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A Survey on Image Restoration by Comparing the Different Deblurring Process and Filtration

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Abstract: *Image processing is an important component of modern technologies as it provides the improvement in pictorial information for human interpretation and processing of image data for storage, transmission and representation autonomous machine perception. This paper focused on image restoration which is sometimes referred to image deblurring and filtering. Image restoration is concerned with the reconstruction of blur parameters of the uncorrupted image from a blurred and noisy one. Image deblurring refers to procedures that attempt to reduce the blur amount in a blurry image and grant the degraded image an overall sharpened appearance to obtain a clearer image. In this paper, the various kind of noise are added and then deblurring process is used to obtain a blurred image. After this image filtering is also implemented for removing these noise.*
KeyWords: *deblurring,image degradation, MSE,PSNR,*

I. Introduction

Image restoration is the process that attempts to recover the image from its corrupted version. Restoration techniques are oriented toward modeling the degradation and applying the inverse process in order to recover the original image. Basically contrast stretching is considered an enhancement technique because it is based primarily on the pleasing accepts it might present to the viewer, whereas removal of image blur by applying a deblurring function is considered a restoration technique. The challenge to scientists, engineers and business people is to quickly extract valuable information from raw image data. This is the primary objective of image processing i.e. converting images to information. The following example introduces some basic image processing concepts. The example starts by reading an image into the MATLAB workspace. The example then performs some contrast adjustment on the image. Contrast adjustment includes the deblurring process and then adding a noises to that loaded image so that we can compare these different images after the filtration process. Image restoration is concerned with the reconstruction or estimation of blur parameters of the uncorrupted image from a blurred and noisy one.

1.1 Image Degradation

In degradation process, a degradation function H that, together with an additive noise term $\eta(x,y)$, operates on an input image $f(x,y)$,to produce a degraded image $g(x,y)$. The objective of a restoration is to obtain an estimate $\hat{f}(x,y)$ of the original image.

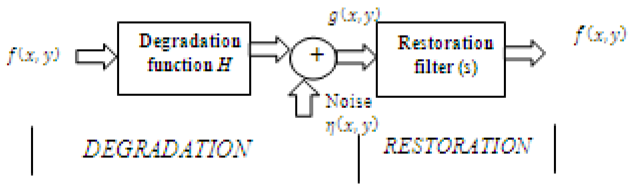

Fig -1:A model of the image degradation/restoration process.

Where, H is a linear , position –invariant process, then the degraded image is given in the spatial domain by

$$g(x,y) = h(x,y) * f(x,y) + \eta(x,y) \qquad \text{equation (1)}$$

Where $h(x,y)$ is the spatial representation of the degradation function and, the symbol ’*’ indicated convolution. As we know that convolution is the spatial domain is analogous to multiplication in the frequency domain, so we may write the above equation in an equivalent frequency domain representation:

$$G(u,v) = H(u,v)F(u,v) + N(u,v) \qquad \text{equation (2)}$$

Where the terms in capital letters are the Fourier transforms of the corresponding terms of the first equation. These two equation are the bases for most of the restoration of images.

Peak Signal to Noise Ratio (PSNR): One of the common reliable methods to measure the accuracy in the image processing field is the (PSNR), the peak signal to noise ratio for a grayscale image can compute using the following equation.

$\mathrm{PSNR} = 20 * \log_{10}\left(\frac{255}{\sqrt{\mathrm{MSE}}}\right)$equation (3)

Mean square error (MSE): Where MSE can be calculated using the following equation:

$\mathrm{MSE} = \frac{1}{\mathrm{M}*\mathrm{N}}\sum_{\mathrm{x}=1}^{\mathrm{M}}\sum_{\mathrm{y}=1}^{\mathrm{N}}\mathrm{f}(\mathrm{x},\mathrm{y}) - \hat{\mathrm{f}}(\mathrm{x},\mathrm{y})$equation (4)

Where, (M, N) are the dimensions of the image, f (x, y) is the original image, f ' (x, y) is the restoredimage. The higher PSNR value means the image has a better quality in the deblurred image. This metric helps to deliver an unbiased standard to compare diverse techniques.

