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A FUZZY BASED CONTRAST ENHANCEMENT METOD AFTER REMOVAL OF IMPULSIVE NOISE

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***Abstract*— Image enhancement is the enrichment of perception of image by reducing impulse noise sharpens the image using some enhancement technique for human viewers. In this paper we propose a fuzzy technique for contrast enhancement in a image after removing impulse noise from the image. Denoised image is further enhanced by implementing fuzzy technique. Experimental result shows that PSNR and MSE value at high noise density are better than all other discussed methods. To the end of work we compare histogram of original and enhanced image to describe the effectiveness and accuracy of proposed method.**

***Index Terms*— fuzzy logic, image denoising, impulse noise, histogram Equalization.**

I. INTRODUCTION

Image enhancement attempts to improve the visual representation of an image to enhance its interpretability by either a machine or a human. Image enhancement comprehends a variety of operations such as deblur-ring, noise removal and gray-level dynamic range modification [1]. Contrast enhancement is often a part of image processing systems in the pre-processing or/and post-processing steps. Contrast enhancement methods based on spatial domain are divided into three main groups: local, global and hybrid. Global enhancement approaches enhance the image from the luminance information of whole image [2]. Local enhancement technique enhanced the image for each pixel based on the information of luminance, saturation, and retinex of its own and its neighbor [3]. Hybrid enhancement methods combined both global and local approaches. In these methods, an image is divided into non-overlay or overly regions and each region is conquered by global methods [4], [5].

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II. CONTRAST ENHANCEMENT ALGORITHM

Proposed method for contrast enhancement method is performed in two successive steps: first step enhance the image by removing noise presents in image using a fuzzy logic filter. Second step perform contrast enhancement of previous image using Histogram equalization method.

Contrast enhancement using fuzzy filter: Consider F is a grayscale image to be processed; w is a filtering window of size $n \times n$ pixels. Filtering window as shown in figure 2.1 below Centered at $F(x, y)$ is surrounded with numbers of neighbor points of different layer. Points at vertical and horizontal direction of outer layer 1 is stored in vec_1 and points at diagonals are stored in, similarly points in layer 2 are stored in vec_3 & vec_4, points in layer 3 are stored in vec_5 & vec_6. In each vec_i no of noisy points are find out and stored in an array named vec.

NW3			N3			NE3
	NW2		N2		NE2	
		NW1	N1	NE1		
W3	W2	W1	(X,Y)	E1	E2	E3
		SW	S1	SE1		
	SW2		S2		SE2	
SW3			S3			SE3

Figure 2II.1: Filter window of size 7*7.

$$vec_1 = [N_1, S_1, W_1, E_1] \quad (1)$$

$$vec_2 = [NW_1, NE_1, SW_1, SE_1] \quad (2)$$

$$vec_3 = [N_2, S_2, W_2, E_2] \quad (3)$$

$$vec_4 = [NW_2, NE_2, SW_2, SE_2] \quad (4)$$

$$vec_5 = [N_3, S_3, W_3, E_3] \quad (5)$$

$$vec_6 = [NW_3, NE_3, SW_3, SE_3] \quad (6)$$

$$vec = [val_1, val_2, val_3, val_4, val_5, val_6] \quad (7)$$

Where, val_i is number of noisy points in vector. vec is allowed as input to the fuzzy inference system to evaluate fuzzy rules. If $F(x,y)$ is corrupted and points of vec_1 is noiseless than mean value of vec_1 is used to assist the restoration of noisy pixel, but if vec_1 is corrupted than $vec_2$is used to assist new value to noisy point. It is not necessary for any vec_i that all points are noiseless or corrupted. To solve this problem fuzzy logic is used. Fuzzy rules are used to find the vec_i, which are responsible to restore the noisy pixel. Filter window is of size 7×7 here but for pixel at corner a limited filter of size $5 \times 5$and $3 \times 3$is used.

Contrast enhancement using fuzzy technique: In this algorithm fuzzy rules are based on square function and cubic function [14]. Fuzzy based algorithm is as given below:

Step1: Read the image.

