Image Resizing based on Summarization by Seam Carving using saliency detection to extract image semantics

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ABSTRACT

Image Processing is an important technology for performing image operations. The analysis and manipulation on a digitized image helps to improve its quality. Image Processing offers a number of techniques to process an image such as Image Resizing, Image Enhancement etc. Image resizing is a key process for displaying visual media on different devices, and it has attracted much attention in the past few years. This paper defines preserving an important region of an image, minimizing distortions, and improving efficiency. Image Resizing can be more effectively reached with a better interpretation of image semantics. A new image importance map and a new seam criterion for image retargeting is presented. Content-aware image resizing is a promising theme in computer vision and image processing. The seam carving method can effectively achieve image resizing which needs to define image importance to detect the salient context of images.

Keywords: Image Resizing, Seam Carving, Saliency, Warping.

1. INTRODUCTION

In recent years Internet and multimedia technologies are growing vastly, so is the use of images. In our daily lives we use number of digital images and for sharing or exchange purposes numerous display devices are developed, such as PDA’s, Cell phone’s, Televisions, Monitors etc. All such devices are having different display sizes and aspect ratios. So to understake the size problems of an image and less distortions image resizing has to be used. It will try to reduce image distortions and adaptively resize an image for optimal displays by considering different conditions [1]. Earlier scaling, cropping methods were used for image resizing. Their solutions were simple and easy to implement but they had some drawbacks. They make modifications without demanding the conservation of semantic information, accordingly resulting in evident artifacts such as oversqueeze, boundary breaking and content loss. Hence both the solutions were not well relevant for display devices with different aspect ratios. As a part of enhancement, to overcome this, the idea of carving is proposed for image resizing process.

The human visual system can quickly focus on one or several interesting contents of an image at a first glance. These interesting contents are also referred as region of interest(ROI). The image structure consists of ROI and the background of an image. Effective image resizing techniques should preserve the ROI as much as possible and reduce the distortion of the image structure to maintain the harmony of the image. This maintenance of the image is referred by the term “content-aware”. In order to assist the ROI in image resizing, some guiding information, which is able to distinguish the ROI from background, should be extracted. Traditional methods employ image clues such as color and brightness contrast to infer the ROI. However, the leading resized images are usually distorted due to low-level feature information which are less expressive for the ROI [3]. In order to meliorate this situation, a novel method based on machine learning is developed by incorporating a high-level boundary feature of the ROI as prior information. The main contribution of this paper is a framework for image resizing by adopting supervised learning of high-level image information. We believe that the internalization of learned high-level clue is the key point to greatly improve the performance of seam carving.

We also proposed method for salient region detection that outputs full resolution saliency maps with well-defined boundaries of salient objects. Visual saliency is one of the perceptual quality that makes an object, person, or a pixel stand out relative to its neighbors and thus capture our attention.

The rest of the paper is planned as follows. Section 2 briefly surveys the literature work. Section 3 presents the proposed resizing method integrated with detected boundary information. To verify the effectiveness and robustness of the proposed method, the Experimental results are shown in Section 4 and Conclusion is made in Section 5.

2. LITERATURE SURVEY

Lots of work have been done in image resizing. Seam carving, warping, multi operator, and some other methods can be used for image resizing system. Intelligent cropping, seam carving, warping, and multi operator resizing represent
content aware resizing methods. In this section we define the basic theories of above mentioned methods and some new methods in recent years. Content-aware image resizing is crucial for displaying media at different resolutions and aspect ratios. Number of approaches attempt to eliminate the unimportant information from the image periphery [1]. The image is cropped to fit the target proportion and then uniformly resized by traditional interpolation. Seam carving methods have been proposed to keep crucial contents while reducing or removing other image areas. These techniques reduce or expand regions that are broke up throughout the image by removing or duplicating monotonic pixel-wide low-energy seams. Continuous resizing methods have been understood through image warping. To understate the resulting distortion, the local regions are squeezed or stretched by globally optimizing warping functions [3]. All these methods dramatically resize or exhaust the homogeneous regions which easily result in noticeable distortions such as breaking and over squeezing of the image.

