Scanned Image De-Screening with Image Redundancy and Adaptive Filtering

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***Abstract*— Halftoning techniques are used by electro-photographic printers for printing the continuous tone image. But drawback of this technique is that, the hardcopies obtained by these methods are corrupted by many screen similar objects. The screen similar objects are such as printing noise and halftone patterns. A new model is proposed which uses adaptive filtering for recovering the high quality halftone image. For reducing the printing noise then attenuating the distortions image redundancy centered denoising algorithm is used. The screen frequency of the scaned image and local gradient features remain the main factor for developing the adaptive filtering. The denoised scanned image is filtered with anisotropic Gaussian kernel to obtain the basic contone image. In gaussian kernel to obtain the basic contone image.**

***Index Terms*— Scanned image, Descreening inverse halftoning, Adaptive filtering.**

I. INTRODUCTION

To print continuous tone (contone) images, electro photographic (EP) printer uses halftone technique for converting contone images into bilevel image. The hardcopy is comprised of halftone patterns.when one bilevel halftone image is printed on paper, which human eyes hardly perceives. In the scanned image annoying artifacts may occurs when the EP printer prints the hardcopy and then the image is been scanned. The high frequency screens like patterns are the artifacts. If the scanned images are reprinted they lead to low aesthetic quality and produce more effect in the hard copies. An ill passed problem is an inverse process of halftoning where half toning is a process with information loss. A variety of different inverse half toning methods have been proposed to reconstruct high quality contone image from halftone image.

Inverse half toning methods cannot be used to descreen scanned halftone images, even though these methods recover contone images with sharp edges and details from binary halftone images. The scanned halftone images are usually designed for binary halftone image and are grey scale images. The binary halftone images are taken as inputs in the methods like lookup table based methods. To constrain the ill posed problem some methods require information about forward half toning process. Such information however usually can hardly be extracted from the currently scanned images. Nowadays though a few more new methods are been designed for better learning of information of halftone algorithm for halftone images they only operate on binary halftone images.

The possibilities of application to scanned halftone deescreening are seen by some methods which are designed for binary halftone. By error diffused method the wavelet based methods produces high quality contone images for binary halftone generation. Hence, the performance is highly dependent on the type of halftone patterns in these methods. There is a limited performance on scanned halftone images. The inverse problem of binary halftone is solved by sparse representation based methods from the contone samples or by training two dictionaries and their corresponding binary halftones. The weight kernel of the LMS filter from the contone pairs and binary halftone is been learned by the least mean square (LMS). The scanned halftone is different in resolution with its contone and position. Whereas the binary halftone image is naturally aligned with its contone version. Therefore to produce high quality contone images and registration must be done to align the contone images and corresponding scanned halftone, high end printing and scanning equipments are needed to generate sample pairs for scanned images descreening.

A new method which descreens the image in order to obtain contone image with smooth regions and sharp edges is proposed. First task is to reduce the random noise from scanned image. For which we are using image redundancy based denoising algorithm. After this this the adaptive filtering removes the halftone pattern and preserves details as much as possible. We are using 2D anisotropic Guassian kernal for adaptive filtering. The screen frequency decides the size of kernel. Saliance of edges and the directions of scanned images are found out from local gradient extraction. We adjust the shape of kernel adaptively according to edge direction and salience. Sharp edges are obtained by using edge preserving filter.

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II. Related Work

There are some of the methods designed for the binary halftone to the show possibilities of application to scanned halftone descreening. These are some of the following types:

a. Wavelet Based Methods.
b. Sparse Representation Methods.
c. Least-mean-square (LMS) filtering methods.

a. Wavelet Based Methods :

Wavelet based methods can produce high quality contone images for binary halftone generated by error diffused method.
However, the performance of these methods is highly dependent on the type of halftone patterns.
Wavelet based methods is initially used for the image denoising i.e. Removing errors from the scanned image.
There were many drawbacks in the previous methods which are been overcome by these methods i.e. Loss of edges, less accurate etc. All these drawbacks will be overcome by our proposed method.

