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A Unique Technique to Minimize Salt-Pepper Noise Using a Fuzzy Set for Gray Level Imaging

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Abstract: This Eliminating noise from the image is one of the deep challenges in the area of image processing and computer vision, where the core objective is to estimate the experimental image, smoothing noise from a noise-impure version of the image. Image noise can becaused by unlike intrinsic and extrinsic conditions that are repeated not possible to avoid in realistic state.. Therefore, denoising image plays an vital role in a ample range of purpose such as image restoration, visual tracking, image registration, image segmentation and classification, where to obtain image content where image filtering has great importance in work fields of life such as medicine, video production, photography, remote sensing, security monitoring, extra .The original is crucial for performance solid. Noise reduction is the process of eliminating noise from images; Each pixel in the image will change from the original values in a small amount. A noise elimination algorithm is to achieve noise reduction and resource preservation, but due to the limitations of the methods, it is blurred. The noise in different pixels can be correlated or not, because noise modeling is a very difficult task. We observed that the performance of the proposed study diffuse set and the 3x3, 3x5, 2x3 size filter windows, the adaptive weighted average filter and the medium filters were used to reduce the salt and pepper noise filters and the elimination context noise, the most relevant value Accuracy is recovered. By using MATLAB software, three objective measures, Mean Square Error (MSE),Peak Signal to Noise Ratio (PSNR were used to evaluate the quality of the filtered image. Finally, our results are compared with the image improvement factor (IEF), the mean square error (MSE) and the peak signal-to-noise ratio (PSNR)

***Index Terms* – Denoising, Fuzzy Filter, IEF, PSNR, MSE,**

I. INTRODUCTION

There are three levels of image processing between transmitting part to receiving end. At the lowest level image acquisition, image filtering, image enhancement and image restoration etc., handle source information directly. Further, the output of the first level processing is exploited for a second or middle level segmentation and edge preservation process. The third or high level processes detail the most useful features for pattern classifications and matching. For Imaging technology is used to diagnose and authenticate the abnormalities in the human body in the field of medicine. It also helps to view the interior portions of the body without really opening too much with the help of digital imaging technology. Recently, image processing techniques are incorporated for analyzing the outputs of medical imaging systems to get the best advantage to examine symptoms of the patients without further difficulty

However, they are susceptible to different noises such as Salt-and- Pepper Impulse Noise (SPIN), Random-Valued Impulse Noise (RVIN), Poisson Noise, Speckle Noise and Additive White Gaussian Noise (AWGN) during acquisition, storage and transmission. Moreover, degradation of an image by noise is a common problem in most image processing applications. Hence, image denoising is a mostly opted technique for medical image analysis tasks. The median based filters and conventional filters are the most popular filters for noise reduction in medical images and videos. Nevertheless, some of the popular methods fail to remove the high noise level densities. This thesis focuses on the removal of impulse noises,

Gaussian noise and mixed noises from noise contaminated medical images and videos using efficient median based filters

In general, image restoration is playing a vital role in the medical imaging field. The image denoising or restoration is used for filtering various types of noise sources present in CT/MRI scanned image. Image restoration, the most significant pre-processing technique of digital image processing where, noise, vagueness and blurriness are removed from the corrupted image, is also analyzed in this study

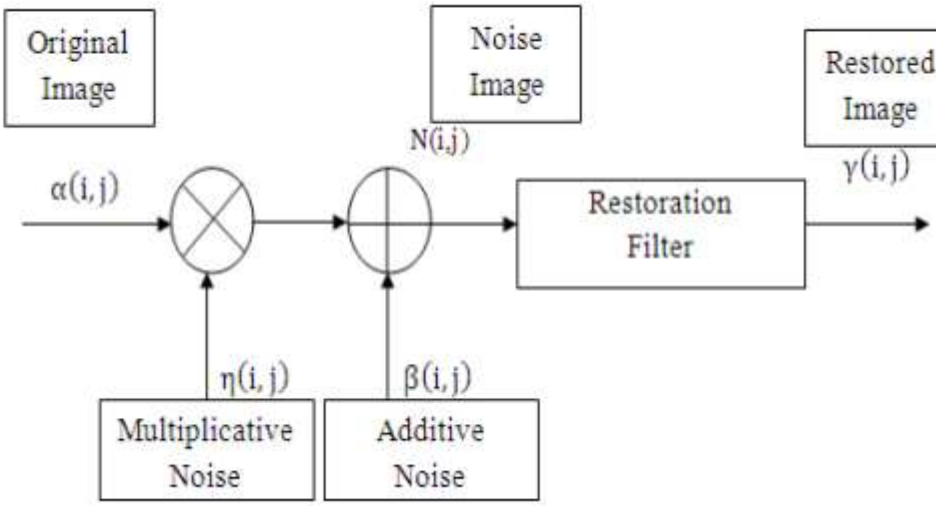

Figure 1.1 Image Restoration Filtering Model

Figure 1.1 shows the denoising model of an image restoration process. A corrupted image N(i,j) is generated when the multiplicative noise η(i,j) and additive noise β(i,j) together operate on an input image α(i,j) which can be denoted in Equation (1.1) as follows:

$$N\ (i, j)\ = \alpha\ (i, j)\ .\ \eta\ (i, j)\ +\ \beta((i, j)) \qquad (1.1)$$

When additive noise β (i, j) is the only degradation present in an image, the expression is as follows:

$$N\ (i, j)\ = \alpha\ (i, j)\ +\ \beta((i, j)) \qquad (1.2)$$

In this thesis, η (i, j) is assumed as an identity operator with no effect on the input image and the noise added in the image is just an additive noise β (i, j) .

DENOISING FILTERING TECHNIQUES

Most of the filtering methods are processes of lifting the quality of the degraded image, performed by operation either in spatial domain or spectral domain. Ideally, filters are classified as linear and nonlinear types and are depicted in Figure 1.2

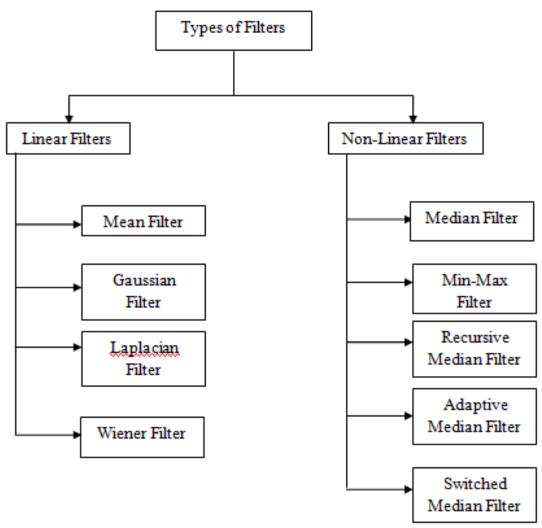

Figure 1.2 Types of Filters

II. LITERATURE REVIEW

The adaptive median filter (AMF) [15] uses varying window size for the removal of noise. Size of window increases until correct value of median is calculated and noise pixel is replaced with its calculated median value. In this filter two conditions are used one to detect corrupted pixels and second one is to check correctness of median value. If test pixel is less than minimum value and greater than maximum value of the pixel present within the window then center pixel is treated as noisy pixel. If calculated median value is less than minimum value and greater than maximum value present in the window then median value is treated as corrupted value. If calculated median is corrupted then increase the window size and recalculate the median value until we get correct median value or else window size reach maximum limit.

▪ Progressive Switching Median Filter:

The Progressive median filter (PMF) [16] is a two phase algorithm. In the first phase noisy pixels are identified using fixed size window of size 3×3. If test pixel is less than minimum value and greater than maximum value of the pixel present within the window present then center pixel is treated as corrupted pixel. In second phase prior knowledge of noisy pixels is used and noisy pixels are replaced by the estimated median value. Here median value is calculated in the same way as in AMF without considering the corrupted pixel present in window.

▪ Tri-state Median Filter:

The Tri-State Median filter (TSMF) [5] is a two phase algorithm. In phase one noisy pixel are identified using standard median filter. In second phase prior knowledge of noisy pixels is used and noise pixels are replaced by Center weighted median filter.

▪ Decision Based Algorithm:

The Decision-Based algorithm (DBA) [17] is a two phase algorithm. In phase one noise pixels are identified using fixed size window of 3×3. In second phase prior knowledge of noisy pixels is used and noise pixels are replaced by middle value of sorted window pixels. In this time complexity of algorithm is analyzed.

Many more modified forms of median filters have been proposed like weighted median (WM) filter [18], switching median [SWM] filter [19], directional weighted median (DWM) filter [20], modified switching median (MSWM) filter [21] etc.

Apart from classical techniques, recent progress in the fuzzy logic results in the development of new noise reduction methods. Fuzzy filters are easy to realize by means of simple fuzzy rules that characterize a particular noise. Already several fuzzy filters for noise reduction have been developed, such as the well-known Fuzzy Inference Rules by Else action (FIRE) filters by Russo[22]-[26].Due to good performance FIRE filters have been used by several authors to improve the efficiency of their work such as Ville [27]. Jiu [28] also proposed a multilevel filter in fuzzy domain. Various fuzzy filters results from the modification of the classical median filter such as a new impulse detector for switching median filters [29]. To improve the efficiency, Arojawa [30-31] employed fuzzy rules to the classical median filter to develop a fuzzy median filter.

One common problem seen while processing of images is blurring of edges. It is due to linear filtering. To deal with blur Overton et al. [32] and Perona et al. [33] developed efficient filters. To preserve edges, an edge preserving fuzzy filter for color images developed by Verma et al. [34] provides efficient results. It is a novel technique to detect and remove impulse noise in color images. More sophisticated algorithms have been developed using fuzzy reasoning as well as non fuzzy mechanisms to provide better detection of noise resulting in accurate restoration. Our goal here is not to give an exhaustive inventory of impulse noise removal algorithms but comparison of some popular ones with our proposed algorithm.

In our study the following filters are used for comparative analysis with our proposed scheme..

III. Proposed methodology

2.1 Salt Pepper Noise and Noise level

Image independent noise can often be defined by an additive noise model, where the recorded image F (m,n) is the sum of the true image I (m ,n)and the noise N (m ,n)

$$F(m, n) = I(m, n) + N(m, n) \qquad 3.1$$

The variance of image is given by σ_s^2 and the noise $N(m, n)$ is repeatedly zero-mean and defined by its variance σ_n^2 . Salt and Pepper Noise (SPN) appears as black and white dots superimposed on the image. This is caused generally due to errors in data transmission. It has only two possible values, 'a' and 'b'. The probability of each is typically less than '0.1'. The Probability Density Function (PDF) of Salt and Pepper Noise is given by;

$$f(x) = \begin{cases} pa\ for\ z = 0 \\ pb\ for\ z = 255 \\ 0\ otherwise \end{cases} \qquad 3.2$$

the image noise variance is not even in an image, granularity of noise-level estimation needs to be smaller in order to recover denoising performance. Pixelwise noise-level estimation is the vital form.

2.2 Median Filter

The pixel values in the particular window are greater than

Arranging from small to small or large to the window

It is the filter that replaces the outlier with the median value.

$$W = (q, t) - N \leq q \leq N, -N \leq q \leq N \qquad 3.3$$

$$Y(i, j) = MED(X(i + q, j + q)(q, t) \in W \qquad 3.4$$

2.3. Adaptive median filter (AMF)

Adaptive median filter (AMF) make use of median filters adaptively. It mostly enlarge the window size by comparing evaluate median value with acute values of image. The problem with AMF is that there might have background pixels which equal the acute values of image. In such a condition, AMF will remain extending its window size until the window contains a median value that is not equal to one of two extreme values. To get better the performance, weighted median (WM) filter]was proposed by assigning weight age to each location with the help of weighted window. WM value of a pixel X(i, j) is

$$WM(i, j) = MED(X(i + q, j + q)(q, t) * W(i + q, j + q)(q, t) \in W \qquad 3.5$$

where ◊ is the repetition operator such that K⋄X ¼ X; X; X; ……; X z}|{

2.4 Adaptive Fuzzy Filter

Triangle type membership function of fuzzy filter uncertainty zone and membership limits defined for According to the fuzzy filter rules are determined. These rule

by; representing noise 0, 255 and these pixels 0 membership degrees at close values, from these values the degree of membership approaching 1 as you move away and the window average value equal to the smallest or largest value if there is a membership degree equal to 1 fuzzy inferences are obtained. Fuzzy rules these inferences are the coefficients of the F fuzzy filter. It has determined. K = 1 and 3x3 dimensions window matrix with MxN size image from left scanned to the right and from top to bottom. Each of the filter F blurry filter by repeating all the rules in motion coefficients were recovered and the fuzzy filter adaptive work was provided. Adaptive fuzzy filter flow diagram and triangle of fuzzy filter

The membership function of the type is Figure 1 and Figure, respectively.

It is shown in 2.

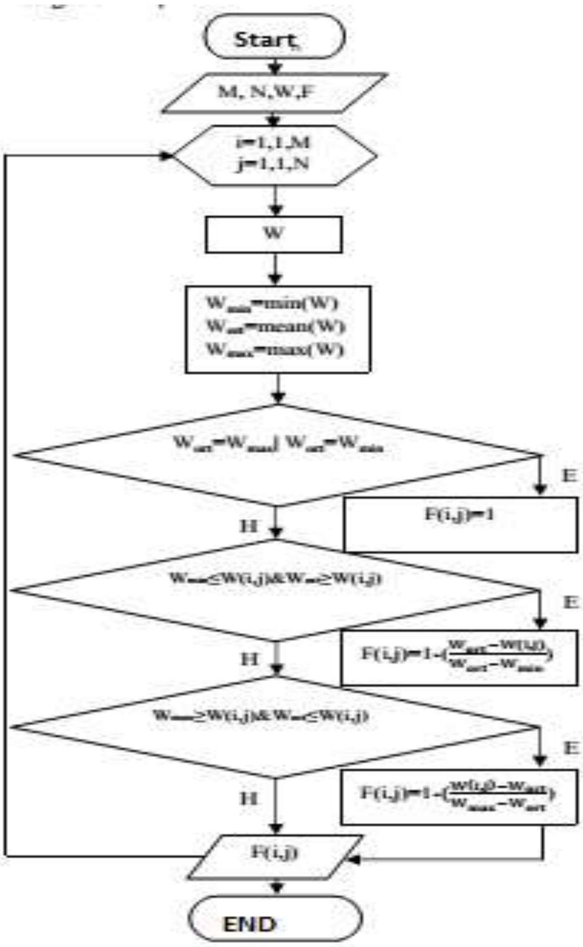

Figure 3: Adaptive fuzzy filter flow diagram.

W- adaptive image matrix (2K + 1) x (2K + 1),
i, j - index values of the window,
Waverage value of the window,
Wmin- the smallest value of the window,
Wmax- window's largest value

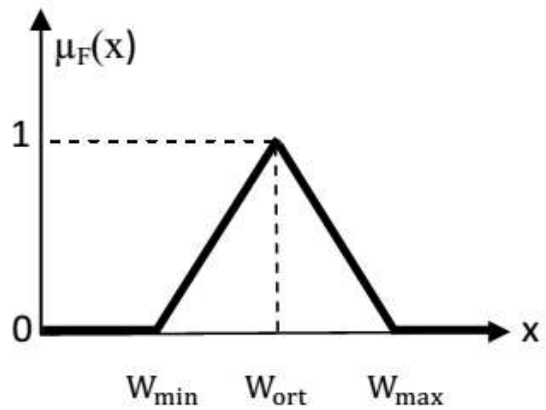

Figure 4: Fuzzy filter membership function

IV.RESULT OBTAINED

The original image has been corrupted by the addition of Salt and Pepper noise of different variance. The IEF of the proposed blur reducing adaptive filter is compared with the IEF of median ,adaptive weighted filters and adaptive fuzzy filter. The IEF for the proposed new adaptive filter is found to be greater than mean, median filters, which shows the significant removal of noise. The IEF has been calculated for various filters with window size of 3X3, and TABLE 1 IEF FOR MIXED NOISE (GAUSSIAN NOISE IS OF VARIANCE 100) are given in Table 1. and Table 2. The impulses are eliminated, with the preservation of edges. Objective analyses of the filter performance shows that the mixture of white Gaussian noise and impulses are eliminated and edges are preserved with the reduction in blur the results of the proposed adaptive adaptive fuzzy filter for various amounts of noise with the window size of 3x3. represents the image corrupted by the mixture of salt and pepper noise of an amount of 10% and Gaussian noise is of variance 200. The corresponding filtered image is depicted

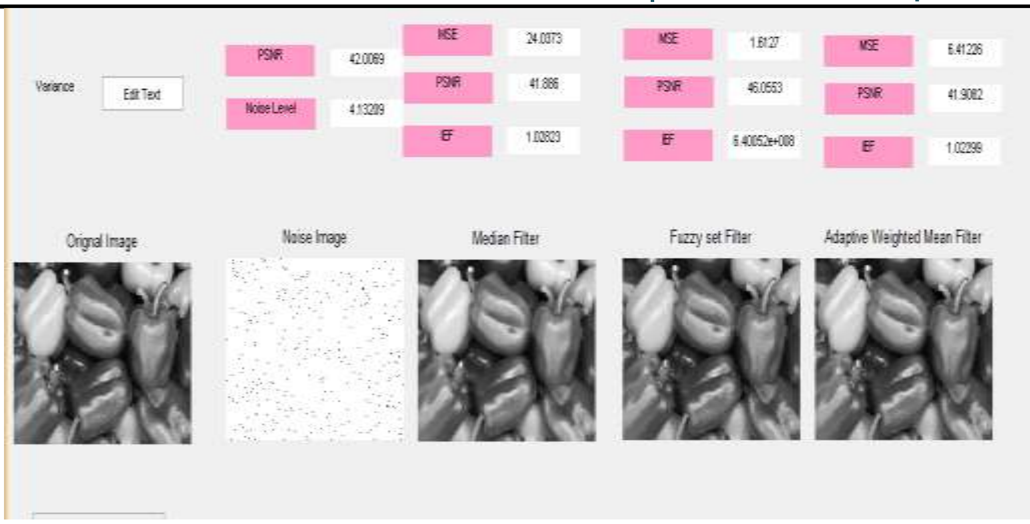

Figure 5 Comparision of Noise level & Median Filter ,Adaptive weighted filter and Adaptive Fuzzy Filtter

. Fig 3. shows the comparison of the results of the proposed blur reducing adaptive fuzzy filter with that of the results of Noise level & Median Filter,Adaptive weighted filter and Adaptive Fuzzy Filtter The comparison results for various amount of SPN noise is shown in Table 1The comparison results are made for various amount of mixed noise. It is found that IEF for the proposed filter increases as the amount of impulse noise increases and is greater than the IEF of other filters. The IEF decreases as the corrupted amount of Saltand pepper noise increases.

Table 1. Comparisons of Noise level

Sr no	Variance(%)	Noise Level	PSNR
1	0.001	4.132	42.069
2	0.002	3.457	42.0122
3	0.003	4.108	41.98
4	0.004	3.8269	42
5	0.005	4.089	42.015

Table 2. Comparisons of Median Filter

Sr. no	Variance(%)	mse	psnr	ief
1	0.001	24.073	41.886	1.0283
2	0.002	24.28	41.866	1.029
3	0.003	23.063	41.8849	1.0249
4	0.004	24.52	41.88	1.02894
5	0.005	24.25	41.885	1.0302

V CONCLUSION

Analog to digital converters, errors due generated by noisy sensors and faulty equipments result in corrupted images by impulse noise. Many techniques have been introduced in the literature to remove noise. At low noise intensity of noise many algorithms perform well but as soon as the noise levels are increased, performance of the method degrades. Therefore, we developed a filter which provides consistent outputs.

Experimental results show that the proposed algorithm significantly outperforms existing well- known techniques. The main advantage of our algorithm is that its performance is not degraded with increasing noise level. It can easily handle high noise levels up to 80%. It is easy to understand as it has uncomplicated structure and intuitive in nature .It provides good results on different images even in real world applications. The application of NAFSM algorithm in the detection phase provides optimal results and makes it a novel technique.

In future, work will be extended for RGB images as well as video images. Our main focus has been the correct detection of noisy pixels so that the restoration provides optimal results. We will extend our work towards optimal restoration of images.

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REFERENCES

[1] C. C. Kang and W. J. Wang, “Modified switching median filter with one more noise detector for impulse noise removal,” Int.J.Electron.Commun.No. DOI: 10.1016/j.aeue.2008.08.009, 2008.
[2] Russo, F, “A FIRE filter for detail-preserving smoothing of images corrupted by mixed noise,” IEEE fuzzy syst., vol.2, pp 1051-1055, July 1997.
[3] Russo F., Noise Cancellation Using Nonlinear Fuzzy Filters, in: IEEE Instrumentation and Measurement Technology Conf., 1997,pp.772-777
[4] Russo F., FIRE operators for image processing, in: IEEE Fuzzy Sets and Systems, Vol. 103, 1999, pp. 265-275.
[5] Russo F. & Ramponi G., A fuzzy filter for images corrupted by impulse noise, in: IEEE Signal proceedings letters, Vol.3, No. 6, 1996, pp. 168- 170.
[6] Russo F. & Ramponi G., Removal of impulse noise using a FIRE filter, in: IEEE Proceedings, 1996, pp. 975-978.
[7] Kwan H.K., Fuzzy Filters for noise reduction in images, in: Fuzzy Filters for Image Processing (Nachtegael M., Van der Weken D., Van De Ville D. & Etienne E.E., editors), Springer-Verlag, 2002, pp. 25-53
[8] Jiu J.Y., Multilevel median filter based on fuzzy decision, DSP IC Design Lab E.E. NTU., 1996.
[9] S. Q. Zhang and M. A. Karim, “A new impulse detector for switching median filters,” IEEE Signal Process. Lett, vol. 9, no. 11, pp. 360–363, Nov. 2002
[10] K. Arojawa, “Median Filter based on Fuzzy Rules and its Application to Image Restoration”, Fuzzy Sets and Systems, Vol. 77, pp. 3-13, 1996.
[11] K. Arojawa, Edited by E.E. Kerre and M. Nachtegael, “Fuzzy Ruled-Based Image Processing with Optimization”, SpringerVerlag, pp.222-247, 2000.
[12] K.J. Overton and T.E. Weymouth, "A noise reducing preprocessing algorithm",Proceedings of the IEEE Computer Science Conference on Pattern Recognition and Image Processing, pages 498-507, Chicago, IL, 1979.
[13] P. Perona and J. Malik, "Scale-space and edge detection using anisotropic diffusion", IEEE Transactions on Pattern Analysis and Machine Intelligence, 12(7):629-639, 1990.
[14] Verma, O.P.; Parihar, A.S.; Hanmandlu, M.; “Edge Preserving Fuzzy Filter for Color Images”; 2010 International Conference on Computational Intelligence and Communication Networks (CICN), : 2010 , pp: 122 – 127.
[15] P.-E. Ng and K.-K. Ma, “A switching median filter with boundary discriminative noise detection for extremely corrupted images,” IEEE Trans. Image Process., vol. 15, no. 6, pp. 1506–1516, Jun. 2006.
[16] R. H. Chan, C.-W. Ho, and M. Nikolova, “Salt-and-pepper noise removal by median-type noise detectors and detail-preserving regularization,” IEEE Trans. Image Process., vol. 14, no. 10, pp. 1479–1485, Oct. 2005