Step 2: The image I=I(i,j), €{1,2,3,4,5….255} is considered to be of size m×n, where i=1,2,3……m and j=1,2,3……n.

Step 3: Assign L=255, maximum intensity in the image.

Step4: The fuzzification of the image is performed.

Step5: To design a new image matrix with values between 0 to 1, Devide each value in the input matrix by L=255.

Step 6: fuzzy rules are applied to enhance the image:

i. If fdata between 0 and 0.25
then fdata=3*(fdata) *(fdata) *(fdata)

ii. elseif fdata between 0.25 and 0.5 then
then fdata=2*fdata*fdata

iii. elseif fdata between 0.5 and 0.75
then fdata=1-2*(1-fdata) *(1-fdata)

iv. else fdata between 0.75and 1.0
then fdata=1-3*(1-fdata) *(1-fdata) *(1-fdata)

Step6: Conversion of image value in 0 to 255

i. Multiply by L=255 to each value in the entire image.

ii. Convert mage in unit8 format.

Step 7: Display the enhanced images.

Step 8: Finding the PSNR and MSE value of the images.

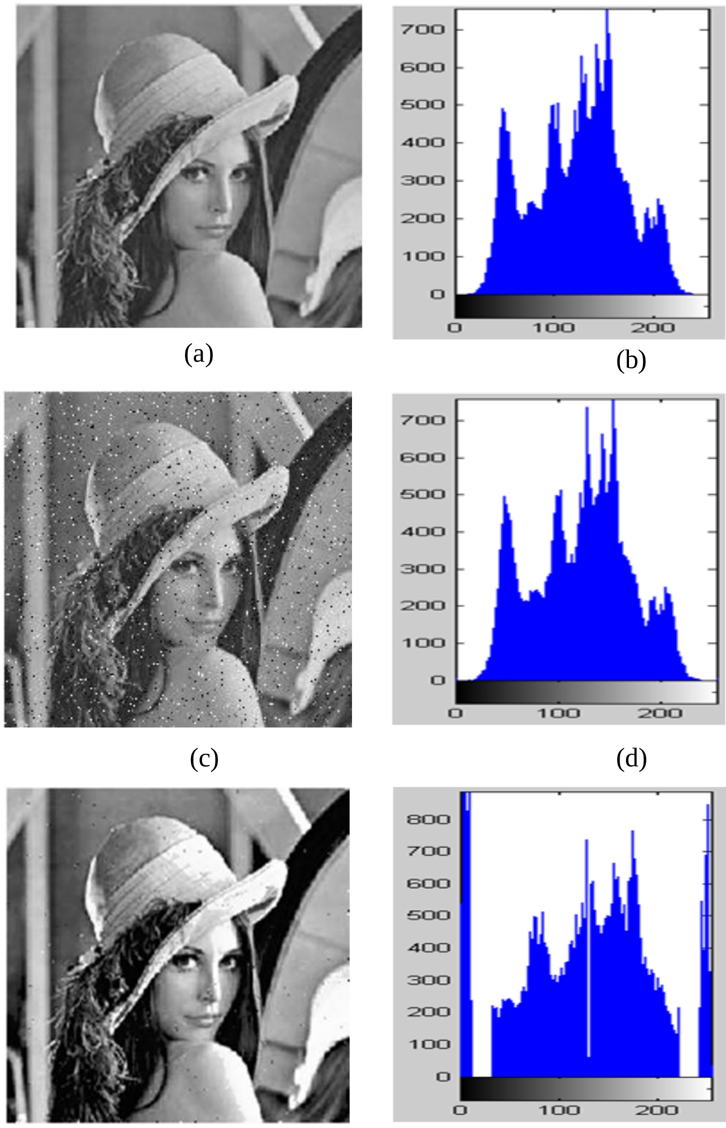
III. RESULT & DISCUSSION

Experiment is performed on two standard image of Lena and Gold Hill image. Value of peak-signal-to-noise-ratio (PSNR) and mean square error (MSE) in images is calculated on the basis of below equation (14) and equation (15).

