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To a Better Digitalization and Visualization of Frontal Face Photographs

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Over time human identity photograph may become noisy for digitalization due to its low original resolution, poor quality of the photographic paper and the addition of artifacts on it such as stamps. This article describes a framework based on filtering, segmentation, binarization and inpainting methods to eliminate small stamps artificially added on frontal face images, improving the digitalization and visualization of the original photos. The framework uses information about the relative size of the stamp on the image and its colour to eliminate such artifact and reconstruct the face image.

Introduction

Human face photographs may lose its quality over time owing to natural and artificial artifacts. Although nowadays photographs are image-based rather than paper-based, in some situations such as in the cases of missing children or adults, especially in developing countries, the only well-framed information available to recognize the subjects is the one present on an old identity document where the frontal face is described with poor quality. In this work, we describe an algorithm that essentially identifies and eliminates small notes, stamps or messages on a frontal face photo improving its quality for further automatic recognition.

Methodology

The methodology has been developed using the following Computer Vision techniques:

Mathematical Morphology: Small stamps represented as texts, messages or words can be considered as dark regions that are commonly smaller in size than other dark regions present on the face images such as hair, eyes, and shadow. To eliminate all the small dark regions on the face images used in this work, the dilation and erosion morphological operators have been applied on the original colour images with cross structuring element and one interaction only, as illustrated in Figure 1(b).

Mask Image Definition: Segmentation can be performed as a union operation of the dilation, erosion and binarization image processing techniques [1]. The dilated image is binarized to separate the regions that must be eliminated from the ones that should be retained. This image is converted to 8 bits to become an image mask. This mask contains the information that defines the regions of each image to be reconstructed in the next inpainting [2] step, as shown in Figure 1(d).

Reconstruction: The inpainting method [2] aims to delete defects, reconstruct damaged parts of the image and remove unwanted ones, such as the stamps artificially written on the images. Since the large dark regions are removed by the inpainting method, only the average and small dark regions remain on the images, as illustrated in Figure 1(e).

Software

The computational tool is composed of the following image processing operations: thresholding, colour conversion, inpainting and morphological operations (dilation and erosion). It has been programmed using C++ language and the OpenCV library from Intel. Figure 1 shows a step-by-step example of the image processing operations performed by the software.

(a) (b) (c) (d) (e) (f) (g)

Figure 1: A step-by-step example of the software: a) Original image; b) Dilation; c) Binarization; d) Mask image definition; e) Inpainting; f) Stamp segmentation; g) Final image.

Results

We evaluated the performance of the proposed methodology using a dataset containing a total of 400 facial images (3x4 photos). Some of these images are obtained from the Missing Children and Adolescents website [3], maintained by the Human Rights Secretary of the Brazilian Government, and others belong to volunteers who agreed to have their face image acquired by a digital camera or lent a 3x4 paper photo to be scanned. Table 1 shows the experimental results achieved by the software.

Results	Image Quantity		Percentage		Variations
	1º Test	2º Test	1º Test	2º Test	
Complete removal without damage	181	326	90,5 %	81,5 %	9 %
Damaged images	15	62	7,5 %	15,5 %	8 %
Artifact (stamp) not eliminated	4	12	2,0 %	3 %	1 %

Table 1: Experimental results.

The first test set is composed of 200 facial images and the second test set is composed of the same 200 facial images of the first test set plus 200 new face images with smaller size. The variations on the results are explained by the fact that the algorithm proposed tends to perform better on photographs where the differences in size between small dark areas that describe discriminant (i.e., eyes) and noisy (i.e., stamps) information are evident.

Conclusion

In this work, we described an image processing algorithm that identifies and eliminates automatically small dark artifacts, such as stamps, on frontal face photos. The proposed methodology identifies the stamps based on the relative size and colour information of each face image, without the use of any specific prior knowledge or general image models. The results are promising, showing a success rate of 90.5% in removing completely small dark artifacts on the face photographs used.

References

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