Different Deblurring Process we used are: Motion Process, Disk Process, Unsharp Process, Sobel process, Log Process, Gaussian Process. And the filters we used are wiener filter, Median filter, and Ordinary filter. For comparing the two different images, we added different noises into the image. They are known as: salt & pepper noise, speckle noise, poison noise, gaussian noise

The following list shows the description for eachfilter type:

- Motion process - This filter type returns a filter to approximate, the linear motion of a camera by length pixels, with an angle of theta degrees in a counterclockwise direction.
- Disk process - Returns a circular averaging filter within the square matrix.
- Unsharp process - Returnsa unsharp contrast enhancement filter.
- Sobel process - Returnsa emphasizes horizontal edges using the smoothing effect by approximating a vertical gradient.
- Log process –This filter is Laplacian of Gaussian filter.
- Gaussian process - Returns a rotationally symmetric Gaussian lowpass filter.

II. Proposed Work

Image restoration techniques such as inverse filtering and Wiener Filtering can be considered as simple. Deblurring images with a known blur function is commonly done using the Wiener filter.

The proposed efforts have been utilized to compare the different deblurring techniques are shown using algorithm. This technique will capitalize on the statistics of the blurry image and the refined image estimate, in an iterative approach to converge on the correct seeing parameter.]direct restoration techniques The problem with such methods is that they require knowledge of the blur function that is point-spread function (PSF), which is, unfortunately, usually not available when dealing with image blurring.

2.1 Results and Discussion:

2.1.1 Methodology:

The following flow chart (methodology) describes the process of implementation of deblurring process and filtration. After this process we get our desired output and comparing the PSNR and MSE values of the outputs.

When an image is read in MATLAB workspace, the different deblurring methods are being used one by one. Let we firstly used motion process is implemented in original image and then after this process one noise is added into this deblurred image. After this, we firstly filter the deblurred image with any of the mention filters and we having its MSE and PSNR values, secondly we filtered the noisy image with same filter and similarly we having an its MSE and PSNR values. From all these values we compare the two different image result and which image is better. By comparing the different values of MSE and PSNR, by using the different filters, it is seen that, when we using the Gaussian deblurring Process with wiener filter the results are far better from other filters.

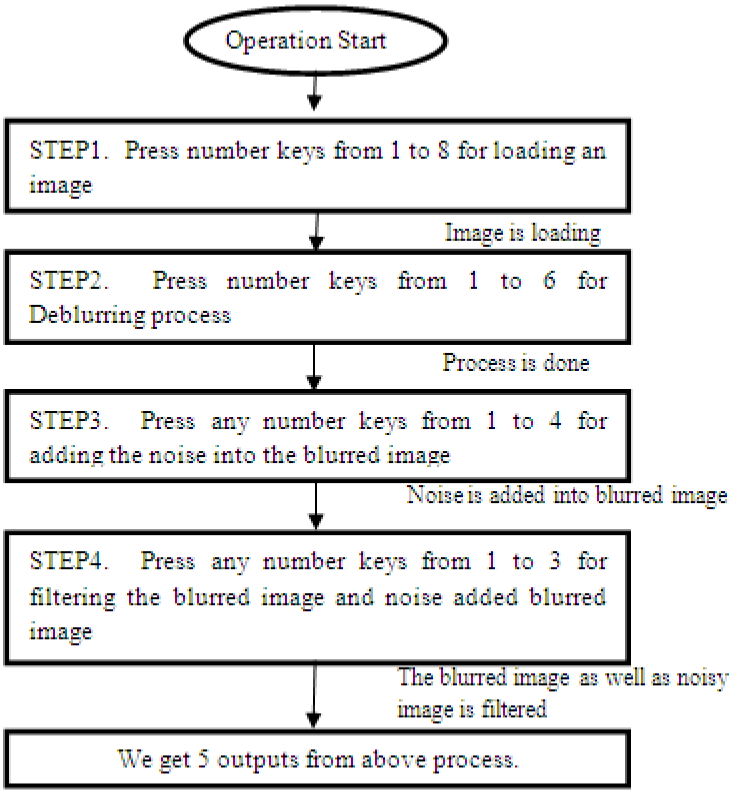

Fig -2: Methodology of the Project

For better result we need lower MSE and higher PSNR values. Now we comparing the two images by using the Gaussian deblurring process with gaussian noise in different filters.

