Descreening the Scanned Halftone Image using Adaptive and Edge Preserving Filters

R. Queenie Merlin Mary¹, K. Suresh²

¹PG Scholar, ²Assistant Professor, Department of CSE, KCG College of Technology, Chennai, Tamilnadu, India

Abstract-- Electro photographic printers utilizes half toning method to print persistent tone pictures, so scanned pictures acquired from such hard duplicates are generally ruined by screen like antiquities. Another model for recuperating filtered halftone shading picture is actualized. This new approach considers both printing distortions and halftone designs. Twists are evacuated by method for a versatile siftin system. At first BM3D calculation is proposed in which Collaborative separating is an exceptional technique, created to manage these 3D gatherings. This BM3D is in light of this novel denoising methodology. Next ginmic extraction methodology is proposed, for example, Screen Frequency Estimation and Local Gradient Extraction. Next Adaptive Filtering Algorithm is utilized for separating the scanned picture with obliged limit esteem. At that point Edge-Preserving Algorithm has been proposed to protect the edge of the checked picture. Here NLM calculation is utilized for Edge-Preserving. Non-neighborhood means is a calculation for picture denoising which takes the mean estimation of a gathering of pixels encompassing a target pixel to smooth the picture. At last the Descreened examined shading pictures with ceaseless tones are acquired.

Keywords— Adaptive Filtering, BM3D, Halftoned image, Image denoising, Screen frequency estimation.

I. INTRODUCTION

The target of this work is to recuperate the ceaseless toned shading picture from a halftoned hues picture that is happened as an after effect of scanning a picture, utilizing the Adaptive and Edge protecting channels. Picture transforming is any type of sign handling for which the info is a picture, for example, a photo or feature outline. The yield of picture handling may be either a picture or a set of attributes or parameters identified with the picture. Most picture transforming strategies include treating the picture as a two-dimensional flag and applying standard sign preparing methods to it. Picture preparing typically alludes to computerized picture transforming, yet optical and simple picture handling additionally is conceivable. Picture handling is nearly identified with PC illustrations and PC vision. Picture transforming is a strategy to change over a picture into advanced structure and perform a few operations on it, with a specific end goal to get an improved picture or to concentrate some valuable data from it.

It is a sort of sign regulation which includes picture, in the same way as feature edge or photo and yield may be picture or qualities connected with that picture. Normally Image Processing framework incorporates treating pictures as two dimensional signs while applying effectively set sign transforming systems to them.

II. OVERVIEW

A. Problem Statement

Electro photographic printers use half toning technique to print continuous tone images, so scanned images obtained from such hard copies are usually corrupted by screen like artifacts. A new model for recovering scanned halftone color image is implemented. This new approach considers both printing distortions and halftone patterns. Distortions are removed by means of an adaptive filtering technique. Initially BM3D algorithm is proposed in which Collaborative filtering is a special procedure, developed to deal with these 3D groups. This BM3D is based on this novel denoising strategy. Next feature extraction process is proposed such as Screen Frequency Estimation and Local Gradient Extraction. Next Unsharp Filtering Algorithm is used for filtering the scanned image with required threshold value.

Then Edge-Preserving Algorithm has been proposed to preserve the edge of the scanned image. Here NLM algorithm is used for Edge-Preserving. Non-local means is an algorithm for image denoising which takes the mean value of a group of pixels surrounding a target pixel to smooth the image. Finally the Descreened scanned color images with continuous tones are obtained.

B. System Architecture

Based on this model, a new descreening method is proposed to obtain contone color images with both clean smooth regions and sharp edges from the scanned halftone color images. First, the scanned color image is given as input to the descreening process. The input scanned image will have random noises in it which need to be eliminated to produce a contone image. The random noise in the scanned image is reduced by using the image redundancy based denoising algorithm called Block Matching 3D transform Domain collaborative filtering (BM3D) algorithm. By searching for similar image patches, the BM3D algorithm can find patches with similar halftone patterns.
When these patches are transformed into the 3D transform domain, the aligned halftone patterns produce responses strong enough to survive in the process of collaborative filtering. On the contrary, the random noise in these patches are reduced because their weak responses in the 3D transform domain are suppressed. The Fig. 1 explains about the detailed step by step progress about the proposed system. The architecture diagram depicts the 4 distinct modules.

