Edge Preservation with Noise Reduction in Arthritis Image

Devkant Sen[1] Neha Tiwari[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Electronics & Communication Engineering
[1,2]BUIT, Bhopal, India

Abstract— In last decade medical image quality improvement most popular topic for research. There are many methods are present for improving medical images. In the field of medical image processing, digital images very often get corrupted by several kinds of noise during the process of image acquisition. In this paper, we will present a new method for removal of impulse noise with edge preservation and enhancing quality. The method is based on eliminating impulse noise from MR, X- Ray images. A mean median-based method to remove impulse noise from digital MRI images has been developed. The method is adjusted in order to decide whether the median operation can be applied on a pixel. In this research, to suppress this deficiency, noisy pixels are initially detected, and then the filtering operation is applied on them. The proposed decision based un-symmetric mean median method (DBUMM) is simple and leads to fast filtering. The results are more accurate than other conventional filters. DBUMM detection stage a more powerful here we have use an alpha trimmed median filter for removal of noisy pixels. As a considerable advantage, some unnecessary median operations are eliminated and the number of median operations reduces drastically by using DBUMM. Decision based un-symmetric mean median filtering method leads to more acceptable results in scenarios with high noise density gives better peak signal noise ratio (PSNR) and better image quality. Furthermore, the proposed method reduces the probability of detecting noise-free pixels as noisy pixels and vice versa.

Key words: Median Filter, Impulse Noise, Magnetic Resonance Image

I. INTRODUCTION

In the field of medical images processing (MIP) digital images play an important role in some medical issues especially in detecting cancers, internal organs diseases and injuries. Some medical images are acquired based on Magnetic Resonance (MR) phenomenon used to investigate brain, liver and other soft tissues [1]. The study depends on the energy absorbing and emitting in the radio frequency range of the electromagnetic spectrum. MR images may be corrupted by some degrading phenomena during the acquisition process such as noise entering. Some degrading phenomena may contaminate MR images. It is based on the characteristics of MR phenomenon, image capturing equipment and some environmental influences. In this regard, impulse noise has an important corrupting influence impact on MR images. Removing noise from degraded images is a challenging research field in image processing. It involves estimation procedure of the image corrupted by noise [1]-[3].In this regard, nonlinear filters such as median filter are preferred as they can cope with the nonlinear property of the image model [2]-[4]. A typical form of impulse noise in a medical image is salt and pepper noise which represents itself as randomly occurring white (salt) and black (pepper) pixels. The noise density is a term used to quantify the amount of salt and pepper noise in an image. A total noise density of *d* in an MxN image means that dx MxN pixels contain noise. In general, if the total noise density of a salt and pepper noise is *d*, then it implies that each of the salt noise and the pepper noise has a noise density of *d*/2. It is possible that the salt noise and the pepper noise have different noise densities as *d1* and *d2*, and consequently the total noise density is *d=d1+d2*.

Impulse noise reduction can be achieved through the use of denoising filters. The median filter is a nonlinear digital filter which is often used in digital image processing to reduce noise in an image. In practice, besides reducing noise, it is important to preserve the edges of an image as edges provide critical information on the visual appearance of an image. Median filtering is a smoothing technique which is effective in reducing noise in the smooth regions of an image, but can adversely affect the sharpness in edges. As using the proposed filter, the noise bias can be removed and the original information can be successfully restored which outperforms three other methods both visually and in peak signal-to-noise ratio (PSNR).

II. IMAGE ENHANCEMENT

Image enhancement operation improves the qualities of an image. They improve an image's contrast and brightness characteristics, reduce its noise content or sharpen its details. Image enhancement techniques may be grouped as either subjective enhancement or objective enhancement. The subjective enhancement technique may be repeatedly applied in various forms until the observer thinks that the image yields the detail necessary for a particular application. Objective image enhancement corrects an image for known degradations. Here distortions are known and enhancement is not applied arbitrarily. This enhancement is not repeatedly applied but applied once based on the measurements taken from the system. Image enhancement fall into two broad categories as below:

- Spatial domain technique
- Frequency domain technique

Spatial domain refers to the image plane itself and approaches in this categories are based on direct manipulation of pixels in an image. Frequency domain processing techniques are based on modifying the Fourier transform of an image. Spatial domain refers to the total of pixels comprising an image. They operate directly on these pixels. Spatial domain processes will be denoted by the expression:

III. NOISE MODEL

Two common types of the impulse noise are the Fixed-Valued Impulse Noise (FVIN), also known as Salt and-Pepper Noise (SPN), and the Random-Valued Impulse Noise (RVIN). They differ in the possible values which

All rights reserved by *www.ijsrd.com*

noisy pixels can take [6]. The FVIN is commonly modeled by –

$$(Y_{ij}) = \begin{Bmatrix} X_{i,j} \text{ with probabilty } p \\ (0,255) \text{ with probabilty } 1-p \end{Bmatrix} \quad \text{.....(1)}$$

Where x(i,j) and y(i,j) denote the intensity value of the original and corrupted images at coordinate (i,j), respectively and p is the noise density. This model implies that the pixels are randomly corrupted by two fixed extreme values, 0 and 255 (for 8-bit grey-scale images), with the same probability. A model is considered as below:

$$(Y_{ij}) = \begin{Bmatrix} (0,m) & \text{with probabilty } p1 \\ X_{i,j} & \text{with probabilty } 1-p \\ (255-m,255) & \text{with probabilty } p2 \end{Bmatrix} \quad \text{.....(2)}$$

Where p = p1 + p2. We refer to this model as Random valued Impulse Noise (RVIN).

IV. PROPOSED ALGORITHM

At present there are many de-noising techniques available for gray level images s noise removal, but in case of high density noise removal in arthritis images with edge preservation is one of the most challenging task in today's scenario. Most of the techniques do not perform well at high noise density. In this paper, we will introduce a new method for arthritis images edge preservation with de-noising which is based on improved first order neighborhood filtering for edge preservation as well as noise removal. In our method we focus on arthritis image, impulse noise removal with improved PSNR and reduced MSE and MAE at high density noisy to 10% to 90%. There are many de-noising techniques have been proposed, several of them are application-dependent. In the field of image processing two main important stages are first is detection stage and the second is noise removal with edge preservation. The proposed method provides an optimum result in 3x3 window size and also gives a better image details meaning loss of the image information is low and better image quality at higher level of noise.

In the proposed method, simulate with the help of MATLAB, in this whole phenomena first we take a color image, then apply a fixed valued impulse noise (FVIN) is added to the arthritis image, after that noisy pixels are detected all de-noised pixels the restored. The complete de-noising process can be divided in following number of steps:

Step 1: Initially in the very first step an image was taken and fixed valued impulses noise (Salt and Pepper noise) was applied on the image.

Step 2: In the second it had been checked whether the pixels in between 0 to 255 ranges or not, consequently two cases were arises.

Check condition
If
X (i,j) = 0<Y (i,j)<255
they are noise free and move to restoration image.
else
X(i,j) = Noisy pixels
If the pixels are not lying in between the specified range it is moved towards step 3.
end

Step 3:- In the third step work is done on noisy pixel of step-2. A window of size 3 x 3 of image was selected. Assuming that the target noisy pixels were W (i,j) and was processed in the next step.

	Column 1	**Column 2**	**Column 3**
Row 1	A_1	A_2	A_3
Row 1	A_4	Central Pixel(A5)	A_6
Row 3	A_7	A_8	A_9

Table 1: Filtering window of size 3x3

A. In case A - If the value of the central pixel in a 3X3 window all pixels are zeros (0s) then calculate the mean of all pixels aspect the central pixel. If all the pixels are zeros they are make a black color.

if (A1 to A9) == 0 // Condition
Mean (A1to A8) = Mean (M)
Central Pixel = M
else
step 4 // Condition
end

B. In case B - If the value of the central pixel in a 3X3 window all pixels are ones (255) then calculate the mean of all pixels aspect the central pixel. If all the pixels are zeros they are make a black color.

if (A1 to A9) == 255 // Condition
Mean (A1to A9) = Mean (M)
Central Pixel = M
else
goto step 4 // Condition
end

Step 4: If the preferred window contains all elements are combination of 0's and 255's. Now find the median of the pixels in the 3X3 windows A1 to A9 elements except Central pixel A (5) was found. This removed noise of image was restored as de-noised image at the last step.

if (A1 to A9) combined 0&&255
Calculate the Median (A1to A9) = Median (Med)
Central Pixel = Med
elseif
Check Med = 0<Med<255 // condition
Restored Check Med = Edge // edge preservation
else
Check Med = 0 or 255
Send to Step no. 2
End

Step-5:- In this step apply canny edge detection for showing edge preservation of our proposed method.

