Automatic extraction of semantic object in image using local brightness variances

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Abstract

This paper deals with the problem of segmenting semantic object in an image. Fully automatic solution of this problem is not possible, but human intervention is needed for outlining the rough boundary of the semantic object to be segmented. Our goal is to make the object extraction automatic after the first semi-automatic segmentation. To achieve our goal, we manipulate the contrast of the object and the background such that any contrast-based object segmentation method can extract the object automatically.

1. Introduction

Extracting semantic objects in image and video is considered as an essential preprocessing for image and video recognition problems. However, with current computing technologies, the fully automatic semantic object segmentation is not possible. Therefore, user assistance is needed somewhere during the segmentation process of a semantic object. That is, whenever we want to extract semantic objects from the video, we need a time-consuming and inconvenient user intervention for roughly outlining the object boundary. To facilitate the semi-automatic process, there have been some efforts to minimize and simplify the human interactions [1][2].

In this paper, we propose a method, which requires the human intervention only once. That is, we just need the very first semi-automatic image segmentation and, after the first segmentation, the object extraction for the image can be done automatically without human intervention. The basic idea is to manipulate the object and the background brightness obtained from the first semi-automatic segmentation such that the object can be separated by the local variance information from the background automatically. This image is called the contrast manipulated image or the automatic-object-extractible image. Now, given the contrast-manipulated image, we can apply the automatic object segmentation proposed for the low depth-of-field (LDOF) images [3][4] to extract the object automatically.

2. Proposed Method

The overall block-diagram for the proposed semantic object segmentation method is depicted in Figure 1 and 2. As shown in Figure 1, given the original image, we first execute a semi-automatic image segmentation method with user assistance [1][2]. This can be done by drawing a rough boundary of the object [1] or by selecting key contour points of the object boundary [2]. Then, the pixel-wise accurate object boundary can be obtained automatically by using a boundary refining method such as the watershed algorithm. After the semi-automatic object segmentation, the extracted object is manipulated by a contrast enhancing method such as the unsharp-masking method and the background is blurred by a contrast suppression method such as the Guassian-blurring. Of course, these contrast manipulations should be done such that the image alterations should be unnoticeable by human vision. Then, the contrast-manipulated object and background are combined together to have an automatic-object-extractible image. This is stored to be used later for the automatic object extractions.

Given the automatic-object-extractible image, we can now extract the object from the background without human intervention. To do that, we first need to calculate the local variances for all pixels. The local-variance-image-field (LVIF) [3] normalized by the maximum local variance can highlight the image areas with high local variances. For example, the LVIF image in Figure 2 clearly identifies the contrast-enhanced object (face) in the image. To automatically extract the object, we can use the segmentation

methods proposed for the LDOF images [3][4]. Even a simple circle drawing method at the center of gravity of the local variances can give a rough region of the object.

3. Experiments

An example of the experimental results is shown in Figure 3. For an original image in Figure 3-(a), the face region is extracted by hand. One can use the semi-automatic segmentation algorithms or the commercial image processing software tools such as the photo shop for the face extraction. Then, the contrast of the face region is enhanced and that of the background is suppressed (Figure 3-(b)). Finally, from the LVIF (Figure 3-(c)), the object region can be simply extracted by drawing a circle at the spatial center of the highest local contrasts (Figure 3-(d)).

4. Conclusions

In this paper, we introduce a novel approach for the automatic object segmentation. By manipulating the contrast of the object and the background of the image, we can automatically extract the semantic object without human assistance thereafter. The proposed method can be used for object-based image editing and the content-based image retrieval problems. The future works include the extension of the proposed object segmentation to the video data and the systematic contrast-manipulation method of the object and the background.

5. References

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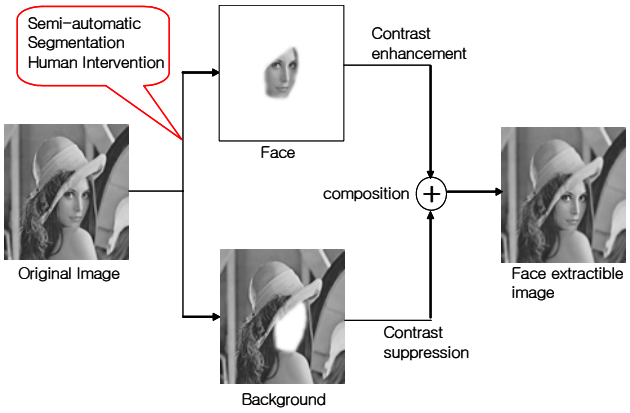

Figure 1. Semi-automatic object (face) extraction and contrast manipulation.

Figure 2. Automatic object (face) extraction for the contrast enhanced image.

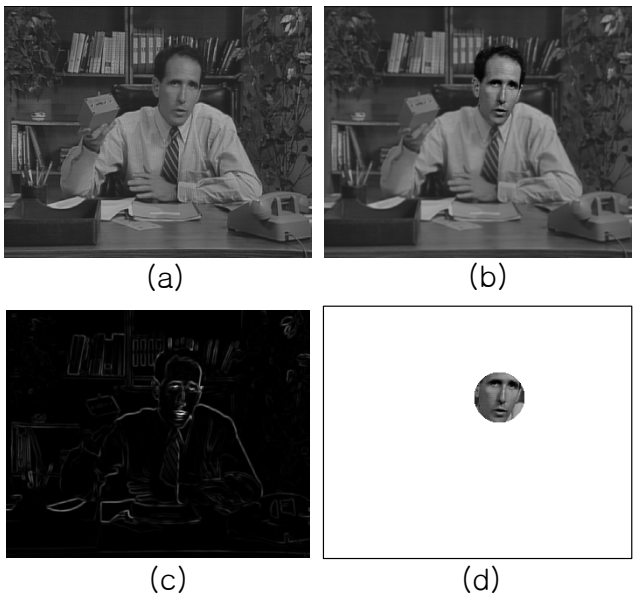

Figure 3. Example of face extraction: (a) Original image, (b) Contrast-manipulated image, (c) Local variance image field, (d) Automatic face extraction (a circular method).