A New Approach of Richardson Lucy Algorithm with Edge Mask Extraction for Image Deblurring

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***Abstract*—when any image is captured, it may be degraded because of sensor noise, blur due to camera miscues, atmospheric turbulence, relative motion between camera and object, and many more. Due to degradation, Quality of an image is decreased. With a view to getting back the original image, the concept of Image Restoration is widely used. Richardson Lucy Algorithm is one of the most popular and widely used deburring techniques. Though it gives better performance, more time consumption and unwanted ringing effects in the output image are the limitations. To overcome with the limitations, a new approach of the Richardson Lucy Algorithm is presented here, where Edge mask extraction method using Gaussian prior is combined with the existing Richardson Lucy Algorithm. PSNR (Peak Signal to Noise Ratio), MSE (Mean Square Error) and time taken by algorithm to deburr the image are the parameters, which are taken into account for performance analysis.**

Keywords—Restoration; PSNR; MSE; Deblurring techniques; Richardson Lucy Algorithm; Edge mask extraction.

I. INTRODUCTION

Image Restoration mainly concerns with reducing the effects of the degradations from the captured image to improve the quality of the image. An image can be recovered to its original form from its degraded form. Deconvolution algorithms are widely used for image restoration. There are two types of deconvolution techniques:

1. Non Blind: here images can be reconstructed even if there is no knowledge about the PSF or there is very little knowledge about it. Richardson Lucy Algorithm is the example.

2. Blind: if we know how the image gets blurred, then only we can reconstruct the image form the degraded one. In other words, we have knowledge about PSF.

Richardson Lucy algorithm was derived by Richardson and Lucy from Bayes theorem in 1970's. In the 1980's, it was delivered again by Shepp and Vardi. It is an example of an iterative procedure [1]. It is based on the basic model of Image Restoration.

Picture restoration, which is used to move forward those caliber of the image, Eventually Tom's perusing which a picture enduring starting with corruption camwood a chance to be restored will its unique form, reconstructs alternately estimates those uncorrupted picture from a smeared Furthermore loud person. Despite particular case might not have the capacity to get the qualities of the debasing framework and the commotion specifically starting with the picture creation procedure practically, they are expected will a chance to be referred to An from the earlier when those picture rebuilding methodology will be utilized. The objective about smudge ID number may be should assess the qualities of the blemished imaging framework from those watched corrupted picture itself former of the rebuilding transform [10]. The blending of picture rebuilding Also smudge ID number is known as picture Deconvolution [10]. Galactic imaging, therapeutic imaging, theory enforcement, and advanced networking rebuilding would those Different requisitions for picture rebuilding.

Figure 1: After & before restoration of Image

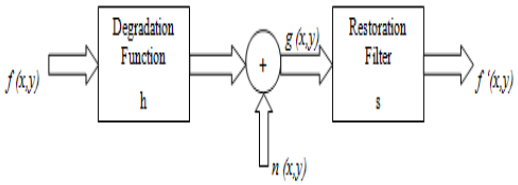

Figure 2: Image Restoration Model

The equation for expressing image blurring or image degradation is:

$$g(x, y) = f(x, y) * h(x, y) + n(x, y)$$

Where; g = the degraded image

f = the original image

h = the degradation function

n = the random noise

The equation for expressing image restoration is:

$$f'(x, y) = g(x, y) * s(x, y)$$

Where; f' = the restored image

s= the restoration function

II. BACKGROUND

Richardson lucy calculation is a well-known calculation for picture rebuilding. It will be an iterative algorithm. Utilizing this algorithm, the smeared picture camwood a chance to be restored of the clearer image, yet the ringing artifacts might show up around the edge. So as to decrease the ringing artifacts, Bo Xin Zuo Also Zhi hua Cai suggested An PDE built non straight strategy [5]. PDE based non straight dispersion comparison plan might have been Additionally recommended by Perona What's more malik done their partake) energizes 1978. To 2012, Jiunn Linwu, Chia Feng chang and Chun shin chen suggested a moved forward richardson lucy calculation to which edge masjid will be registered Toward utilizing EMD (Extrema built Multiscale Decomposition) system with a perspective with decreasing those ringing artifacts from those picture [8] it will be said that those focal point about Kalman sifting system for picture rebuilding is that it abstains from overwhelming computational load. The methodology about most extreme probability estimation aides on assess the genuine picture that is generated all the during every cycle and the algorithm may be effectively ended when outcome may be gotten.

