a saliency map of an image as a linear combination of high-dimensional color space where salient regions and backgrounds can be distinctively separated. This is based on an observation that salient regions often have distinctive colors compared to the background in human perception, but human perception is often complicated and highly nonlinear. By mapping a low dimensional RGB color to a feature vector in a high-dimensional color space, we show that we can linearly separate the salient regions from the background by finding an optimal linear combination of color coefficients in the high-dimensional color space. Our high dimensional color space incorporates multiple color representations including RGB, CIELab, HSV and with gamma corrections to enrich its representative power. Our experimental results on three benchmark datasets show that our technique is effective, and it is computationally efficient in comparison to previous state-of-the-art techniques.

We have presented a high-dimensional color transform based salient region detection, which estimates foreground regions by using the linear combination of various color space. The trimap-based robust estimation overcomes limitations of inaccurate initial saliency map. As a result, our method achieves a fine performance and is computationally efficient in comparison to the other state-of-the art methods. We note that our high dimensional color transform might not fully coincide with the human vision. However, it is effective in increasing the success of foreground and background color separation since the low dimensional RGB space is very dense where distributions of foreground and background colors are largely overlapped. We also note that if identical colors appear in both foreground and background or the initialization of color seed estimation is very wrong, our result is undesirable. In future, we plan to use more features to solve these limitations and improve the accuracy of saliency detection.

Shamik Sural, Gang Qian and Sakti Pramanik "Segmentation and Histogram Generation using the Hsv Color Space for Image Retrieval" IEEE ICIP 2002.

We have analyzed the properties of the HSV (Hue, Saturation and Value) color space with emphasis on the visual perception of the variation in Hue, Saturation and Intensity values of an image pixel. We extract pixel features by either choosing the Hue or the Intensity as the dominant property based on the Saturation value of a pixel. The feature extraction method has been applied for both image segmentation as well as histogram generation applications – two distinct approaches to content based image retrieval (CBIR). Segmentation using this method shows better identification of objects in an image. The histogram retains a uniform color transition that enables us to do a window-based smoothing during retrieval. The results have been compared with those generated using the RGB color space.

We have studied some of the important properties of the HSV color space and have developed a framework for extracting features that can be used both for image segmentation and color histogram generation – two important approaches to content based image retrieval. Our approach makes use of the Saturation value of a pixel to determine if the Hue or the Intensity of the pixel is more close to human perception of color that pixel represents. The K-means clustering of features combines pixels with similar color for segmentation of the image into objects. We are also able to generate a histogram that enables us to perform a window-based smoothing of the vectors during retrieval of similar images. While it is well established that color itself cannot retain semantic information beyond a certain degree, we have shown that retrieval results can be considerably improved by choosing a better histogram.

Radhakrishna Achanta, Francisco Estrada, Patricia Wils, and Sabine S˜usstrunk "Salient Region Detection and Segmentation"
Detection of salient image regions is useful for applications like image segmentation, adaptive compression, and region-based image retrieval. In this paper we present a novel method to determine salient regions in images using low-level features of luminance and color. The method is fast, easy to implement and generates high quality saliency maps of the same size and resolution as the input image. We demonstrate the use of the algorithm in the segmentation of semantically meaningful whole objects from digital images.We presented a novel method of finding salient regions in images, using low level features of color and luminance, which is easy to implement, noise tolerant.

Khouloud Meskaldji, Samia Boucherkha, Salim Chikhi "Color Quantization and its Impact on Color Histogram Based Image Retrieval"

The comparison of color histograms is one of the most widely used techniques for Content-Based Image Retrieval. Before establishing a color histogram in a defined model (RGB, HSV or others), a process of quantization is often used to reduce the number of used colors. In this paper, we present the results of an experimental investigation studying the impact of this process on the accuracy of research results and thus will determine the number of intensities most appropriate for a color quantization for the best accuracy of research through tests applied on an image database of 500 color images.

In this work we have been able to show in the first place the need of a quantization process in CBIR system using color histograms. We have also demonstrated that the use of a quantization scheme of great values does not necessarily lead to an optimal precision of search. On the contrary it can lead to less efficient search. Then a thorough study must be established in order to be able to determine the best parameters of quantization for a better search for all color models. This implies the use of this process on other image bases as well as on other color models. In perspective we will study the impact of quantization on the recall of search.

