Survey on Image Resizing Techniques

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Abstract: ***Image Processing is an important technology for processing on images. The analysis and manipulation of a digitized image and improves its quality. Processing offers a number of techniques for process on image such as Image Resizing, Image Enhancement etc. Image resizing is a key technique for displaying images on different devices, and it has attracted much attention in the past few years. This paper surveys the image resizing methods proposed in recent years, they Defines preserving an important region of an image, minimizing distortions, and improving efficiency. Image Resizing can be more effectively achieved with a better understanding of image semantics. Content-aware image resizing has been a promising theme in the communities of image processing and computer vision. Furthermore, this paper discusses the research trends and points about this field. We believe this survey can give some guidance for researchers from relevant research areas.***

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

1. Introduction

Now a days speedy development of Internet technologies and different multimedia technologies, numerous images are available on Internet and that can be frequently used by no of people's. Increasing use of spacious variety of display devices such as computer's, Mobile phone's, Television's. So, all of them are having trenchant sizes and aspect ratios. If the resultant images are not fitted to the aspect ratios of an display device then the image has been distorted and this leads to be poor visual interpretation. To overcome this, the images are expected to automatically adopted different display devices. Image Resizing is important for displaying visual media at different resolutions and aspect ratios. Image Resizing can be more effectively achieved with better understanding of image semantics. There are some traditional solutions for image resizing such as traditional scaling and cropping both solutions are simple and easy to implement but they are having some drawbacks. They make modifications without requiring the preservation of semantic information, accordingly resulting in evident artifacts such as oversqueeze, boundary breaking and content loss. So, the both solutions are not well applicable for display devices with different aspect ratios. To overcome this challenge, the idea of object carving is proposed. Then the content aware image resizing technique has attracted much attention in the communities of computer graphics and image processing.[1]

The diversity of image consumption conditions introduces a new problem: images must be resized for optimal display or use in different applications. This is also known as image retargeting or image resizing, consists of modifying the image's aspect ratio and size in order to best satisfy the new requirements. However, straightforward image resizing operators, such as scaling, often do not produce satisfactory results, since they are oblivious to image content. To overcome this limitation, classes of techniques attempt to resize the images in a content-aware fashion, i.e., taking the image content into consideration to preserve important regions and minimize distortions. This is a challenging problem, as it requires preserving the relevant information while maintaining an aesthetically pleasing image for the user.

The content-aware methods contain two steps: Saliency measures and resizing images using resizing operator. The purpose of writing this paper is to provide a literature review in this area of image resizing. Section II introduces the Literature review on Image Resizing techniques. Section III introduces Literature review on Object Carving.

2. Literature Survey on Image Resizing Techniques

Seam carving, warping, multi operator, and some other methods. Intelligent cropping, seam carving, warping, and multi operator resizing are corresponding to content aware resizing methods. In this section we describe the basic theories of above methods and some new methods in recent years.Content-aware image resizing is important for displaying media at different resolutions and aspect ratios. Numerous approaches attempt to eliminate the unimportant information from the image periphery [2]. The image is cropped to fit the target aspect ratio and then uniformly resized by traditional interpolation. Setlur et al. [3] resized the background of an image and reinserted the important regions. Seam carving (SC) methods have been proposed to retain important contents while reducing or removing other image areas. These techniques reduce or expand regions that are scattered throughout the image by removing or duplicating monotonic pixel-wide low-energy seams. Continuous resizing methods have been realized through image warping. To minimize the resulting distortion, the local regions are squeezed or stretched by globally optimizing warping functions. Multi-Op resizing methods combine different operators in an optimal manner [4]. Such operators include homogeneous scaling, cropping, seam carving, and warping. All these methods easily result in

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noticeable distortions, such as breaking and over squeezing, when the image is dramatically resized or if the homogeneous regions are exhausted.