III. PROPOSED SYSTEM

Another methodology of the richardson lucy calculation is exhibited here, the place edge masjid extraction strategy utilizing gaussian former is consolidated with the existing richardson lucy calculation. Edge masjid holds the structure from claiming picture Be that not hold numerous ringing artifacts. Along these lines it could make utilized with those essential picture rebuilding algorithm. Those edge masjid Furthermore smeared picture would utilized Likewise principal inputs to deconvolution In this way that The majority of the ringing artifacts could be evacuated. In the next step, the deblurred picture will displace those first smeared picture Similarly as information and the edge masjid are Additionally necessary on make registered once more with get new edge masjid. Here, edge masjid may be concentrated Eventually Tom's perusing gaussian former technique.

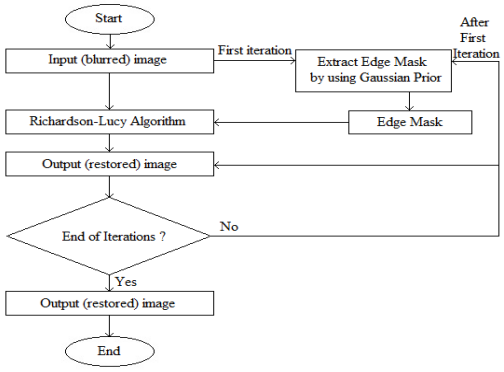

Figure: 3 Flowchart of the proposed system

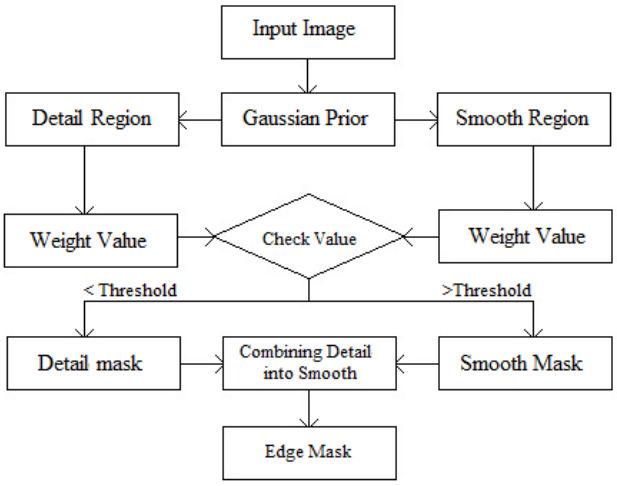

Figure: 4 Flowchart of Computing Edge Mask

Step-1: Select the Blurred image.

Step-2: Calculate Distribution of Gaussian Prior with Zero mean Value.

$$P(K) \propto exp\,[-(a_1||h_1 * K||_2^2 + a_2||h_2 * K||_2^2)]$$

Where; h_1 and h_2 are the first order of the horizontal and vertical derivative filters. a_1 and a_2 are the scalar parameters.

$h_1 = [1\ -\ 1],\ h_2 = [1\ -\ 1]^T$

Step-3: Check the Weight Value if it is greater than or less than threshold.

$$M = \begin{cases} 1, & G(x,y) < \textbf{Threshold} \\ 0, & G(x,y) \geq \textbf{Threshold} \end{cases}$$

$$G(x,y) = \frac{(|\Sigma G_1 * T_w(x,y)|^2 + |\Sigma G_2 * T_w(x,y)|^2)}{N * N}$$

Where; **Threshold** is the threshold to distinguish smooth region and texture region. $G(x,y)$ is a parameter to determine the value of M. G_1 and G_2 are the horizontal and vertical gradient operators.