Step 6:- Steps one to five were repeated until all pixels in the whole image 255X255 was processed. Hence a better de-noised image was obtained with improved PSNR, MSE and also shows a better image with very low blurring and improved visual and human perception.

V. SIMULATION RESULTS AND COMPARISONS

We have used MATLAB R2012b as the simulation tool. Performance of the proposed algorithm is tested with different grey scale and color images. The images are corrupted by fixed value impulse noise i.e. salt and pepper noise. Performances are quantitatively measured with various noise densities for Peak-Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE) and Image

All rights reserved by *www.ijsrd.com*

Enhancement Factor (IEF) defined (1), (2) and (3) respectively:

$$PSNR = 10\log_{10}\frac{(255)^2}{MSE} \quad (1)$$

$$MSE = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\{Y(i,j) - \hat{Y}(i,j)\}^2}{m \times n} \quad (2)$$

$$MAE = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\left|Y(i,j) - \hat{Y}(i,j)\right|^2}{m \times n}$$

Noise Density %	MF	AMF	PSMF	DBA	MDBA	New Approach
10	28.4938	21.9845	30.6494	36.7565	36.7569	38.79
20	25.7542	21.9297	28.2089	33.2606	33.2607	35.59
30	21.8465	21.4735	25.559	30.5659	30.5308	33.26
40	18.4076	21.4735	22.6909	28.2609	28.2981	31.66
50	14.734	20.6542	19.4425	26.2846	26.2503	30.06
60	12.2348	18.4092	12.8511	24.5361	24.6321	28.56
70	9.9837	14.8564	10.5206	22.7798	22.9338	26.88
80	8.0229	11.2968	8.4849	20.1441	20.4098	24.85
90	6.5759	8.0603	6.7847	17.1205	17.2242	21.56

