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Scale and Object Aware Image Thumbnailing

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Abstract In this paper we study effective approaches to create thumbnails from input images. Since a thumbnail will eventually be presented to and perceived by a human visual system, a thumbnailing algorithm should consider several important issues in the process including thumbnail scale, object completeness and local structure smoothness. To address these issues, we propose a new thumbnailing framework named scale and object aware thumbnailing (SOAT), which contains two components focusing respectively on saliency measure and thumbnail warping/cropping. The first component, named scale and object aware saliency (SOAS), models the human perception of thumbnails using visual acuity theory, which takes thumbnail scale into consideration. In addition, the "objectness" measurement (Alexe et al. 2012) is integrated in SOAS, as to preserve object completeness. The second component uses SOAS to guide the thumbnailing based on either retargeting or cropping. The retargeting version uses the thin-plate-spline (TPS) warping for preserving structure smoothness. An extended seam carving algorithm is developed to sample control points used for TPS model estimation. The cropping version searches a cropping window that balances the spatial efficiency and SOAS-based content preservation. The proposed algorithms were evaluated in three experiments: a quantitative user study to evaluate thumbnail browsing efficiency, a quantitative user study for subject preference, and a qualitative study on the RetargetMe dataset. In all studies, SOAT demonstrated promising performances in comparison with state-of-the-art algorithms.

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1 Introduction

With the increasing popularity of image capturing and displaying devices, effective ways for presenting and browsing image datasets are drawing a significant amount of new research attention. In image browsing, tiny thumbnails provide the basic function for a user to quickly explore an image dataset visually, such as personal photo albums or scientific image collections. In this paper we use the term *image thumbnailing* to indicate the process of creating a thumbnail from an input image. A straightforward thumbnailing approach is to simply shrink the original image. Such a solution, despite being widely used in image browsing and management systems, has been shown to be less effective than smarter solutions such as thumbnail cropping (Chen et al. 2003; Lam and Baudisch 2005; Suh et al. 2003) and retargeting (Liu and Gleicher 2005; Avidan and Shamir 2007). This is particularly true for tiny thumbnails displayed on devices with small sized screens just as a smart phone.

Thumbnailing can be viewed as a special case of image resizing, where the basic philosophy is to preserve important content as much as possible while changing the image size. Many image resizing methods generate aesthetically impressive results when the target image size is comparable to size of the original image (Rubinstein et al. 2010b). By contrast, insufficient attention has been paid to image thumbnailing scenarios where the target image is much smaller than the input one. Several important issues need to be addressed by an effective thumbnailing algorithm: