A Performance Evaluation on Face Image Enhancement with Salt & Pepper Noise Using Gaussian Filtering

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Abstract- Filtering of noise is one of the most important tasks in digital image processing. Elimination of noise is an image is still a challenging task for the researchers. Various researches were underlying on face recognition due to the variations in image acquisition such as poor illumination, viewing directions etc. However, the authenticity of noises that might insert into an image document will affect the performance of face recognition algorithms. Hence, different filtering algorithms are presented for noise elimination using various filtering algorithm. Finally, the experiments and results show that a Gaussian filter outperforms the other existing filtering algorithms like Mean, Median, Wiener, High Boost, under Salt and Pepper Noise.

Keywords- Mean Filter (MF), Median Filter, Wiener Filter, GF, HBF, PSNR.

I. INTRODUCTION

In the computer era there is a rapid growth within the field of information technology and also the security system was affected by numerous problems. Today, criminals have been entered into the field of information technology known as cyber crime. Lot of security systems has emerged to solve the various security problems like password, username, secret codes, but failed due to cyber attacks. in order to beat such security problems the biometric system has been emerged with various options like face recognition, fingerprints recognition, gait, palm print, voice, signatures etc.

Every human being will identify a faces in a scene with no effort, with an automated system such objectives are the very challenging one because of various factors which affects the quality of the image. Hence, face recognition system has been used to verify the identity of a personal. It can be accomplished by matching process using various methods and features. Filters are widely accepted to remove impulsive and high frequency noise for signal and image processing. Spatial filtering term is the filtering operations that are performed directly on the pixels of an image.

II. RELATED WORK

In recent years, considerable progress has been made in the area of face recognition with the development of many techniques. Even these techniques perform extremely well under various constrain, the problem of face recognition in uncontrolled by noisy environment remains unsolved. Image noise can originate in film grain or in electronic noise in the input device such as scanner digital camera, sensor and circuitry or in the unavoidable shot noise of an ideal photon detector. Noise affects the identification of images in authentication and also in pattern recognition process. The identification of the nature of the noise [1] is an important part in determining the type of filtering that is needed for rectifying the noisy image. Noise in imaging systems is usually either additive or multiplicative. The basic types of noise can be further classified into various forms such as amplifier noise or Gaussian noise, Impulsive noise or salt and pepper noise, quantization noise, shot noise, film grain noise and nonisotropic noise.

A model [2] proposed with noise removal filtering algorithms. Most of them follows certain statistical parameters and know the noise types. Applying various a filtering algorithms that is sensitive to additive noise to an image that has been degraded by a multiplicative noise which does not provide best results. Many algorithms have been developed to remove salt & pepper noise in document images with different performance in removing noise and retaining fine details of the image.

Various filtering techniques exist to perform the inverse of the imperfections in the degraded image [3], [4]. These filtering techniques are application oriented. Some filtering techniques perform better than the others techniques based on the noise category. These filters are used in a variety of applications [5] efficiently in preprocessing module.

III. NOISE TYPES

The noise is characterized by its pattern and its probabilistic characteristics. There is a wide variety of noise types while this paper focus on the most important types they are Gaussian noise, salt and pepper noise, poison noise, impulse noise, speckle noise.

Gaussian noise is statistical noise that has its probability density function equal to that of the normal distribution, which is also known as the Gaussian distribution.

Salt and pepper noise is a form of noise typically seen on images. It represents itself as randomly occurring white and black pixels.

Speckle is a complex phenomenon, which degrades an image quality. Speckle noise is a multiplicative noise. The speckle noise follows a gamma distribution [6]. For the quality and edge preservation of images are taken different denoising techniques into consideration.

IV. EXISTING METHODOLOGY

A. Filters

Generally filters are used to filter unwanted object in the images are affected by noises. The filters is to improve the quality of image using enhancement. Image filtering is used various applications they are smoothing, sharpening, noise removal and edge detection. A filter is defined by a kernel which is small array applied to each pixel and its neighbours within an image. A general structure of a filter mask is as follows.

-1	-1	-1
-1	N	-1
-1	-1	-1

Fig.1.1 Filtering Mask

B. Frequency and Spatial Filters

The frequency domain technique is based on convolution theorem. It decomposes an image from its spatial domain to form brightness are represented as the following equation.

$$g(x,y) = h(x,y) * f(x,y) \quad (1)$$

Where $f(x,y)$ is the input image, $h(x,y)$ is a position invariant operator and $g(x,y)$is the resultant image from the convolution theorem.

$$G(u,v) = H(u,v)\, F(u,v) \quad (2)$$

Where G, H, F is the fourier transform of g, h, f respectively. The transform H (u, v) is called transfer function of the process. Here the edge in f(x,y) can be boosted by using H(u,v) to emphasis the high frequency component of F(u,v). In case of spatial filter works on pixels in the neighbourhood of the pixel. The operation on sub image pixels is defined using mask.