- Image Denoising
- Feature Extraction
- Adaptive Filtering
- Edge preserving Filters

The denoised image obtained from the denoising process is given as input to the feature extraction process. In screen frequency estimation process the screen frequency estimation and the local gradient information are extracted. The screen frequency estimation is determined by considering both the Lines Per Inches (LPI) and the Dots Per Inch (DPI). Apart from the screen frequency, local gradient information of image content is also used to tune the parameters of the adaptive filter. Then an adaptive filtering algorithm is developed to remove halftone patterns in the scanned image and preserves as much details as possible. The outputs of both the BM3D phase and the screen frequency estimation process are given as input to the Adaptive filtering process. A 2D anisotropic Gaussian kernel is used for the adaptive filter. With the features extracted from the scanned image, the parameters of the kernel function are tuned automatically. The kernel size is adaptively adjusted for scanned images at different resolution, and the kernel can change its shape to adapt to different image content.

Finally, an edge preserving filter called NLM filtering is adopted for edge sharpening. The edge-preserving filter takes two input images: the denoised scanned image and the basic contone estimate. It first computes the kernel for each pixel in the basic estimate, and smooth the denoised scanned image with these kernels to predict contone values for the corresponding pixels in the denoised scanned image. The denoised continuous toned image with sharper edged is obtained as output from the entire denoising process.

III. RELATED WORK

In this article authors Kaiming He, Jian Sun and Xiaoou Tang (2013) proposed an equipment neighborly nonlinear separating procedure for descreening together with a discretionary deblurring of advanced filtered records. The proposed calculation, which we allude to as Hardware-Friendly Descreening (HFD) [5], works by first removing a spatial peculiarity vector containing the force slopes processed at diverse pixel areas in a little neighborhood of the given pixel. The peculiarity vector is separated from presmoothed variants of the checked picture. The spatial gimmick vector is then utilized as a part of a mathematical structure that relies on upon a blend of nonlinear. Polynomial capacities to figure the nearby channel coefficients needed for directional smoothing. Once the neighborhood channel coefficients have been resolved, the estimation of the descreened picture at a given pixel area is processed as the weighted normal of pixel values in a nearby window of the checked picture around the given pixel.

In this article authors Zhen He (2009) proposed a strategy utilized for attaining to perceptually satisfying shading halftone. Controlling three discriminating component Dot-covering control, Achieving Minimum Brightness Variation Color Density (MBVCD) Dot-situating control, Employing the implanted monochrome lapse dispersion, Dot-shading control, Thresholding the components in halfway thickness total vector. Scattered dab half toning scheme is utilized for rendering constant tone pictures on gadgets with restricted local essential hues. Achieving constant tone deception through spot recurrence adjustment. Diffusing the pixel quantization mistake to nearby neighboring pixels Grayscale half toning calculation. Original Floyd-Steinberg mistake dispersion. Two most discernible halftone composition antiques are Directional “diseased” halftone composition in the highlight and shadow territories Regular halftone design at the products of 1/4 and 1/3 Shading half toning calculation utilizes the accompanying set of the halftone speck shading. Composite-dark, blue, red, green, fuchsia, cyan, yellow and white.
BRISQUE has low computational multifaceted nature, making it appropriate for continuous applications. BRISQUE gimmicks may be utilized for bending recognizable proof also. To delineate another reasonable utilization of BRISQUE, we depict how a non-visual impaired picture denoising calculation can be enlarged with BRISQUE keeping in mind the end goal to perform visually impaired picture denoising. In this article authors Kaiming He, Jian Sun and Xiaoou Tang (2013) a novel express picture channel called guided filter [7]. The separating yield is provisionally a direct change of the direction picture. On one hand, the guided channel has great edge-safeguarding smoothing properties like the two-sided channel, yet it doesn't experience the ill effects of the slope inversion curios. Then again, the guided channel can be utilized past smoothing: With the assistance of the direction picture, it can make the sifting yield more organized and less smoothed than the info. We exhibit that the guided channel performs exceptionally well in an incredible mixed bag of uses, including picture smoothing/improvement, HDR pressure, streak/no-blae imaging, tangling/feathering, dehazing, and joint up sampling. Channel that shows the decent property of edge-safeguarding smoothing however which can be registered effectively and no approximately. Our channel is more nonexclusive than "smoothing" and is material for structure-exchanging, empowering novel utilization of sifting based feathering/tangling and dehazing.

