문서 영상의 전반사 영역 보정 기법

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Correction of Specular Region on Document Images

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Abstract

The quality of document images captured by digital camera might be degraded because of non-uniform illumination condition. The high illumination (glare distortion) affects on the contrast condition of the document images. This condition leads to the poor contrast condition of the text in document image. So, optical character recognition (OCR) system might hardly recognize text in the high illuminated area. The method to increase the contrast condition between text (foreground) and background in high illuminated area is proposed in this paper.

1. Introduction

Contrast enhancement plays an important role in OCR system. Document images captured with non-uniform illumination (non-uniform contrast/brightness) can degrade the quality of image and recognized characters by OCR system. The area covered by high illumination usually has low contrast between background and text. Fig. 1 shows the example of images with high and low contrast. This problem usually appears when document image is capturing from glossy document such as magazine.

(a) (b)

Fig. 1. (a) Text area with glare distortion (low contrast); (b) Text area with normal contrast.

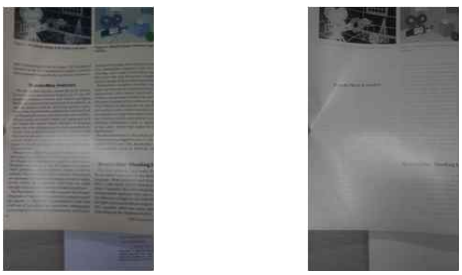
The binarization result for low contrast region might have some inaccurate separation between text and background. To overcome this problem, a method to increase the contrast between text and background area is proposed.

2. Proposed Method

The proposed method for specular region correction is explained in the following section: background extraction, subtraction, hole-filling, noise removal, and reconstruction. These sections are described as follows.

2.1. Background extraction

The background image is extracted by using the dilation process. The pixels in text area in the image is replaced by pixels in background area after dilation process. The dilation process selects maximum value in 3x3 blocks, then all values in the block are replaced by that maximum value. The result in this step is shown in Fig. 2.



(a) (b)

Fig. 2. (a) Input image; (b) Image after background extraction.

2.2. Subtraction

Subtraction is the process of extracting candidate image which represents the text area. The input image is subtracted by image after background extraction. After subtraction process, it forms a candidate image that is used for increasing contrast later. The candidate image is shown in Fig. 3.

Fig. 3. Image after subtraction (candidate image).

2.3. Hole-filling

Hole-filling is a process to cover the text area which is not covered by dilation process. Firstly, adaptive thresholding [3] is done to get the text area to be filled. After that, pixels in text area of thresholded image are filled with maximum value (255) to candidate image. The result in this section is shown in Fig. 4(b).

(a) (b)

Fig. 4. (a) Candidate image and its zoomed image; (b) Candidate image after hole-filling technique and its zoomed image.

2.4. Noise Removal

The candidate image might contain some noise. Therefore, it is needed noise removal algorithm to remove the noise. In this section, the algorithm based on local contrast algorithm is explained to reduce the noise appearance in the output image.

$$LC = \frac{I_{max} - I_{min}}{I_{max} + I_{min}} \quad (1)$$

Local contrast (LC) is calculated by finding maximum and minimum value in 3x3 blocks in input image. The equation of LC is shown in (1). Then, the average value of local contrast from all pixels is computed. Pixels in candidate image which have local contrast less than α×average will be set to zero (in this experiment α=1/3). Noise removed hole-filled image is shown in Fig. 2(b).

2.5. Reconstruction

Finally, the input image is subtracted by the noise removed hole-filled image. The final output image is shown in Fig. 5(c).

3. Result

Fig. 6 shows the results of the proposed method. The left side is original image and the right side is result image. It is noted that the proposed approach can improve the quality of the text.

(a) (b) (c)

Fig. 5. Input image is subtracted with noise removed hole-filled image. (a) Input image; (b) Noise removed hole-filled image; (c) Result image.

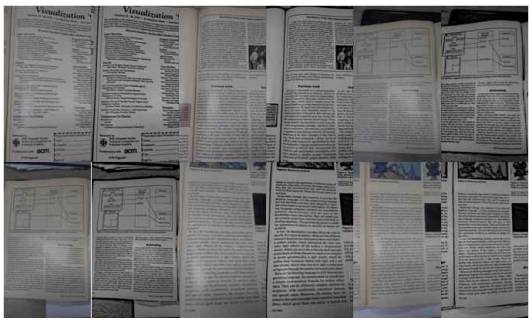


Fig. 6. Results of the proposed method.

4. Conclusion

In this paper, we proposed a method to increase the contrast between text and background area from document images. This method enhances contrast between text and background by subtracting input image with candidate image (foreground image).

Acknowledgement

This work was supported by Samsung Electronics.

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