C. Mean Filter (MF)

The Mean Filter is linear filter which uses mask over each pixel in signal. Each components of pixels are fall under mask are averaged together to form single pixel. This filter is also called average filter and the mean filter is poor for edge preserving. The Mean filter is defined by:

$$\hat{f}(x,y) = \frac{1}{mn}\sum_{(s,t)\in S_{xy}} g(s,t) \quad (3)$$

Where M is total number of pixels in the neighborhood N. Mean filtering is simple and easy to implement method of smoothing images are used to reduce noise in images.

D. Median Filter (MF)

Median filter is used for removing a impulse noise. The corrupted images are replaced by individual pixels of an image. The median is also known as special type of low-pass filter. The median filter takes area of an image sorts out all the pixel values are replaced with center pixel value. Median filters are popular because of random noise are provides with less blurring than linear smoothing filters of similar size.

E. Wiener Filter

The wiener filtering requires information about spectra of the noise with the original signal is smooth. Wiener method implements spatial smoothing. Wiener filtering able to achieve significant noise removal in the variance of noise is low they cause blurring and smoothening of the sharp edges of the image [7]. Detecting an emotion in highly corrupted noisy environment this approach involves removal of noise [8].

$$\hat{F}(u,v) = \frac{1}{H(u,v)}\{\frac{|H(u,v)|^2}{|H(u,v)|^2 + s_\eta(u,v)/s_f(u,v)}\}G(u,v) . \tag{4}$$

Where

H(u, v) = Degradation function

H*(u, v) = Complex conjugate of degradation function

Pn (u, v) = Power Spectral Density of Noise

Ps (u, v) = Power Spectral Density of un-degraded image

F. High Boost Filter (HBF)

A high boost filter is also known as a high frequency emphasis filter. A high boost filter is used to retain some of the low-frequency components to and in the interpretation of a image. In high boost filtering the input image f(m,n) is multiplied by an amplification factor A before subtracting the low pass image are discuss as follows.

High boost $=A\times f(m,n)$ - low pass

Adding and subtracting 1 with the gain factor,

High boost = $A-1 \times f\ (m,n\ )+f(m,n)$ - low pass

Where $f(m,n)$ - low pass= high pass

High boost= $\boldsymbol{A-1} \times \boldsymbol{f(m,n)}$+high pass (5)

G. Gaussian Filter (GF)

Gaussian filters are a class of linear smoothing filter with the weights chosen according to the Gaussian functions. Mainly these kind filters are used to smooth the image and to eliminate the Gaussian noises. The Gaussian smoothing filter is very good in noise removal in normal distribution function. This filter is rotationally symmetric the amount of smoothening is all direction.

V. ALGORITHM

Input: Input image from IDB
Output: Pre-processed Image

Step 1: Read an image from the image database (IDB)
Step 2: Perform procedure_ filtering ()
Step 3: Repeat step 2 for all images in database (IDB).
Step4: Stop

// Procedure for Noise Elimination//
Perform procedure_filtering ()
Begin
Step 1: *Pre-process the image by the following*

- *Apply mean filter, median filter, wiener filter, High boost filter, Gaussian filter on the input image .*

Step 2: *Estimate the MSE and PSNR using the equation 6 and the equation 7.*
end

VI. EXPERIMENTS & RESULTS

6.1 Performance Measure

The following mathematical metrics are used for the evaluation of the algorithm.

- Peak Signal to Noise Ratio (PSNR)
- Mean Squared Error (MSE)

6.1.1 Peak Signal to Noise Ratio (PSNR)

The peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale.

The PSNR is defined as,

$$PSNR = 10\log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \quad (6)$$

Here, MAX_I is the maximum pixel value of the image. When the pixels are represented using 8 bits per sample, this is 255. More generally, when samples are represented using linear PCM with B bits per sample, maximum possible value of MAX_I is 2^B-1.

6.1.2 Mean Squared Error (MSE)

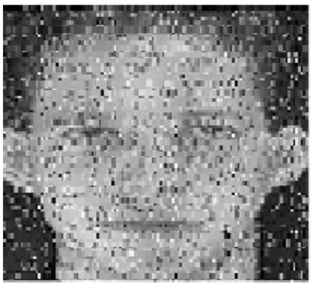
The PSNR is most commonly used as a measure of quality of reconstruction in image compression etc. It is most easily defined via the mean squared error (MSE) which for two m×n monochrome images I and K where one of the images is considered a noisy approximation of the other is defined as,

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1} \| I(i,j) - K(i,j) \|^2 \quad (7)$$

For color images with three RGB values per pixel, the definition of PSNR is the same except the MSE is the sum over all squared value differences divided by image size and by three. In general, a good reconstructed image is one with low MSE and high PSNR. That means that the image has low error and high image fidelity.

The performance of the existing filters is measured by conducting the following procedure. The performance of the filters is measured by applying salt and pepper noise on the face images. The sample face images downloaded are used to analysis this work. For our experiments, the sample facial images from the standard facial image database are used. It contains a total of 400 images containing 40 subjects each with 10 images that differ in poses, expressions and lighting conditions. Figure 1.2 shows the sample images used in our experiments used with Salt & Pepper noise. From the figure 1.3 shows noise removed using mean filter, median filter and wiener filter.