Table 2: Comparison of PSNR Values of Different Filters for Lena Image

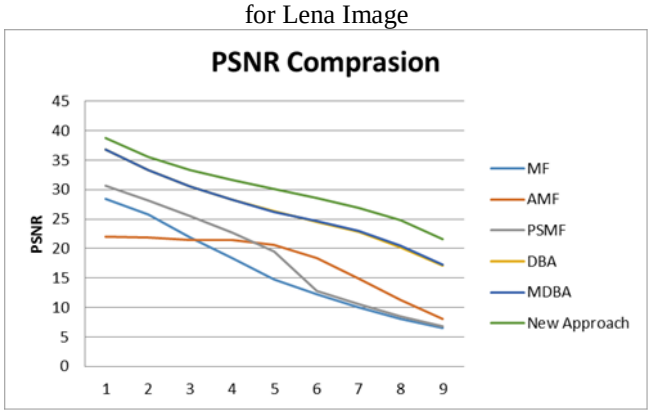
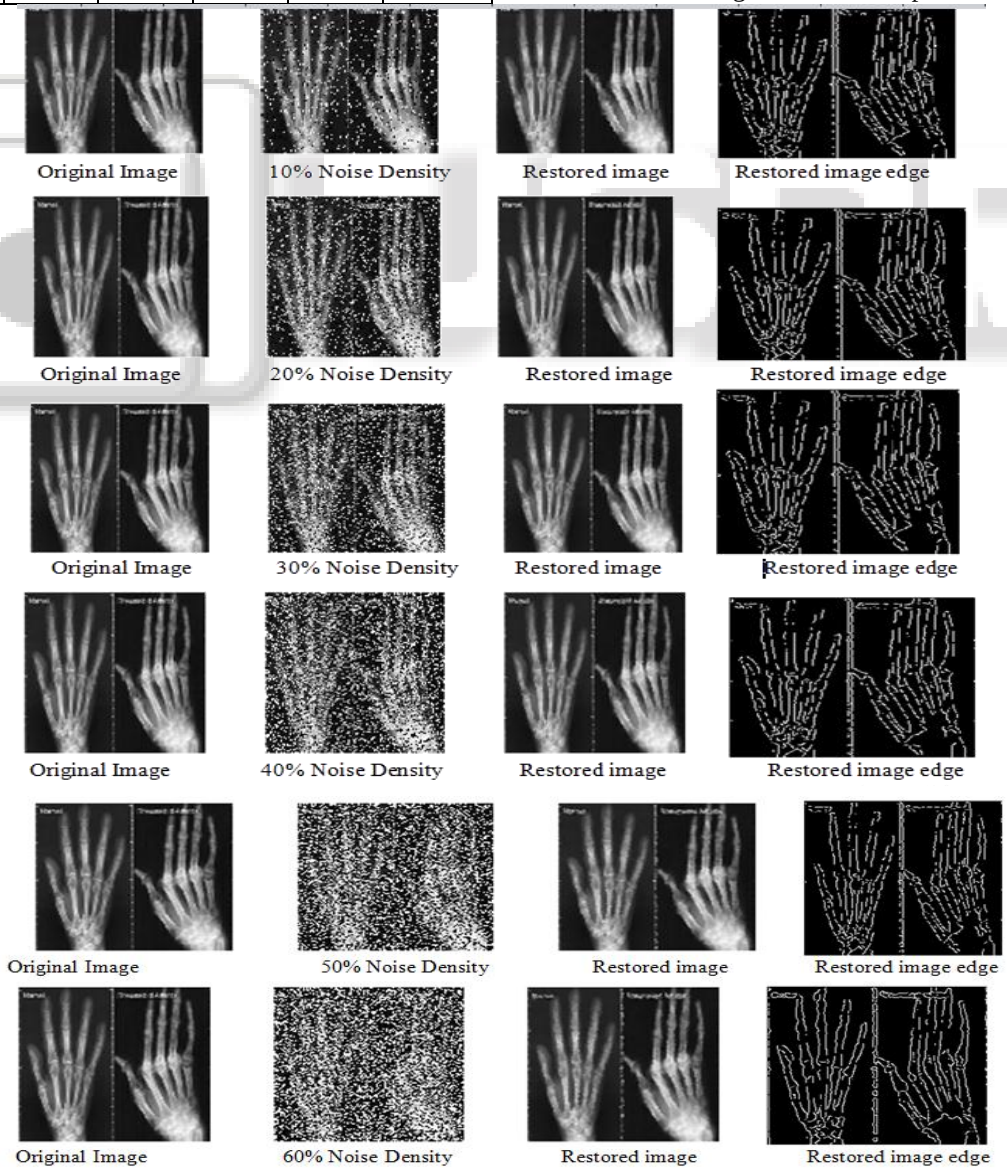


Fig. 1: PSNR Comparison



All rights reserved by *www.ijsrd.com*

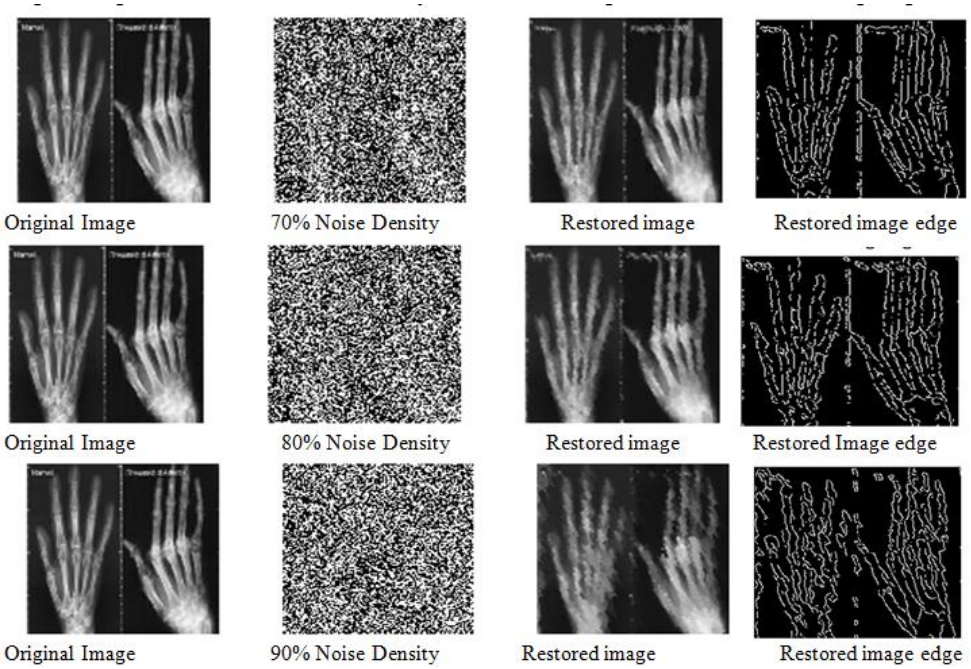


Fig. 2: de-noising and edge detection of an arthritis image with noise density 10 to 90%.