In this article authors Thomas D. Kite, Niranjan Damera-Venkata and Brian L. Evans (2001) a versatile edge adjustment structure to enhance halftone quality by improving lapse dissemination parameters at all squares sense. This versatile edge algorithms is utilized to streamline edge upgrade half toning and green clamor half toning. It minimize direct bending by controlling the honing control parameter.

The result of existing system is shown in the Figure 2.
IV. SYSTEM PROPOSAL

A. Denoising Stage

In view of this model, another descreening technique is proposed to acquire contone shading pictures with both clean smooth locales and sharp edges from the checked halftone shading pictures. First, the examined shading picture is given as information to the descreening process. The data checked picture will have arbitrary commotions in it which need to be wiped out to create a contone picture.

The arbitrary commotion in the examined picture is lessened by utilizing the picture excess based denoising calculation called Block Matching 3D change area community separating (BM3D) calculation. Via looking for comparable picture fixes, the BM3D calculation can discover patches with comparative halftone designs. At the point when these patches are changed into the 3D change area, the adjusted halftone examples produce reactions solid to such a degree as to get by at the present time communitarian sifting.

In actuality, the arbitrary commotion in these patches is diminished on the grounds that their frail reactions in the 3D change area are smothered. This is explained in the Figure 3 [8].

Step 1) Basic estimate
a) Block-wise evaluations: For every square in the boisterous picture, the accompanying methodology is carried out
i) Grouping: Find obstructions that are like the at present transformed one and afterward stack them together in a 3-D show (bunch).
ii) Collaborative hard-thresholding: Apply a 3-D change to the shaped gathering, lessen the clamor by hard-thresholding of the change coefficients, transform the 3-D change to deliver evaluations of all assembled squares, and return the assessments of the pieces to their unique positions.

b) Aggregation: Compute the fundamental evaluation of the genuine picture by weighted averaging the majority of the got square astute appraisals that are covering.

Step 2) Final assessment: Using the fundamental evaluation, perform enhanced gathering and shared Wiener sifting.
 a) Block-wise appraisals: For every piece, do the accompanying.
  i) Grouping: Use BM inside the fundamental assessment to discover the areas of the squares like the right now prepared one. Utilizing these areas, structure two gatherings (3-D exhibits), one from the loud picture and one from the essential assessment.
  ii) Collaborative Wiener sifting: Apply a 3-D change on both gatherings. Perform Wiener sifting on the loud one utilizing the vitality range of the fundamental gauge as the genuine (pilot) vitality range. Produce assessments of all gathered pieces by applying the opposite 3-D change on the sifted coefficients and return the evaluations of the squares to their unique positions.

b) Aggregation: Compute a last gauge of the genuine picture by conglomerating the greater part of the got nearby gauges utilizing a weighted normal.