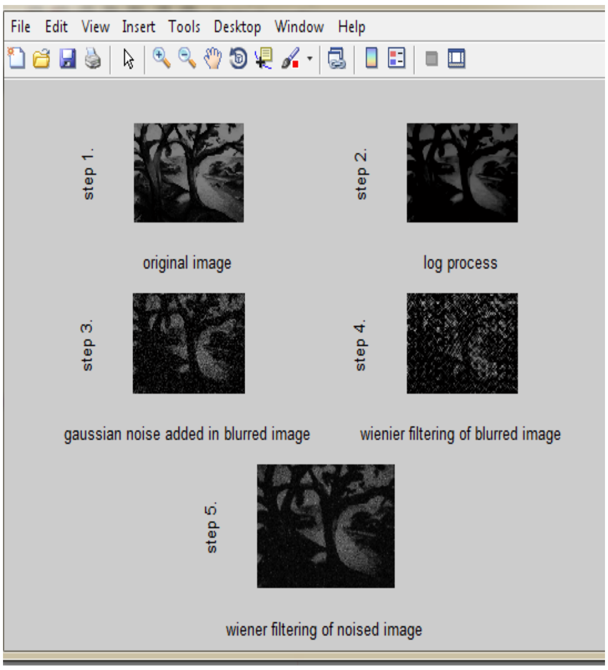

Fig -3: Log deblurring process with gaussian noise in Wiener filtering.

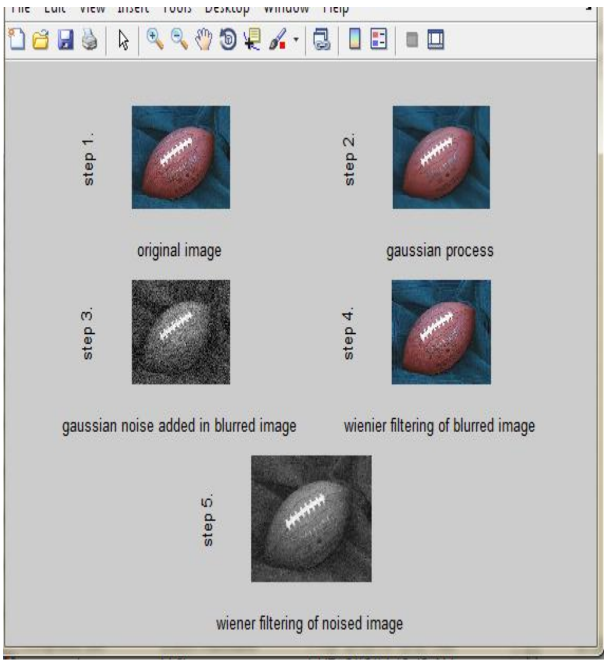

Fig -4: Gaussian deblurring process with gaussian noise in Wiener filtering.

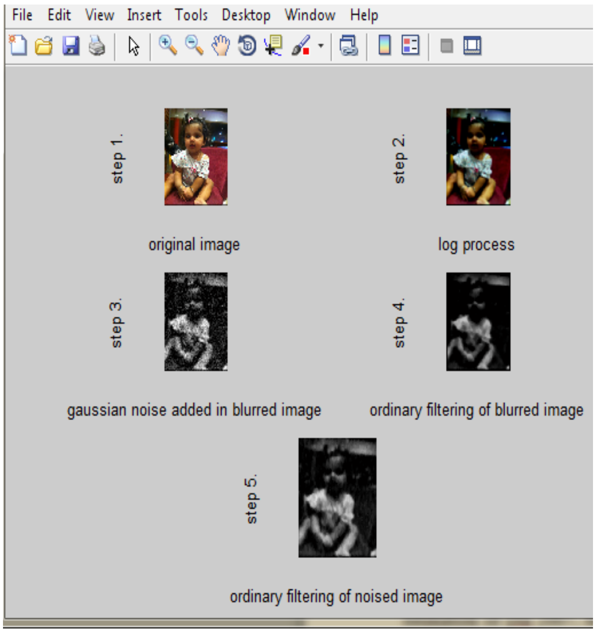

Fig -5: Log deblurring process with gaussian noise in Ordinary filtering.