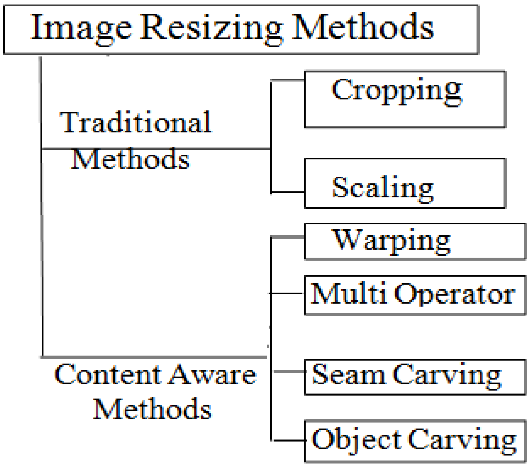

Figure 1: Taxonomy of Image Resizing methods

2.1 Scaling

The Scaling is defined by a homogeneous map between pixels of the original image and pixels of the target image. The most common approach for scaling adopts the interpolation of original image pixels. Nearest neighbor interpolation, bilinear interpolation, and bi-cubic interpolation are the three most commonly used interpolation methods. Image scaling can be performed in real time and the global visual effects can be preserved when interpolation methods are employed. However, these interpolation scaling methods can bring artifacts, such as an artificial block and aliasing. Scaling causes obvious distortion if the aspect ratio of the input image is obviously different from that of the output image.

2.2 Cropping

The cropping method extracts a rectangular window with a desired size from the original image. The content within the window is kept and others are discarded. The traditional cropping method simply crops a cropping rectangle from the center of the image as its output resizing result. This method is very simple. However, it has a limitation of losing those important contents lying on the periphery of an image. So, the effect is seriously damaged.

A user can draw a rectangle around the image content which he want to extract so, using this direct method it helps to preserve important content of an image. But there is problem, it is time-consuming and burdensome. So, to overcome the above problem content-aware intelligent cropping method is proposed. The intelligent cropping method contains two steps, i.e., main content detection and cropping. Suh et al. [5] used a saliency map for define important contents of an image. To improve the result of automatic thumbnail cropping they consider the face detection as a image semantic. This method is substantially more recognizable than the original cropping method, but due to dependability on the detection algorithm it often produces inaccurate results.

Chen et al. [6] introduced an image attention model. An image attention model can be based on three attributes, that is, region of interest (ROI), attention value (AV), and minimal perceptible size (MPS). An attention object (AO) often represents a semantic object, such as a human face and a text sentence. Three attention models (saliency, face, and text) were used to calculate their attention values respectively. They classified an image into five different categories. Then different rules were used to adjust the AV weights for different classes. They developed a new algorithm for finding efficient optimal adaptation namely, branch-and-bound. However, this method relies on the semantic extraction techniques. If the corresponding semantic technique is absent, it is difficult to obtain a good result.

Zhang et al. [7] invented auto cropping as an optimization problem. Using composition submodel, conservative submodel, and penalty submodel they defined an objective function. Then to obtain an optimal solution they utilized particle swarm optimization (PSO) by maximizing the objective function. So, the optimal result was obtained for digital photographs. According to the belief map, Luo [8] 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 important regions from the original photo. However, not taking account of the quality of the cropped region, these methods are always disagreeable to users. Tang et al. [9] presented content-based photo quality assessment using both regional and global features. All the above-mentioned methods achieve impressive results, but they rely on traditional image cropping operations, which may lose some interesting information of images if the output resolution is significantly lower than the input resolution.

2.3 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 magnifications in different parts of the image. The warping resizing method emphasizes 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, they select ROI, and then used a nonlinear fisheye-view warping to warp the rest of the image. This method could maintain required details and necessary contexts, but it conceives only a single ROI. They cannot handle multiple ROI's of an single image. To solve an image with multiple ROIs, Zhang et al. [11] presented image resizing with a multi-focus fisheye transformation. They designed three fisheye transformation methods and their corresponding implemented multi-focus conflict solution schemes. Because this method locates the focus areas clearly, it could not solve images without obvious focus areas. Wang and Abdel-Dayem [12] applied non-uniform scaling to a content-aware image resizing system which preserves important regions and minimizes distortions. They adopted a gradient map, content-

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aware saliency detection, and face detection to construct the importance map. Image warping has been proposed to resize images non. Gal et al. [13] warped an image into arbitrary shape and preserved user-specified features. They used the Laplacian editing optimization to accommodate similarity constraints. By an inhomogeneous 2D texture mapping method they preserved the shape of masked regions and warped the rest of the image. These methods attempts to keep prominent regions as they are while distorting only homogeneous regions. However, homogeneous regions would have obvious distortion with the resizing direction. Instead of strengthening the salient image unchanged, Wang et al.