B. Characteristic Extraction Stage

1) Screen Frequency Estimation

The denoised picture acquired from the denoising procedure is given as information to the gimmick extraction process. In screen recurrence estimation handle the screen recurrence estimation and the neighbourhood slope data are extracted. The screen recurrence estimation is controlled by considering both the Lines Per Inches (LPI) and the Dots Per Inch (DPI).
Aside from the screen recurrence, neighbourhood slope data of picture substance is additionally used to tune the parameters of the versatile channel. If the LPI and DPI are known priori, the screen frequency of the scanned image can be calculated using the Equation 1.

\[
F = \frac{L_p \cos \pi/4}{R_s}
\]  

(1)

Where \(L_p\) is the LPI parameter of the printer, \(R_s\) is the DPI parameter of the scanner, and \(\pi/4\) is the usually utilized screen plot for dark scale printing. Since the most critical use of the descreening is the print-to-output way in the multi-capacity printer, the above parameters of printing and filtering are thought to be now known

2) Local Gradient Extraction

To estimate the edge direction and salience, a more robust method called steerable filter [30] is adopted. Equations 2, 3 and 4 describes the kernel of the steerable filter along direction \(\phi\).

\[
G^0(x,y) = \partial_x \exp(x^2+y^2/2 \sigma^2) 
\]  

(2)

\[
G^\pi/2(x,y) = \partial_x \exp(x^2+y^2/2 \sigma^2) 
\]  

(3)

\[
G^{\phi}(x,y) = \partial_x \exp(x^2+y^2/2 \sigma^2) 
\]  

(4)

Where \(x, y = -r, -r + 1, \ldots, 0, \ldots, r\) and \(\sigma G\) is the scale factor. Note that the kernel along an arbitrary direction is a linear combination of two basic kernels \(G^0\) and \(G^{\pi/2}\). The radius \(r\) and scale factor \(\sigma G\) of the steerable filter are determined by the screen frequency of scanned image. They are calculated as follows using the formulas 5 and 6.

\[
r = \frac{\lambda_r}{f_s} 
\]  

(5)

\[
\sigma G = \frac{\lambda_s r}{\lambda_r} 
\]  

(6)

Where \(\lambda_r\) is the kernel radius factor and \(\lambda_s\) is the kernel scale factor. The two factors are selected empirically in the experiments. The gradient magnitude along different directions is shown in the Figure 4 [2].

The gradient magnitude along direction \(u(s_1, s_2)\) in the denoised image can be calculated using the equation 7.

\[
g\Phi(s_1, s_2) = \left| \sum_r \sum_r G\Phi(x,y) u(s_1, s_2, y) \right| 
\]  

(7)

For each pixel in the denoised scanned image, gradient magnitudes along different directions are calculated by using the steerable filters. In the proposed method, gradient magnitudes along several different directions are calculated independently. As shown in Figure 5.2, steerable filters along \(-\pi/3, -\pi/4, -\pi/6, 0, \pi/6, \pi/4, \pi/3, \pi/2\) are used to extract gradient magnitudes along these 8 directions.

C. Versatile Filtering Stage

At that point a versatile sifting calculation is created to uproot halftone designs in the examined picture and jelly as much points of interest as possible. The yields of both the BM3D stage and the screen recurrence estimation procedure are given as data to the versatile separating methodology. A 2D anisotropic Gaussian piece is utilized for the versatile channel. With the gimmicks removed from the filtered picture, the parameters of the bit capacity are tuned consequently. The piece size is adaptively balanced for checked pictures at distinctive determination, and the bit can change its shape to adjust to diverse picture content.

At the point when the target pixel is in the smooth area, its part grows to the same scale along all bearings; when the target pixel is on an edge, the bit extends more along the edge than other directions. The screen recurrence of the examined picture is utilized to focus the versatile channel. With the gimmicks removed from the filtered picture, the parameters of the bit capacity are tuned consequently. The piece size is adaptively balanced for checked pictures at distinctive determination, and the bit can change its shape to adjust to diverse picture content.
D. Edge Preservation Stage

At last, an edge safeguarding channel called NLM separating is received for edge honing. The edge-safeguarding channel takes two data pictures: the denoised filtered picture and the essential contone gauge. It first processes the part for every pixel in the fundamental gauge and smooth’s the denoised filtered picture with these parts to anticipate contone values for the relating pixels in the denoised examined image. The denoised constant toned picture with more keen edged is gotten as yield from the whole denoise.