$G_1 = [1 - 1],\ G_2 = [1\ -\ 1]^T$

Step-4: If it is greater than then Detail region and less then smooth region.

Step-5: Combine Detail region with Smooth region.

Step-6: Final Edge Mask formation.

Step-7: Apply Richardson-Lucy Algorithm.

Step-8: Check the deblurred image.

Step-9: Repeat the Step-7 until image is totally deblurred.

Step-10: Output deblurred image.

IV. Results and Analysis

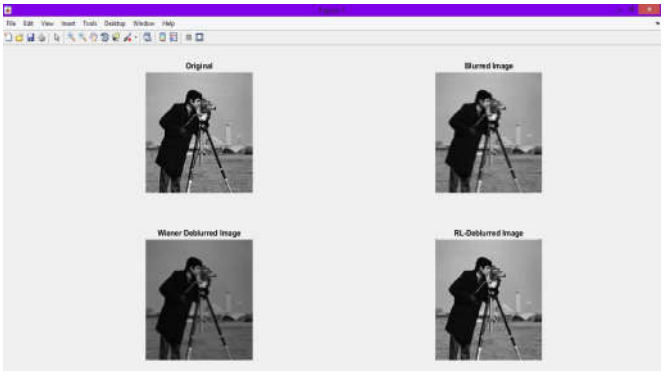

Figure 5: Results

Table 1: Winner Analysis

Images	MSE	PSNR
Cameraman	0.026464	63.904169
Lena	0.018728	65.405923
Rock	0.018457	65.469101
Mine	0.033330	62.902431
River	0.024938	64.162264

Table 2: RL Analysis

Images	MSE	PSNR
Cameraman	0.002505	74.143129
Lena	0.001243	77.184985
Rock	0.002684	73.843148
Mine	0.002412	74.306300
River	0.001206	77.317214

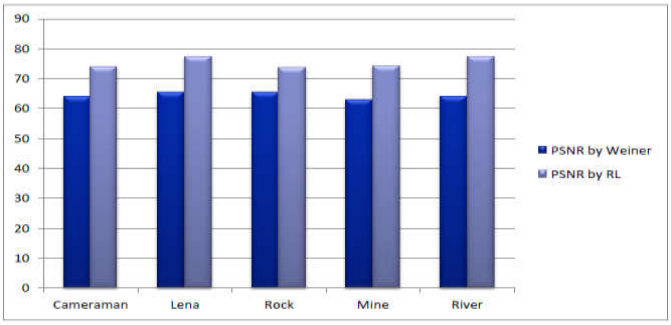

Figure 6: PSNR Comparison

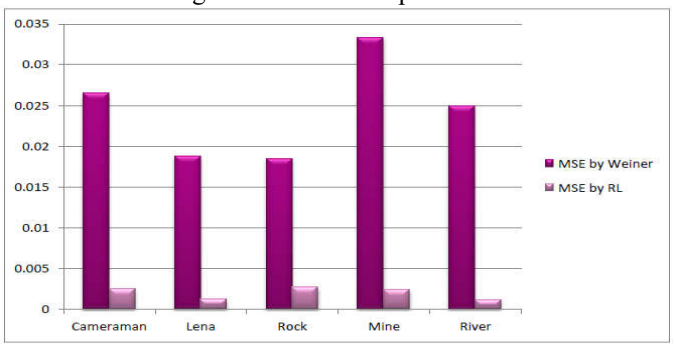

Figure 7: MSE Comparison

V. Conclusion

The existing Richardson-Lucy algorithm gives results better than Weiner deconvolution. But it produces unexpected ringing artifacts. It is required to modify or extend it in such a way that it can perform better than the existing one. Therefore, edge mask extraction by gaussian prior method is combined with the existing Richardson Lucy algorithm. Here, the existing method and the proposed method are implemented. The experiments and results show the better performance of the proposed system than the existing one. The proposed method is also faster than the existing method. In future, this method can be extended for restoring the colour images also.

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