$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right)(db) \quad (8)$$

$$MSE = \frac{\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}[y(i,j)-o(i,j)]^2}{M.N} \quad (9)$$

Where, $y(i,j)$ is resultant image of original image $O(i,j)$, having M rows and N columns.



(a) (b) (c) (d) (e) (f)

Figure 3.1 Enhancement results for lena image. (a) Original color image (b) histogram (c) noisy image (d) histogram (e) enhancement result by proposed method (f) enhancement histogram.

Figure 3.1 describe complete process of current method. Figure 3.1(a) show the original lena image and corresponding histogram is shown in figure 3.1(b). In figure 3.1 (c) noises is added to lena image and denoised using above described fuzzy method to enhance the contrast. Histogram of noisy image is shown in figure 3.1(d), in last step histogram equalization method is applied to image and finally enhanced image is generated as shown in figure 3.1(e) and histogram of enhanced image is shown in figure 3.1(f).

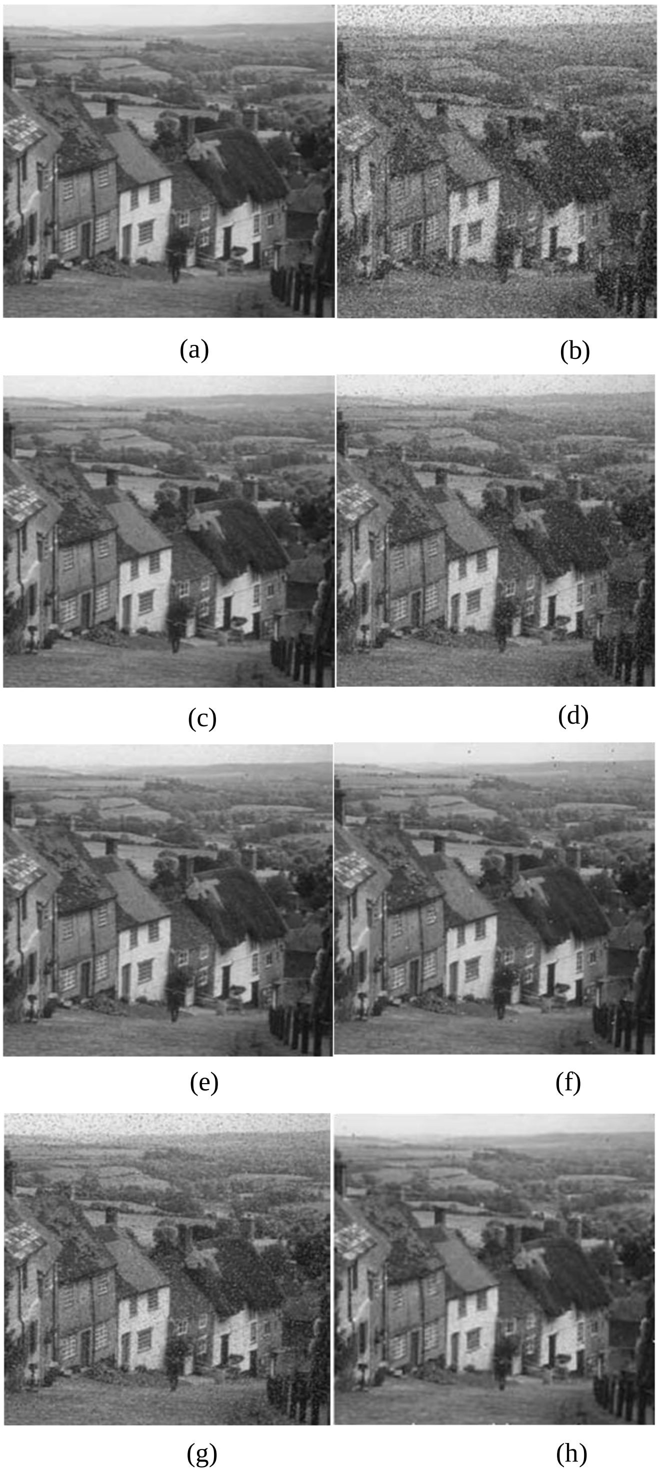


Figure 3.2 Experimental result with gold hill image (a) standard gold hill image, (b) noisy image with 30% impulse noise, Restoration result by corresponding (c) FIRE, (d) BDND, (e) DWM, (f) FMEM, (g) SAM, (h) PROPOSED FUZZY filters.

Figure 3.2 presents visual quality of resultant denoised image of various methods. Figure 3.2(a) shows the original lena image. Figure 3.2(b) shows 30% noisy gold hill image. Figure 3.2(i) shows the resultant image of proposed method. Remaining figures are output image of described methods

PSNR values of denoised image of various methods at different noise density are detailed in table 1 using standard lena image. It is clear from the results that lower the noise density, higher PSNR value. PSNR value of all methods in table 1 is also calculated in another image gold hill image. In both table 1 and table 2 FIRE and DWM have greater signal to noise ratio corresponding to all other methods.

Table 1: PERFORMANCE COMPARISONS OF PSNR VALUE IN STANDARD LENA IMAGE

Method	10%	20%	30%	40%
FIRE [7]	35.16	31.49	28.96	26.63
BDND [8]	23.64	20.41	18.55	17.06
DWM [9]	34.82	31.30	29.24	27.05
LUO [10]	30.71	24.98	21.73	19.37
FMEM [11]	34.19	28.68	23.73	20.96
SAM [12]	22.25	19.24	17.47	16.26
CURRENT METHOD	27.91	27.91	27.90	27.85

Mean Square Error MSE of resultant denoised image by use of different filtering methods in standard lena image is tabulated in table 3. Like PSNR, MSE values are decreasing linearly for corresponding noise density. DWM and current methods have better MSE at higher noise level. Table 4 also describes the MSE values for all method in previous table in gold hill image. In gold hill image DWM and current methods have better result.

Table 2: PERFORMANCE COMPARISONS OF PSNR VALUE IN GOLDHILL IMAGE

Method	10%	20%	30%	40%
FIRE [7]	34.43	31.13	28.51	26.43
BDND [8]	23.07	19.95	18.10	16.54
DWM [9]	34.20	30.66	28.83	26.42
LUO [10]	30.02	24.68	21.36	19.00
FMEM [11]	31.90	27.52	23.32	20.57
SAM [12]	22.02	19.08	17.27	16.04
TLIDE	33.95	29.06	23.67	20.77
CURRENT METHOD	26.37	26.37	26.37	26.38

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Table 3: Comparison Of Mse Value In Standard Lena Image

Method	10%	20%	30%	40%
FIRE [7]	1.01	2.11	3.38	4.93
BDND [8]	3.03	6.36	9.85	13.99
DWM [9]	0.80	1.69	2.68	3.91
LUO [10]	0.98	2.83	5.48	8.99
FMEM [11]	1.42	2.22	3.86	6.57
SAM [12]	3.82	7.76	11.56	13.49
TLIDE	0.80	1.92	4.27	7.89
CURRENT	1.04	1.04	1.05	1.05

Table 4: COMPARISON OF MSE VALUE IN GOLDHILL IMAGE

Method	10%	20%	30%	40%
FIRE [7]	1.10	2.28	3.61	5.22
BDND [8]	3.38	6.98	10.80	15.36
DWM [9]	0.98	2.09	3.37	5.01
LUO [10]	1.26	3.26	6.12	9.88
FMEM [11]	2.24	3.19	4.93	8.05
SAM [12]	3.99	7.95	12.03	16.10
TLIDE	0.98	2.27	4.78	8.43
CURRENT METHOD	1.49	1.49	1.49	1.50

PSNR and MSE value of proposed method is described in table 5 in standard lena image. Highest PSNR value is 27.91 which is better compare to all other methods as in literature. MSE value should be as possible as smaller, is 1.04 at 10% noise in lena image. Table 6 presents corresponding PSNR, and MSE values in gold hill image. In order to noise density, PSNR is linearly decreasing but it can be considered as constant and MSE is in increasing order.

Table 5: Determination of the PSNR &MSE values in Lena Image

Noise level	PSNR	MSE
10	27.91	1.04
20	27.91	1.04
30	27.90	1.05
40	27.85	1.05

Table 6: Determination of the PSNR & MSE values in Gold Hill Image.

Noise level	PSNR	MSE
10	26.37	1.49
20	26.37	1.49
30	26.37	1.49
40	26.38	1.50

IV. CONCLUSION

In this paper we present fuzzy logic based noise removal & contrast enhancement, detail preserving restoration method. Even at very high noise density image details texture and edges are preserved. It is noticeable from result that in high noise density like 50% noise, proposed method is better than all other methods. The proposed method for image enhancement is sufficient but the future work is to develop a method for image enhancement in RGB color image and video sequenced image.

REFERENCES

[1] G. Sudhavani, G. Madhuri, P. Venkateswara Rao & K. Satya Prasad "Removing of Gaussian Noise from Color Images by Varying Size of Fuzzy Filter", *International Journal of Computer applications*, vol. 72, no. 17, June 2013.
[2] C. C. Sun, S. J. Ruan, M. C. Shie, and T. W. Pai, "Dynamic contrast enhancement based on histogram specification", *IEEE Transactions on Consumer Electronics*, vol. 51, no. 4, pp. 1300-1305, 2005.
[3] B. N. Chatterji and N. R Murthy, "Adaptive contrast enhancement for color images", In Proc. of 1997 International Conference on Information, Communications and Signal Processing, vol 3, pp. 1537-1541, 1997.
[4] J. Y. Kim, L. S. Kim, and S. H. Hwang, "An advanced contrast enhancement using partially over-lapped sub-block histogram equalization", *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 11, no. 4, pp. 475-484, 2001.
[5] S. C. Pei, Y. C. Zeng and C. H. Chang, "Virtual restoration of ancient Chinese paintings using color contrast enhancement and Lacuna texture synthesis", *IEEE Trans. Image Processing*, vol. 13, no. 3, pp. 416-429, 2004.
[6] Gowthami Rajagopal, K Shanthi, "contrast enhancement using equalization with brightness preservation", *International Journal of Computer Trends and technology*, vol. 4, no. 5, pp 1010-1014, 2013.
[7] F. Russo and G. Ramponi, "A fuzzy filter for images corrupted by impulse noise", *IEEE Signal Process*, vol 3, no 6: pp 168-170, june 1996.
[8] 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, june 2006.
[9] Y. Dong and S. Xu, "A new directional weighted median filter for removal of random-valued impulse noise", *IEEE Signal Process. Lett.*, vol 14, no. 3, pp. 193-196 Mar 2007.
[10] W. Luo, "An efficient algorithm for the removal of impulse noise from corrupted images", AEU-Int. J. Electron. Commun, vol. 6, pp. 551-555, 2007.
[11] J. Zhang, "An efficient median filter based method for removing random valued impulse noise", *Digit. Signal Process.*, vol. 20 no. 4, pp. 1010-1018, July 2010..
[12] H. Ibrahim, N. S. P. Kong, and T. F. Ng, "Simple adaptive median filter for the removal of impulse noise

from highly corrupted images", *IEEE Trans. Consumer Electron.*, vol. 54, no. 4, pp. 1920-1927, Nov. 2008.

[13] Chun-Ming Tsai, Zong-Mu Yeh, Yuan-Fang Wang, "Decision tree-based contrast enhancement for various color images", *Machine Vision and Applications*, vol. 22. pp. 21–37, 2011, DOI 10.1007/s00138-009-0223-x.

[14] Suple Nutan Y, Kharad Sudhir M, "Design of Fuzzy inference system for Contrast Enhancement of Color Images", *International Journal of Advanced Computer Research*, vol. 3. Issue 11, ISSN (online) 2277-7970, pp. 427-431, 2013,