On the off chance that contrasted and other extraordinary denoising methods, for example, the Gaussian smoothing model, the anisotropic dispersion demonstrate, the aggregate variety denoising, the area channels and a rich variation, the Wiener nearby experimental channel, the interpretation invariant wavelet thresholding, the non-neighborhood implies strategy commotion looks more like repetitive sound.

Assume is the range of a picture, and and are two pixels inside the picture. The mathematical statement 8 speaks to the NLM calculation.

\[ u(p) = \frac{1}{c(p)} \int_{\Omega} v(q)f(p,q)\,dq \]  

Where \( u(p) \) is the filtered value of the image at pixel \( p \), \( v(q) \) is the unfiltered value of the image at pixel \( q \), \( f(p,q) \) is the weighting function, and the integral is evaluated over \( \nabla q \in \Omega \). \( c(p) \) is a normalising factor, given by the equation 4.9.

\[ c(p) = \int_{\Omega} f(p,q)\,dq \]  

The reason is that the proposed versatile channel can make its portion fit the edges by utilizing nearby inclination data. The proposed produces smooth areas with the most astounding perceptual quality.

The proposed system matches halftone designs in neighborhood fixes and diminishes irregular clamor utilizing the excess data contained as a part of these patches. On the other hand, the arbitrary clamor and bends brought on by printing are not thought to be in the other methods. Therefore, they deliver uproarious smooth districts. As a rule, the proposed strategy meets expectations extremely well on the test pictures checked at 300 dpi, and produces guaranteeing results for the others without tuning parameters physically.

As the checking determination builds, the halftone examples are more notable. At that point versatile channels with a bigger bit are expected to stifle the halftone designs. By contrasting the outcomes on pictures printed at 300 dpi and 600 dpi, it can be discovered that the difference of results for the filtered pictures printed at 600 dpi is lower than that printed at 300 dpi. This is brought on by the printer the differentiation of unique filtered pictures likewise diminishes when print determination increments.

Results of the proposed descreening method are shown in Figure 6.

V. RESULT AND ANALYSIS

The proposed strategy is intended to descreen picture parts in the filtered archive images. It can be observed that the proposed system evacuates halftone designs along edges and in smooth areas. Besides, the edges in the consequences of the proposed system are more honed and clearer.
As the scanning resolution increases, the halftone patterns are more and more salient. Then adaptive filters with a larger kernel are needed to suppress the halftone patterns. By comparing the results on images printed at 300 dpi and 600 dpi, it can be found that the contrast of results for the scanned images printed at 600 dpi is lower than that printed at 300 dpi. This is caused by the printer the contrast of original scanned images also decreases when print resolution increases. It can be seen that when the value of noise level increases, more and more noise is removed. But on the other hand, less spatial details are preserved. The high computational efficiency of the adaptive filter is achieved by approximating the adaptive filter with an adaptive kernel family, which is comprised of 160 kernels with different $\theta$ and $\sigma_1$ values. For real-time applications, there are two ways to reduce computation of the proposed method. Figure 7 shows the comparison of existing and proposed system in terms of PSNR values.

It can descreen examined shading pictures at diverse printing and checking resolutions without tuning parameters physically. Investigations on genuine checked pictures show that the proposed system can recuperate great contone pictures from the filtered pictures. Contrasted and the best in class strategies, the proposed strategy delivers sharp edges and much cleaner smooth districts of filtered shading pictures.

VI. CONCLUSION

The proposed versatile separating based descreening system can create excellent consistent tone shading pictures for checked halftone images. The proposed technique identifies screen recurrence of the filtered picture and exploits the nearby slope data to perform versatile sifting.

REFERENCES