A Review on Scanned color image improvement using image descreening

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ABSTRACT

To print continuous tone images, Electrophotographic (EP) printer uses halftoning technique. Image halftoning prints the image as matrix of dots which are halftone patterns those are hardly perceived by human eyes. So scanned images obtained from such hard printed copies are normally affected by screen like artifacts and moiré patterns. Scanned color Image improvement using Image descreening technique will be used to descreen color scanned images so as to remove screening patterns and Moiré effects. Technique applied on grayscale images produces clean smooth regions and sharp edges from scanned halftone images. The main purpose of this paper is to study and review different methods used for scanned halftone image descreening for color and grayscale images.

Keywords: Halftoning, descreening, denoising, adaptive filtering

INTRODUCTION

Descreening is a process of removing halftone patters, moiré effects and other screen like artifacts that occur in the scanned images. To print continuous tone images electrophotographic printer uses halftoning technique in case of printing newspapers, books and magazines. Halftoning technique used in Electrophotographic printer converts a high-resolution image to a low-resolution image. Images printed with these devices contain a series of dots arranged in a specific patterns to simulate different shades of gray. This halftoning technique used is called as clustered-dot halftoning technique in which size of the dots is varied according to the gray level value of the underlying grayscale image whereas the frequency of the dots is kept constant. This is called as Amplitude Modulation(AM) technique of halftoning.[2]

There are three different types of halftoning techniques which includes Amplitude Modulation halftoning, Frequency modulation and error diffusion. In Amplitude modulation, as stated above size of the dots is varied whereas frequency of the dots is kept constant. In frequency modulation technique, size of the dots is kept constant usually one pixel thick whereas the frequency of the dots is varied according to the gray level value of the underlying grayscale image. In error diffusion method, quantization error at every pixel is filtered and fed back to the input so as to diffuse the error among neighboring grayscale pixels.

When we scan these images, scanned image contains annoying artifacts such as moiré patterns and halftone patterns. The artifacts are high frequency screen like patterns. They lead to low aesthetic quality and produce Moiré effect in the hard copies if the scanned images are reprinted [3]. To remove this affects we can simply smooth the image using low pass filter but this is not advisable since it blurs the image and smoothes out the edges also. Since halftoning is a process which incurs loss of information inverse process is an ill-posed problem. Inverse halftoning method can be used to reconstruct continuous tone image from halftone image. These methods can obtain continuous tone images with most of the details preserved and sharp edges from binary halftone images but these methods cannot be used to descreen halftone images. This is because these methods have been designed for binary halftone images and scanned halftone images are usually grayscale images.

LITERATURE REVIEW

Siddiqui, H and Bouman, C.A.[3], proposed Training-based descreening method. Color scanned documents can be descreened by using this method whose main goal is to provide robust solution to Moire acute problem in various imaging devices that includes multifunction printers and copiers. The algorithm consists of two nonlinear image-processing techniques, mainly resolution synthesis-based denoising (RSD), and modified smallest univalue segment assimilating nucleus (SUSAN) filtering. RSD predictor is usually based on stochastic image model, in which a separate training procedure is carried out to determine optimized parameters. These optimized parameters are used by RSD to classify local window that surrounds current pixel in the scanned image and applies suitable filter for selected classes. The main strength of RSD lies in the fact that inspite of having strong halftone noise it can correctly identify whether the local window is a part of smooth region or it is a part of an edge of particular orientation. The output of RSD predictor is considered as the first-order estimate to the descreened image. SUSAN filter is a non linear filter which means in this filter output is not a linear function of its input. This filter is used to preserve fine image structure even in the presence of noise. The fine details can be thin lines or sharp corners in the image. SUSAN filter smoothes only those pixels in the local neighbor of the center pixel whose brightness is same as the center pixel. SUSAN filter does not remove halftone noise properly so an improved version of this filter called Modified SUSAN filter is used. This method does not require any prior knowledge of screening method such as screen frequency or dither matrix coefficients. The main advantage of this method is that it does not only removes wide range of clustered dot screen frequencies but also removes error diffusion noise.

A. Jaimes, F. C. Mintzer, A. R. Rao, and G. Thompson [4], proposed Scanned halftone images descreen technique. It first segments a grayscale image document into halftone image areas then detects the presence and frequency of screen patters that appear in halftone areas and finally suppress their detected screens. It is novel techniques that performs fast segmentation -based on α-crossings technique and Fast Accumulator Function detects the screen frequencies and suppresses detected screens by using low-pass filtering. α-crossings technique is used to determine picture and non-picture areas that helps in document segmentation. Here α is threshold which used to determine number of times signal crossing this value and use this as a base to perform segmentation. Fast Accumulator Function is used to detect the frequency of the halftone areas. It uses intensity value of the pixel in the desired area to determine the halftone screen frequency. It is applied separately in the vertical and horizontal area since screen frequency in vertical and horizontal area may differ.

Kyu-Sung Hur, Yeul-Min Baek and Whoi-Yul Kim[5], proposed Histogram of oriented gradients (HOG) descreening technique for scanned halftone images. This method is based on adaptive smoothing filter and it applies HOG for distinguishing edges. The amount of smoothing to be performed on the halftone image is calculated according to the magnitude of the HOG in the edge and edge normal orientation. On applying the above method on the halftone images results found that it removes halftone noise and the moiré pattern effectively while still preserving the image details.