III. PROPOSED WORK

We propose a novel approach to automatically detect salient regions in an image. Our approach first estimates the approximate locations of salient regions by using a tree based classifier. The tree based classifier classifies each super pixel as either foreground, background or unknown. The foreground and background are regions where the classifier classifies salient and non salient regions with high confidence. The unknown regions are the regions with ambiguous features where the classifier classifies the regions with low confidence. The foreground, background and unknown regions form an initial trimap, and our goal is to resolve the ambiguity in the unknown regions to estimate accurate saliency map. From the trimap, we propose two different methods, high dimensional color transform (HDCT) based method and local learning based method to estimate the saliency map. The results of these two methods will be combined together to form our final saliency map. The overview of our method is presented in Fig.1(b). Our algorithm is performed in super pixel level in order to reduce computations.

The initial saliency trimap composed of a foreground candidate, background candidate, and unknown regions using existing saliency detection techniques are shown in Fig.1(c). The HDCT based method is a global method. The motivation is to find color features which can efficiently separate salient regions and background. The key idea is to exploit the power of different color space representations to resolve the ambiguities of colors in the unknown regions. The high dimensional color transform combines several representative color spaces such as red, green, and blue (RGB), CIELab, and HSV together with different power law transformations to enrich the representative power of the HDCT space. Note that each of the color spaces has a different measurement about color similarity.

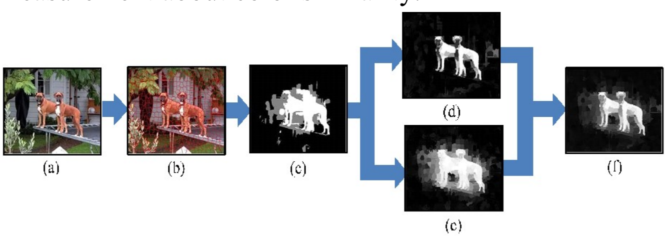

Figure.1. Overview of our algorithm: (a) Input image. (b) Over segmentation to super pixels. (c) Initial saliency trimap. (d) Global salient region detection via HDCT. (e) Local salient region detection via random forest. (f) Our final saliency map.

For example, two colors in RGB with short distance may have long distance from each other in HSV or CIELab color spaces. Using the HDCT, we map a low dimensional RGB color tuple into a high dimensional feature vector. Starting from a few initial color examples of the detected salient regions and backgrounds, the HDCT based method estimates an optimal linear combination of color values in the HDCT space that results in a per pixel saliency map as shown in Fig.1 (d). The local learning based method utilizes a random forest with local features, i.e. relative location and color contrast between super pixels. Since the HDCT based method uses only color information, it can be easily affected by texture and noise. We overcome this limitation by using location and contrast features. If a super pixel is closer to the foreground regions than the background regions, it has higher chance to be a salient region. Based on this assumption, we train a random forest classifier to evaluate the saliency of a super pixel by comparing the distance and color contrast of a super pixel to the K nearest foreground super pixels and the K nearest background super pixels. Fig.1 (e) shows an example of saliency map obtained by the local learning based method. The value of K for the K nearest neighbor is systemically found by measuring the performance of the local learning based method on a validation set. We combine the saliency maps from the HDCT based method and the local learning based method by weighted combination (Fig.1 (f)).

IV.CONCLUSION

A novel salient region detection method that concludes the foreground regions from a trimap using two different methods: global saliency estimation via HDCT and local saliency estimation via regression. Our main idea is to represent a saliency map of an image as a linear combination of high dimensional color space where salient regions and backgrounds can be distinctively separated. This is based on an observation that salient regions often have distinctive colors compared to the background in human perception, but human perception is often complicated and highly nonlinear. By mapping a low dimensional RGB color to a feature vector in a high dimensional color space, we will show that we can linearly separate the salient regions from the background by finding an optimal linear combination of color coefficients in the high dimensional color space. Our high dimensional color space incorporates multiple color representations including RGB, CIELab, and HSV to enrich its representative power. The trimap based robust estimation overcomes the limitations of inaccurate initial saliency classification.

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