2.1 Scaling

The Scaling is defined by a uniform map between pixels of the original image and pixels of the target image. Scaling may guide to distortions and produce artifacts when the aspect ratio of the images change [4].

2.2 Image Segmentation

Huiying Liu et al. [5] introduced a Density-Based Image Segmentation. This segmentation method incorporates the spatial connectivity and color feature of the pixels to cluster them into different groups. It uses density-based clustering to discover the spatial connectivity and measure the color similarity in Munsell color space to ensure the perceptive smoothness of color change in regions. Segmentation grounded methods [6] present a way to address the image resizing problem with segmentation techniques. Firstly, the ROI is segmented from an image. Then the background is resized into the desired ratio. At the end, the segmented ROI is inpainted to the renewal background. Nevertheless, these methods trust on accurate segmentation of ROI. The inaccurate segmentation may lead to deformations of ROI.

2.3 Cropping

The cropping method pull out a rectangular window with a desired size from the original image. The content inside the window is kept and others are discarded. The traditional cropping method simply crops a rectangle from the center of the image as its output resizing result. However, it has a limitation of losing those important contents consisting on the periphery of an image. So, the effect is severely damaged.

Content-aware cropping methods [7] are important improvements of the original cropping method. There are two main steps for this kind of methods, first one is detecting the salient portions and then cropping them by fixed windows. However, these methods can only be applied to specific images instead of natural images, which limits their applicability. A user can draw a rectangle around the image which he wants to extract. This direct method helps to preserve important content of an image. But there is problem, this is time-consuming and onerous. So, to overcome the above problem content-aware intelligent cropping method is proposed. The intelligent cropping method contains two steps, first one is content detection and other is cropping. Ling et al. [7] used a saliency map for delineate important contents of an image. To meliorate the result of automatic thumbnail cropping, they consider the face detection as a image semantic. This method is considerably more recognizable than the original cropping method, but due to dependability on the detection algorithm it often produces inaccurate results.

Wang et al. [8] devised auto cropping as an optimization problem. Using composition submodel, conservative submodel, and penalty submodel they determined an objective function. Then to get an optimal solution they used particle swarm optimization (PSO) by maximizing the objective function. So, the optimum result was obtained for digital photographs. According to the belief map, Luo [9] maximized the subject content, and developed an efficient global search algorithm using the concept of the integral image to locate the best cropping window which satisfies multiple constraints. These automatic photo cropping techniques search for significant regions from the original photo. However, not taking invoice of the quality of the cropped region, these methods are always disagreeable to users.

2.4 Warping

The warping method can be defined by the warping function, which maps positions in a source image to positions in a target image. The warping function is nonlinear and shows different enlargements in different parts of the image. The warping resizing method underlines the ROI and does not discard other parts of the image completely.

Liu and Gleicher [10] proposed automatic image resizing with fisheye-view warping for emphasizing the important parts of an image and to retain surrounding context. Firstly, select ROI, and then used a nonlinear fisheye-view warping to warp the rest of the image. This method could keep commanded details and necessary contexts, but it conceives only a single ROI. They cannot handle more than one ROI’s of an single image. Bao and Li [11] sampled mesh vertices according to the saliency map, and used different quadratic error metrics including shape, orientation, and scale distortion to measure distortion. By employing a patch-linking scheme, the global visual effect could be better.
Joo et al. [12] proposed image resizing system based on the frequency domain analysis. They used gradient and saliency information to construct an importance map, and partitioned image pixels into several strips according to similar importance levels. Then, they adaptively scaled each strip to minimize the whole image distortion. Computational complexity of these methods is lower.

### 3. IMPLEMENTATION DETAILS

In this section, the Seam Carving based Image Resizing system is represented in the form of work flow structure illustrated in Fig 1.