b. Sparse Representation Methods:

The sparse representation based methods solve the inverse problem of binary halftone.
This is achieved by training two dictionaries or from the contone Samples and their corresponding binary halftones.
A sparse Representation method is secondly used for the image denoising i.e. Removing errors from the scanned image after the wavelet based method.
There were many drawbacks in the previous methods which are been overcome by these methods i.e. Filter kernel is no adaptively generated, less accurate etc. All these drawbacks will be overcome by our proposed method.

c. Least-mean-square (LMS) filtering methods:

In Least Mean Square (LMS) we learn the weight kernel of the LMS filter from the binary halftone and contone pairs.
The binary halftone image is naturally aligned with its contone version, while the scanned halftone is different with its contone in resolution and position.
Least Mean Square (LMS) methods is thirdly used for the image denoising i.e. Removing errors from the scanned image after the process of wavelet based method and sparse representation method.
There were many drawbacks in the previous methods which are been overcome by these methods i.e. Image blurring after denoising etc. All these drawbacks will be overcome by our proposed method.

III. System Overview

Here we just take a look on the overview of system. The model which we are implementing is basically based on the adaptive filtering. The anisotropic Gaussian kernel is the main foundation of our proposed model.
We take the scanned image as an input. The scanned images are obtained from the hard copies of bi-level images which consist of artifacts. Then we perform the denoising operation for reducing these artifacts. After this denoising we get the image which is denoised. Now we have to extract the information from the image. The information like screen extraction & local gradient extraction. These factors will help to generate adaptive kernel. After this we need to do the filtering operation.
Then after this stage we get the basic estimate & now we have to do some extra improvement like edge sharpening, smoothing etc. Finally at output we get the image which is smooth & contone.

IV. Problem Formulation

Here we are using the Gaussian kernel for adaptive filtering. The equation listed below will fulfill our requirement of adaptive filtering.

$$\mathbf{hg}(n_1, n_2) = exp^{\frac{-(n_1^2+n_2^2)}{2\sigma^2}}$$

We will perform the filtering operation in the form of matrix as we know in the matlab every operation in the matlab is in the matrix form, filtering will be also done in the matrix form.
As we are implementing this equation three inputs are required. The number of rows, number of columns and the value of standard deviation are these three inputs. Number of rows and columns will decide the size of matrix. Dependent on these three inputs the kernel is generated. Next is to normalize the output and for that purpose another equation have to be used. The simple logic that is averaging is used. The equation is as bellow

$$\mathbf{H}(n_1, n_2) = \frac{hg(n_1, n_2)}{\sum_{n_1}\sum_{n_2} hg}$$

Here in this equation we are doing the summation of all the values in the matrix and dividing each value in matrix by this summation.

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V. ALGORITHM/ FLOWCHART

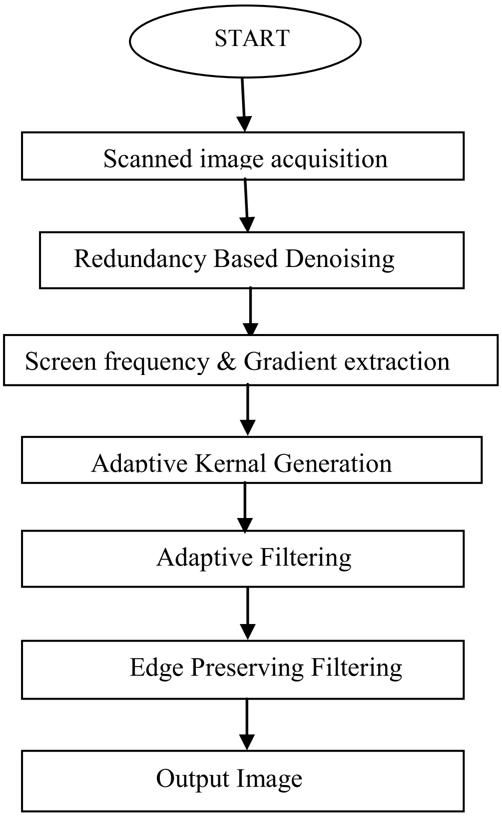

Fig. flowchart of image descreening

VI. RESULTS

In our result we are showing filtered image in matlab. We are performing the experiments on various images.