Xiaohua Duan, Guifeng Zheng and Hongyang Chao[6], proposed Adaptive real-time descreening method based on Support Vector Machine (SVM) and modified Smoothing over Univalue Segment Assimilating Nucleus (SUSAN) filter for imaging devices, including scanners and multifunction printers. SVM is used by image classifier to classify the scanned image into either of the three category that is Amplitude modulation, Frequency modulation and continuous tone. Modified SUSAN filter is then used to descreen the scanned halftone image. It considers screen cell size to choose the optimal filter parameters which can preserve more high frequency image detail. Various experimental results show that the algorithm is fully automated and very effective and it also maintains higher image quality.

Siddiqui, H., Boutin, M. and Bouman, C.A.[7], proposed Hardware-friendly descreening technique that removes a wide range of frequencies that tend to produce Moire effects in a scanned document while preserving the image sharpness and edge details. The method uses noniterative, nonlinear and space variant descreening filter for descreening of the scanned halftone images to produce better results. Because of its hardware friendly structure it is low cost method in a real time imaging system. The drawback of this method is that descreening performance is based on a couple of nonlinear polynomial function which are empirically optimized for the target environment.

Jiebo Luo, de Queiroz, Ricardo ; Fan, Z.[8], proposed wavelet-based method to obtain continuous-tone (contone) image from halftone image. A Discrete wavelet transform (DWT) is carried out in order to decompose halftone image into different frequency subbands. We obtain two kinds of subbands namely high frequency subbands and low frequency subbands. A low frequency subbands contain signal energy whereas a high frequency subband contain energy of the halftoning process. Wavelet decomposition employs selective processing in the space as well as frequency domain. By wavelet decomposition we get three different high frequency subband images in diagonal, horizontal and vertical direction respectively. After this, a noise attenuation also called frequency correlation is performed. In this, high frequency subband coefficients are clipped such that their magnitude should not be greater than the weighted magnitude of their parent. Intraband filtering also called as spatial correlation is then performed to reduce halftone noise near edges and to preserve edge details. A L-point filter which is one dimensional low pass filter is applied onto vertical and horizontal subbands and on the diagonal subbands X-shaped lowpass filter is applied. Finally nonlinear post filtering is applied to improve the image obtained from inverse wavelet recomposition.

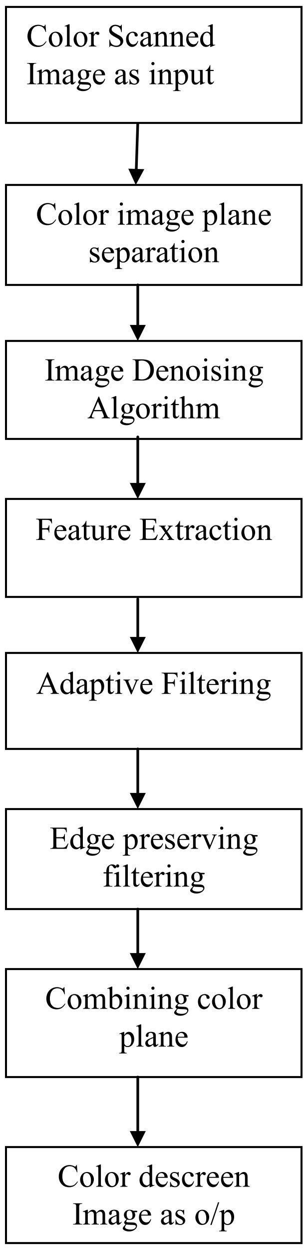
Er-Hu Zhang, Hua-Bing Ma, He, Meng, Luo, Bin [9], proposed descreening algorithm based on wavelet. This method first performs linear transformation to convert color image into CMYK color space. Then wavelet decomposition is carried out to determine appropriate filter that is suited to each channel. In order to remove sawtooth an edge preserving filtering can be carried out. This is optional step but if performed gives improved results. Experimental results showed that this method gives high definition descreening results.

Chunghui Kuo, Tewfik, A.H. and Rao, A.R.[10], proposed a color halftone descreening technique which is based on the color sigma filter. A decision function is build up based on color halftone segmentation process which is mainly wavelet packet based technique to find out halftone regions. A sigma filter based filtering is then carried out which results in descreening of the color image. Advantage of this method is that it does not require any prior knowledge of the halftoning process such as screen frequency estimation thus making it suitable for any color halftone image.

PROPOSED TECHNIQUE

Till now we have studied and reviewed various techniques for removing halftone patterns and to get better descreening results. In the proposed technique the main focus is on color halftone image descreening which is mainly based on adaptive filtering. The same technique has been successfully tested on grayscale image and found that it produces very good results. Experimental results have been compared with Training based descreening and Hardware friendly descreening methods and it is found that the proposed method gives excellent results for grayscale images[1]. The same method we will apply on color halftone images. In this, firstly scanned color halftone image will be taken as input and then each of its CMYK planes will be separated out. Each plane will be processed and descreened separately and finally combination of descreened plane will give a complete color descreened image.

FLOWCHART OF PROPOSED TECHNIQUE



CONCLUSION

We have studied different methods and techniques for scanned image descreening for both color as well as gray scale images. Each method uses different strategy and their proposed filters to achieve a good quality descreening results. Experimental studies also comment about their robustness and quality of the result that they produced. A new technique for color scanned image descreening is proposed to achieve even better results as compared to existing methods. The same method gives good results for grayscale images and it has been also compared with existing techniques to prove its robustness.

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