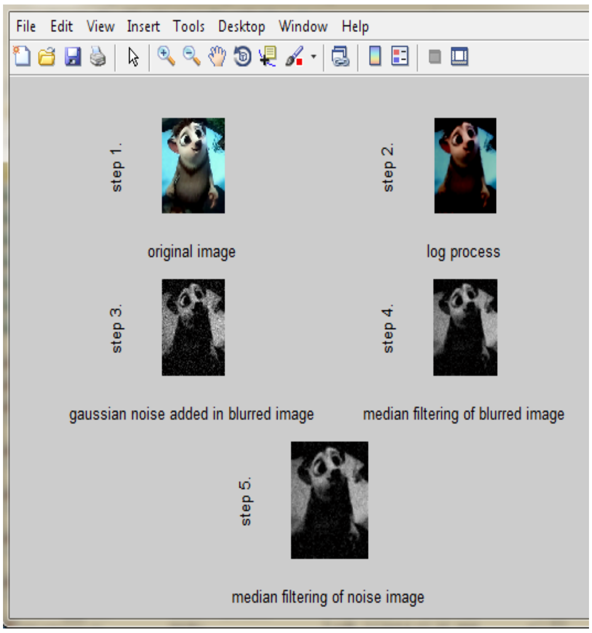

Fig -7: Log deblurring process with gaussian noise in Median filtering.

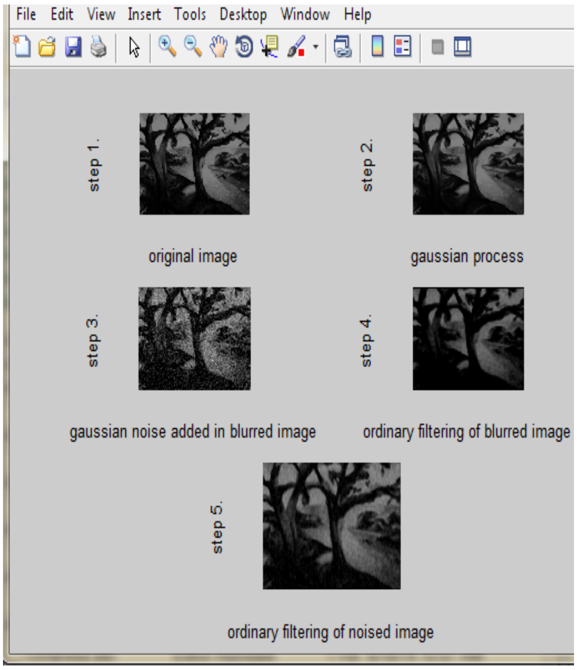

Fig -6: Gaussian deblurring process with gaussian noise in Ordinary filtering.