To preserve the global image configuration, non homogeneous mesh warping methods were proposed. Bao and Li [14] sampled mesh vertices according to the saliency map, and used different quadratic error metrics including shape, orientation, and scale distortion to measure distortion. By applying a patch-linking scheme, the global visual effect could be better preserved. Niu et al. [15] also applied a nonhomogeneous warping resizing method. They defined quadratic metrics to measure image distortion and introduced a patch-linking scheme. This method solves the energy minimization problem for the resizing mesh, which could better preserve the global image configuration. However, this method would be ineffective as an image is full of salient features. Image warping methods place a grid mesh on an image, and optimize its geometry for a desired scale. These methods usually need to solve large linear systems, so they are time-consuming. To improve efficiency, researchers proposed some improved methods. Kim et al. [16] proposed image resizing based on Fourier analysis. They used gradient information to divide the input image into several strips, and then scaled each strip adaptively as a constrained optimization problem, which could be solved by using the Lagrangian multiplier technique. Similarly, Kim et al. [17] proposed image resizing 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.

2.4 Seam Carving

Seam carving is an image processing operator for content-aware image resizing including reduction and expansion. 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 importance of a pixel is defined by an energy function based on the image gradient.[18]

2.5 Multi-operator

No single resizing operator is proved to be optimal for all images, so some researchers proposed multi-operator methods, which will potentially give better results for the resizing image. These multi operator methods benefit from the advantages of each technique, and avoid the shortcomings of these operators.

Before the multi-operator was put forward, some researchers have been combining multiple operators for image resizing. Hwang and Chien [19] proposed perceptual seam carving by using face and saliency maps to obtain a more accurate energy function according to the human attention model. When the average of the minimum-energy seam is greater than the threshold, seam carving degenerates to traditional resampling. Han et al [20] improved seam carving by exploiting a wavelet-based energy function to preserve content and shape. When the difference in energy is larger than the experimental threshold, seam carving is switched to scaling to resize the rest of the image. Kumar et al. [21] proposed a distortion-sensitive seam carving algorithm. They applied the seam carving method by using local gradient information to select the seam, and replaced the seam carving method with some other algorithms when they reach the stopping criteria. Resampling or cropping was used instead of seam carving for the rest of the image. These methods could avoid distortion caused by seam carving excessively. Transition methods between these operators could be viewed as preliminary ideas of the multi-operator method. Rubinstein et al. [22] proposed multi-operator media resizing. They combined several resizing operators, such as cropping, scaling, and seam carving to define a resizing space as a conceptual multi-dimensional space by using a dynamic programming algorithm to look for the best (or optimal) path in this space. Bi-directional warping (BDW) was used as a global similarity measure to compare and evaluate different resizing results between the source and target images. The multi-operator methods avoid the drawbacks of a single operator, i.e., removing too much important information about cropping, distorting many structured media of scaling, and inserting artifacts of seam carving in some cases. However, this algorithm has high complexity and does not always agree with users' preference. Above-mentioned multi-operator methods are time consuming and do not consider users' preferences. So, Dong et al. [23] proposed fast and interactive multi-operator image resizing. They used the image energy function and dominant color descriptor to formulate operator cost functions. To meet users' preferences, they used a coefficient to revise the operator costs. Also, they designed an interactive multi-operator image resizing framework to integrate users' real visual preferences tightly. However, this method might damage the global spatial structure of the image. Dong et al. [24] proposed summarization based image resizing by intelligent object carving on the basis of a multi-operator framework, which could handle similar objects in scenes.