Original Image



Noisy Image

Output Image

Fig.1.2 Sample and Noisy image

Fig.1.3 Noise Removed image

Table.1 PSNR Comparison Values

Image No.	Mean Filter	Median Filter	Wiener Filter	High Boost Filter	Gaussian Filter
1	22.47	29.35	30.77	17.90	**32.13**
2	22.78	27.95	31.63	18.09	**32.46**
3	21.62	28.43	30.95	17.95	**31.31**
4	22.86	27.12	31.99	17.93	**32.53**
5	24.34	29.54	33.15	18.64	**33.97**
6	24.46	30.51	33.87	20.19	**34.21**
7	21.85	29.01	30.79	17.69	**31.62**
8	22.40	27.64	31.73	17.02	**32.05**
9	22.53	29.54	31.98	20.48	**32.29**
10	25.00	29.46	33.98	19.07	**34.62**

From the above Table.1 it is observed that the PSNR values of the Gaussian Filter gives better performance for face images affected by salt and pepper noise when compared with mean, median filter, wiener filter and high boost filter. The below figure 1.4 shows the pictorial representation of the performance evaluated. By analysing the obtained results the Gaussian filter produced the best results. Hence the Gaussian filter is an efficient one.

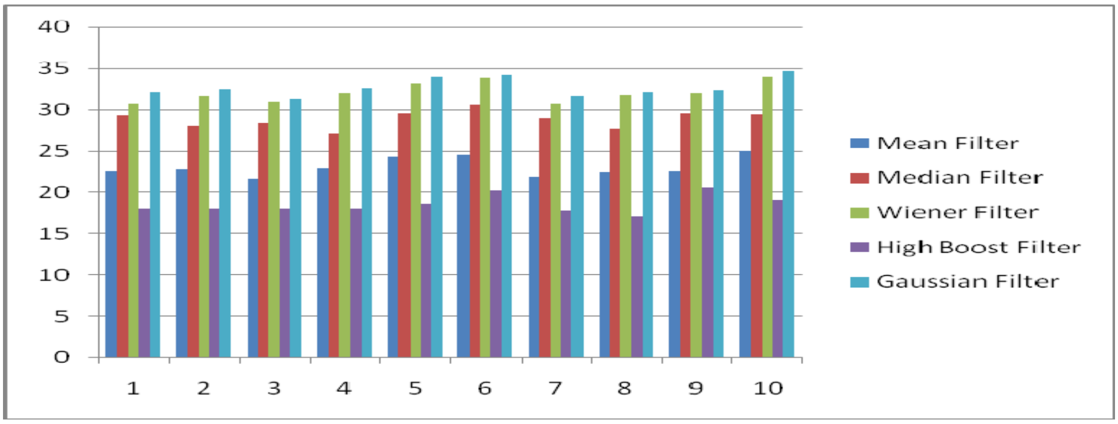


Fig.1.4 Performance Evaluation

VII. CONCLUSION

In this paper the performance various filtering techniques are evaluated for salt and pepper noise. The image quality plays an important role in face images. In order to improve the quality of face there are various preprocessing methods are available. From the experimental and results it is conclude that Gaussian Filter (GF) is best for face image noise removal gives better performance by estimating the PSNR values.

VIII. REFERENCES

[1] L. Beaurepaire, K.Chehdi, B.Vozel, ‘Identification of the nature of the noise and estimation of its statistical parameters by analysis of local histograms’, Proceedings of ICASSP-97, Munich, 1997.

[2] H.S.M. Al-Khaffaf , A.Z. Talib, R. Abdul Salam, ‘A Study on the effects of noise level, cleaning method, and vectorization software on the quality of vector data’, Lecture Notes in Computer Science 299-309.

[3] D.Gnanadurai, and V.Sadasivam, “An Efficient Adaptive Thresholding Technique for Wavelet based Image Denoising”, International Journal of Signal Processing, Vol.2, pp.115-128, no.2, 2003.

[4] Chan, Chung Wa Ho, and Mila Nikoloya, “Salt-andPepper Noise Removal by Median-type Noise Detectors and Detail-preserving Regularization”, Image Processing, IEEE Transactions. Volume 14, pp: 1479-1485, Issue 10, Oct.2005.

[5] C.Lakshmi& M.Sundararajan, “Biometric Security system using Face Recognition”, Publication of International Journal of Pattern Recognition and Research, pp. 125-134, July 2009.

[6] Jappreet Kaur, Manpreet Kaur, Poonamdeep Kaur, Manpreet Kaur,” Comparative Analysis of Image Denoising Techniques”, International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume2, Issue 6, June 2012.

[7] Anjali Malviya,” Fractal Based Spatial Domain Techniques for Image De-Noising”.

[8] Kanchan Lata Kashyap et.al. “Noise Removal of Facial Expression Images using Wiener Filter”, National Conference on Emerging Trends in Computer Science and Information Technology (ETCSIT) 2011 Proceedings published in International Journal of Computer Applications.

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