모니터 문서 영상의 모아레 잡음 제거

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Moire Noise Removal from Document Images on Electronic Monitor

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Abstract

The quality of document image captured from electronic display might be worse when it is compared with document image captured from paper. The problem appears because of Moiré noise. This problem can lead to achieve inaccurate intermediate result for further image processing. This paper proposes a method to remove Moiré noise of document images captured from electronic display. The proposed algorithm is separated in two parts. In the first step, it corrects the text area region (foreground) with small area of smoothing. Then, it corrects the background area with large area of smoothing.

1. Introduction

Document image is usually corrupted by noise when it is captured by digital camera (i. e. captured from electronic display). Noise in image captured from electronic display is known as Moiré noise. It might degrade the quality of characters because of the bad sampling of the image captured from electronic display [1].

Optical Character Recognition(OCR) system scans the document image to get information about specific characters, words, or sentences. However, the characters in document image captured using camera from electronic display might have some noise that disturbs OCR system to read accurately.

In this paper, a method to improve the quality of document images suffered from Moiré noise is proposed. The proposed method is divided into two parts to create smooth and anti-aliased edges around the region. The first part is smoothing around the text region and the other part is smoothing the background image.

2. Proposed Method

The proposed method to remove Moiré noise consists of several steps as shown in Fig. 1. As a preprocessing, smoothing the input image by 3x3 Gaussian filter is required.

2.1 Foreground Extraction

In foreground extraction, first binary image of the image

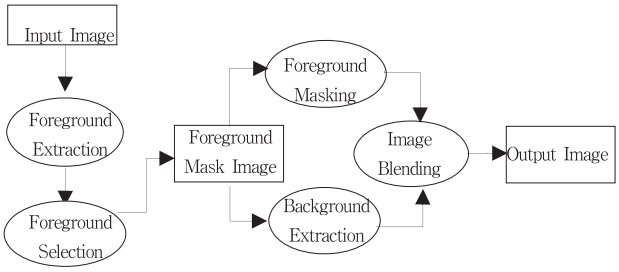


Fig. 1. The diagram of the proposed method.

foreground (Fig. 2(a)) is extracted using adaptive threshold [2]. Then, noise pattern is eliminated using run length histogram technique horizontally and vertically. Strokes that has value less than or equal to the highest peak in the run length histogram are eliminated [8]. The output of this step is shown in Fig. 2(b).

2.2 Foreground Selection

Run length histogram technique in some cases might eliminate characters in the text region. Therefore, it is needed to check whether the run length histogram technique operates properly. To check it, the number of eliminated pixels inside the text area and non-text area is calculated. Text area is obtained by using erosion upon image after run length histogram process. The ratio between E_1 as number of eliminated pixels inside text region and E_0 as number of eliminated pixels outside text region is used to calculate the ratio. If ratio E_1/E_0 is more than threshold value

then first binary image is used. Otherwise, the binary image from run length histogram result is utilized as foreground mask image.

$$E_1 = \sum_{i,j\,\epsilon\,inside} [P(i,j) = Pattern] \quad (1)$$

$$E_0 = \sum_{i,j\,\epsilon\,outside} [P(i,j) = Pattern] \quad (2)$$

2.3 Foreground masking

In this step, the result from foreground selection process will be utilized as mask to obtain the text area of final output image. The foreground is retrieved using the mask image and its 8-neighbors from the input image. The final foreground image is shown in Fig. 2(c).

2.4 Background extraction

The foreground mask image is utilized to create the background (without text area) image. The pixels in the input image with the same position with foreground mask image are replaced by the pixel value from their neighbors (outside mask area). After that, background image is formed as shown in Fig. 3(a). The noise in background image is smoothed by mean filtering. The noise, shown in Fig. 3(b), is detected using adaptive thresholding method [2]. The noise, the black pixels in binary image after adaptive thresholding, is not utilized in mean filtering. The final background image is shown in Fig. 3(c).

(a) (b) (c)

Fig. 2. (a)Result of first binary; (b)Result after run length histogram technique(with horizontal and vertical pattern width are 2); (c)Result after masking from input image.

2.5 Image blending

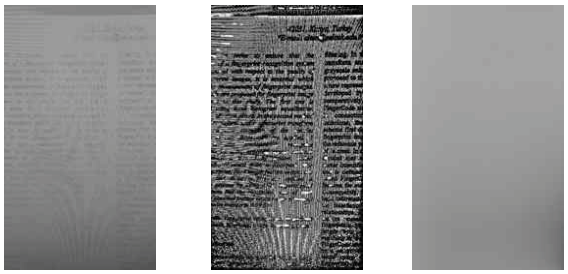
The output image is obtained by blending the final background and foreground image. The final result is in grayscale image.

3. Result

The results of the proposed method are shown in Fig. 4. The left side is original image and the right side is our result image.

4. Conclusion

In this paper, the algorithm to suppress the Moiré noise is proposed. The proposed method does smoothing operation for foreground and background images with different window size. The experimental results show that our proposed method could remove the noise in the input images.



(a) (b) (c)

Fig. 3. (a)Result of background image; (b)Result after adaptive thresholding from background image; (c)Result after mean filter.

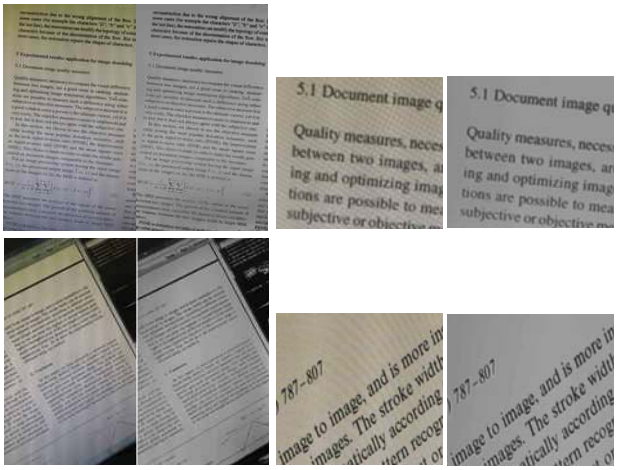


Fig. 4. The result of the proposed method and its zoomed image.

Acknowledgement

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