**Figure 1.** Flow of proposed Image Resizing system

In this proposed method, the first step is Feature Extraction, to extract the features from an input image. After feature extraction stage, Object Detection. In object detection step to detect the objects based on features. The applied features are brightness, color, and texture. In Saliency Detection to compute the degree of standing out or saliency of each pixel. The saliency of an item be it an object, a person, a pixel, is the state or quality by which it stands out relative to its neighbors with respect to its neighbourhood in terms of its color and lightness properties.

Seam carving is one of the image processing operator for content aware image resizing. A seam is defined as an optimal 8-connected path of low energy pixels crossing the image from top to bottom, or left to right. The grandness of a pixel is defined by an energy function based on the image gradient. Seam carving is an algorithm for image resizing, also known as image retargeting, content-aware image resizing. The aim of the algorithm is to display images without distortion on various media using document standards.

Seam carving and Object carving both can be used for image resizing system. In seam carving process, energy seams are cut down and in Object carving objects are removed based on visual importance of an object. The objects which are brighter are considered as important and less brighter objects are removed during resizing process.

3.1 Proposed system has following phases:

3.2.1 Preprocessing
In this phase, the original image is taken from dataset and the total number of pixels present in an image is counted.

3.2.2 Feature Extraction
In this phase, the features which are present from an input image are extracted.

3.2.3 Object Detection
In this Object Detection phase, it detects the objects from an input image.

3.2.4 Saliency Detection
In Saliency Detection to compute the degree of standing out or saliency of each pixel. A new IIM and a seam criterion is based on the fact that the human visual system (HVS) realizes a scene efficiently only with edge gist, the HOS in diffusion space is used to detect salient edges. The method is successful in detecting salient edges and suppressing high energy falsely generated in the background. Cheered by this, used the HOS in cartoon component of an image to detect salient edges. The cartoon part comprises the smooth area and large scale edges of the image while the texture part contains textures, small scale details and possible noise. The main structure of salient objects is generally contained in the cartoon part and detecting the salient edges in this part can avoid influence of small scales in backgrounds, then
construct a window to detect the salient region and define a distance dependent weight to modify the HOS. The weighted HOS is used to define IIM. The weight verifies importance of the non salient region and makes seams pass through it. This helps to preserve salient objects. A new seam criterion which introduces the least change of energy in seam carving. The criterion tends to make the seam spread uniformly in the non salient region and avoid distortion in large scale structure.

3.2.5 Seam Carving

In this phase, the low energy pixels crossing the image from top to bottom, or left to right are found using energy function and carving of the low energy pixels from an image in the process of resizing are performed.

4. RESULTS

The proposed system defines basic Image Resizing System which is based on seam carving approach. The input image is resized using energy function. The data set is generated by collecting different sized images that are freely available online. Currently the system is using 100 images.

The Fig. 2 shows the Feature Extraction of an image and returns the total count of number of features extracted. In Fig. 3 shows the original image and resized image by using seam carving approach and Fig. 4 shows comparative result with existing seam carving method. The x-axis contains number of images, and y-axis corresponds to the number of persons in percent are satisfied with results. After observation of result shows that more number of persons are satisfied with results of proposed system than existing system.

![Figure 2. Feature Extraction of an image](image1)

![Figure 2. Final Result](image2)
The Image resizing has been one of most important research topics in recent years. In this paper, a novel method based on supervised learning has been proposed for image resizing. The boundary model discovers a rule of combining image features such as brightness, color, and texture by a logistic regression algorithm. Beneath this model, the learned boundary acts as the prior information to guide the process of resizing. Therefore, the significant regions and the structural consistency of the input image can be preserved when the image is resized into the target size. Though we formulate the proposed method in the context of seam carving, our method can be readily extended for Thumbnail images. In this situation, the learned boundary can process as an implication of the ROI. As for the segmentation based or cropping based methods, the extension is similar because they all need a accurate indication of ROI and the learned boundary can fulfill this task. However, we include that there might be other high level clues that can be incorporated into the resizing procedure. The key problem is to preserve the most attractive regions and useful information, minimize visual distortion, achieve real-time resizing, and satisfy user preferences under the constraint of topological relations and the global context.

REFERENCES

AUTHORS

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