3. Related Work of Object Carving

W.Dong et al.[1] have addressed the problem of image resizing. They have developed new techniques applicable for Image Resizing. In real world there are many similar pattern images are exist. By using Object Carving technique that are analysed. In object Carving interactively detects similar objects in an image. The image content can be summarized rather than simply cropped. This method enables the manipulation of image pixels or patches as well as semantic objects in the scene during image resizing process.

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In Object Carving Method it firstly detects similar objects from an image. These objects might be overlapped, distorted. After detecting an object extracts the shape and color information from an image. They have employed a robust template matching method to locate all instances. The method with a joint matching metric of shape and color details, it can accurately detect and cut out similar objects from a single image. The algorithm is directly applied to the original image without any segmentation. In this system summarization operator based on object carving is designed as an enhancement which can coordinate with other resizing algorithms to reduce artifacts and salience distortions in results.

3.1 Salient Object Detection

Ali Borji et al. [25] introduced Detection and Segmentation of salient objects in natural scenes, it is also known as salient object detection, it has attracted a lot of focused research in computer vision and has resulted in many applications. However, while many such models exist, a deep understanding of achievements and issues is lacking. It aims to provide a comprehensive review of the recent progress in the field of object detection. They situate salient object detection among other closely related areas such as generic scene segmentation, object proposal generation, and saliency for fixation prediction.

3.2 Repfinder: Finding Approximately Repeated Scene Elements for Image Editing

Repeated elements are ubiquitous and abundant in both manmade and natural scenes. Editing such images while preserving the repetitions and their relations is nontrivial due to overlap, missing parts, deformation across instances, illumination variation, etc. Manually enforcing such relations is laborious and error-prone. M Cheng et al. [26] propose a novel framework where user scribbles are used to guide detection and extraction of such repeated elements. The detection process, which is based on a novel boundary band method, robustly extracts the repetitions along with their deformations. The algorithm only considers the shape of the elements, and ignores similarity based on color, texture, etc. Then they use topological sorting to establish a partial depth ordering of overlapping repeated instances. Missing parts on occluded instances are completed using information from other instances. The extracted repeated instances can then be seamlessly edited and manipulated for a variety of high level tasks that are otherwise difficult to perform. They demonstrate the versatility of framework on a large set of inputs of varying complexity, showing applications to image rearrangement, edit transfer, deformation propagation, and instance replacement.

3.3 Fast Multi-Operator Image Resizing

Current multi-operator image resizing methods that succeed in generating impressive results by using image similarity measure to guide the resizing process. They found an optimal operation path in the resizing space. But their slow resizing speed caused by inefficient computation strategy of the bidirectional patch matching becomes a drawback in practical use. Wei-Ming Dong et al. [4] presents a novel method to address above mentioned problem. By combining seam carving with scaling and cropping, it can realize content-aware image resizing very fast. They define cost functions combing image energy and dominant color descriptor for all the operators to evaluate the damage to both local image content and global visual effect. The algorithm can automatically find an optimal sequence of operations to resize the image by using dynamic programming or greedy algorithm. They extend algorithm to indirect image resizing which can protect the aspect ratio of the dominant object in an image.

3.4 Image Summarization

Denis Simakov et al. [27] propose a principled approach to summarization of visual data based on optimization of a well-defined similarity measure. The problem we consider is re-targeting of image data into smaller sizes. They propose a bi-directional similarity measure which quantitatively captures these two requirements: Two signals S and T are considered visually similar if all patches of S (at multiple scales) are contained in T, and vice versa. The problem of summarization or re-targeting is posed as an optimization problem of this bi-directional similarity measure.

3.5 Paint Selection

Jiangyu Liu et al. [28] presents Paint Selection, a progressive painting-based tool for local selection in images. Paint Selection facilitates users to progressively make a selection by roughly painting the object of interest using a brush. More importantly, Paint Selection is efficient enough that instant feedback can be provided to users as they drag the mouse. They establish high quality selections can be quickly and effectively "painted" on a variety of multi-mega pixel images.

4. Conclusion

The Image resizing has been one of most important research topics in recent years. In this paper, we summarize some existing methods for image resizing. Focus on content-based Object Carving, seam carving, warping, and multi-operator methods. Information loss is inevitable in the process of image resizing. 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.

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