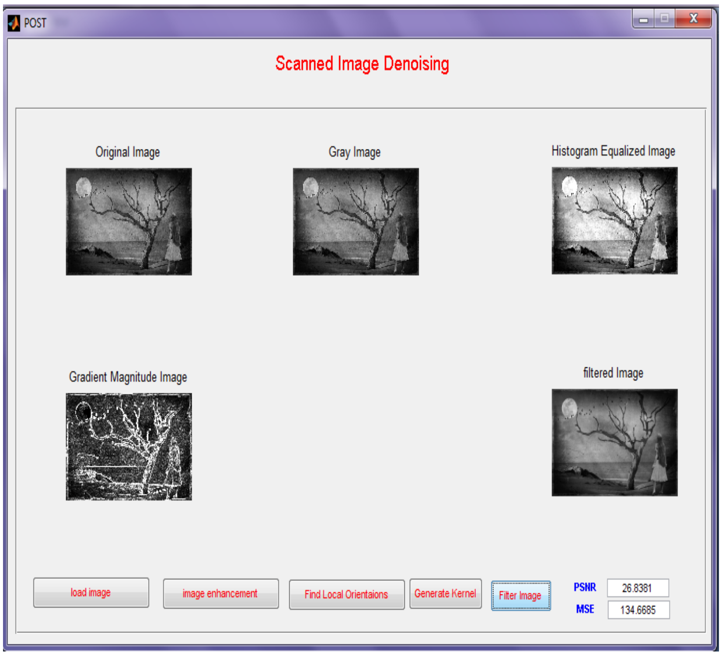

Fig. result shows filtered image

As we are using adaptive filtering with the Gaussian kernel the following figure will illustrates the same.

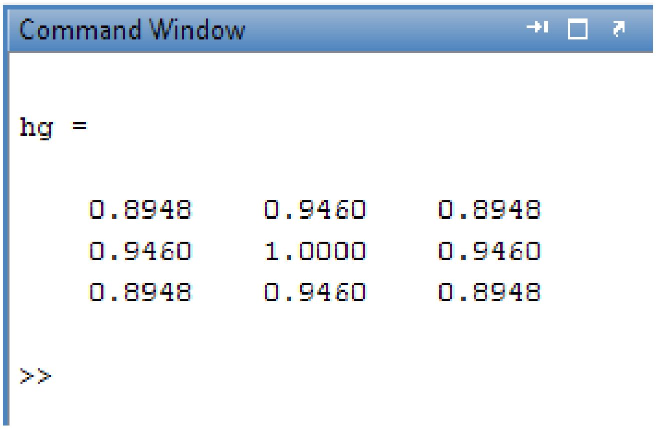

Fig. command window in matlab

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VII. Conclusion and Future Work

Conclusion

We build a model for a scanned image with clustered dot halftone patterns, which consist of distortions and noise because of printing. Our proposed method produces high quality continuous tone images for these type of scanned halftone images by using the adaptive filtering based descreening . At the output of our proposed method we get very sharp edges and clean smooth regions on real scanned images. For performing the adaptive filtering our proposed method takes the advantage of screen frequency and local gradient information. It can descreen the scanned images at different printing and scanning solutions without tuning parameters manually. Our proposed method is not usefull for descreening the colour scanned image.

Future scope

In our model we are using adaptive filtering for reducing the distortions and noise which are caused by printing. Our method can produce high quality contone image for scanned halftone image. Very sharp edges and clean smooth regions are output of our proposed method. Our proposed method is not useful for descreening the color scanned image as it is having 4 tangled screens with different color angles in CMYK color space. So for descreening each one separately we have to untangle the 4 screens and this can be our future task. We can also propose a design for rougher bust screen frequency detector.

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