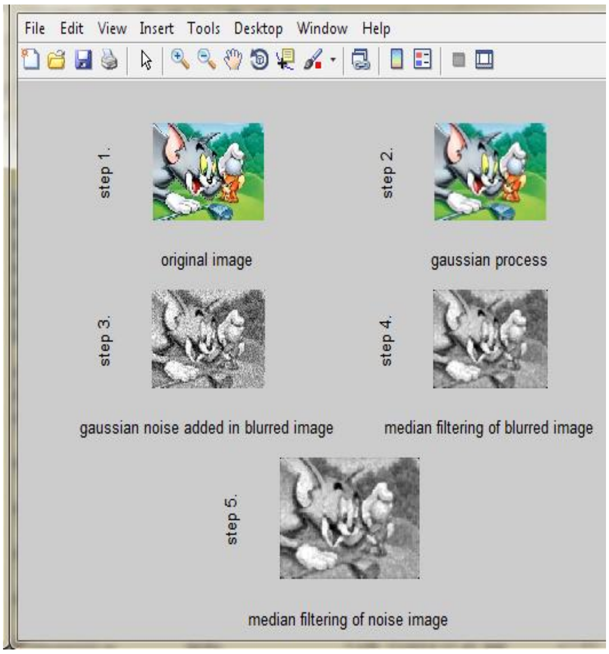

Fig -8: Gaussian deblurring process with gaussian noise in Median filtering.

The following tables shows the different PSNR and MSE values through which we can judge that which filter is best and comparing them.

Table 1 – PSNR in dB in Wiener Filtering

Deblurring Methods / Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	59.5448	56.6984	54.7804	50.4465
Disk Process	55.3720	54.4907	53.6547	55.5710
Unsharp Process	52.9114	54.2014	53.8087	53.3154
Log Process	-	52.3872	-	-
Gaussian Process	62.4521	49.943	63.0100	59.4788

Table 2 –PSNR in dB in Ordinary Filtering

Deblurring Methods Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	38.4364	40.84887	41.9184	40.9500
Disk Process	40.7439	45.7442	45.5759	40.4713
Unsharp Process	37.6836	38.4473	40.3584	38.5415
Sobel Process	37.0322	34.3100	37.1451	34.6314
Log Process	41.7645	38.4883	45.3884	38.5371
Gaussian Process	37.2425	43.6027	41.2532	38.9401

Table 3 –PSNR in dB in Median Filtering

Deblurring Methods Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	49.7371	42.0637	50.8290	51.0116
Disk Process	50.9572	40.1936	52.1178	50.0039
Unsharp Process	43.0350	42.4453	43.4982	46.0546
Sobel Process	37.7114	37.4848	41.7345	39.0547
Log Process	50.1520	38.1229	48.384	41.1875
Gaussian Process	47.1520	46.0855	50.8828	59.8618

Table 4 –MSE in wiener filtering

Deblurring Methods Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	0.0562	0.1083	0.1884	0.4538
Disk Process	0.1469	0.1800	0.2182	0.1404
Unsharp Process	0.2590	0.1924	0.2106	0.2360
Sobel Process	-0.4103	0.3704	-0.2243	-0.0248
Log Process	-0.1368	0.2922	-0.1528	-0.1797
Gaussian Process	0.0288	0.5125	-0.0499	0.0571

Table 5 –MSE in ordinary filter

Deblurring Methods Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	7.2565	4.1638	3.2548	4.0678
Disk Process	4.2656	1.3488	1.4021	4.5418
Unsharp Process	8.6298	7.2383	4.6615	7.0831
Sobel Process	10.0265	18.7658	9.7692	19.4272
Log Process	3.3722	7.1703	1.1639	7.0902
Gaussian Process	9.5524	2.2085	3.7935	6.4619

Table6 –MSE in Median filtering

Deblurring Methods Noise	Speckle noise	Salt & Pepper noise	Poisson noise	Gaussian noise
Motion Process	0.5378	3.1477	0.4183	0.4011
Disk Process	0.4061	4.8417	0.3109	0.5058
Unsharp Process	2.5169	2.8829	2.2623	1.2558
Sobel Process	8.5748	9.0341	3.3956	6.2935
Log Process	0.4888	7.7997	0.7349	3.8514
Gaussian Process	1.0028	1.2468	0.4131	0.0523

Hence from the above comparisons, it is clear that wiener filter is the best. It shows better results from all other filters. It has high PSNR value and lower MSE.

III. Conclusions

This paper shows various approaches for image restoration based on deblurring methods. The performance of different deblurring methods and their experimental results shows that Gaussian process yield best result. The relative performance of various deblurring process with noise as well as filtering is carried out with an image by using MATLAB software. Also, the different filtering techniques are applied in this project which tells that wiener filtering gives better performance on the basis of PSNR, than median filter and ordinary filter.

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