VI. CONCLUSION

The new proposed algorithm has been proposed to deal with the problems, namely, poor image enhancement at high noise density, which is frequently enhanced in the decision based un-symmetric mean median method (DBUMM). In this decision based un-symmetric mean median method (DBUMM) is used for enhancing the peak signal to noise ratio (PSNR) .The performances of proposed 'Robust trimmed mean median filter' are quantitatively vies as well as the visual and human perception vies shows better result in both conditions as compared to other existing filters.

REFERENCES

[1] Manohar Annappa Koli," Review of Impulse Noise Reduction Techniques" International Journal of computer science and Engineering Vol 4. No 02 February 2012

[2] S.K. Satpathy, S. Panda, k k Nagwanshi and C Ardil, "Image Restoration in Non-Linear Filtering Domain using MDB approach",International Journal of Signal processing 6:1 2010..

[3] subg-Jea KO and Yong Hoon, "Center Weighted Median Filters and Their applications to image enhancement", IEEE Transactions oncircuits and systems vol 38, no 9, September 1991.

[4] H Hwang and R A Haddad,"Adaptive Median Filter: New Algorithms and Results", IEEE Transactions on image processing Vol 4 No4 April 1995

[5] Zhou Wang and David Zhang,"Progressive Switching Median Filter for the Removal of Impulse noise from Highly CorruptedImages", IEEE Transaction on circuits and systems-II : analog and digital signal processing Vol 46 No 1 January 1999.

[6] Tao Chen, Kai-Kuang Ma and Li-Hui Chen,'Tri-State Median Filter for Image Denoising", IEEE Transactions on Image processing,vol 8, no 12, December 1999.

[7] K.S. Srinivasan and D. Ebenezer, " A New Fast and Efficient Decision-Based Algorithm for Removal of High-Density Impulse Noises", IEEE Signal Processing Letters Vol 14 No 3 March 2007.

[8] M. A. Mottalib and Golam Moktader Daiyan "Removal of High Density Salt & Pepper Noise Through a Modified Decision Based Median Filter" IEEE, 978-1-4673-1154-0112/$31.00©2012

[9] S. Arastehfar , A. A. Pouyan and A. Jalalian "An enhanced median filter for removing noise from MR images" Journal of AI and Data Mining, Vol.1, No.1, 2013.

[10] Wenshou Gao, Lei Yang, Xiaoguang Zhang, Huizhong Liu,"An In Improved Sobel Edge detection",IEEE,978-1-4244-5540-vol-9-2010.

[11] Sabina Priyadarshini, Gadadhar Sahoo,"A new edge detection method based on additions and division", International Journal of Computer application (0975-8887) Volume 9- N0.10, November 2010.

[12] Tapas Kumar, G. Sahoo,"A Novel Method of Edge Detection using Cellular Automata", International Journal of Computer application (0975-8887)Volume 9-N0.4,November 2010.

[13] Shihu Zhu,"Edge Detection Based on Multi-structure Element Morphology and Image Fusion", IEEE, 978-1-4244-9600-VOL-6, 2011.

[14] C.NagaRagu, S.NagaMani, G.rakesh Prasad, S.Sunita, "Morphology Edge Detection Algorithm Based Multi-structureElement of Different Direction"International Journal of Information and Communication Technology Research Volume 1 NO.1,May 2011.

[15] Rashmi , Mukesh Kumar, and Rohini Saxena "Algorithm And Technique On Various Edge Detection: A Survey" Signal & Image Processing :

All rights reserved by *www.ijsrd.com*

An International Journal (SIPIJ) Vol.4, No.3, June 2013

[16] Mohammed Aslam. C, Dr. Satya Narayana. D, Dr. Padma Priya. K & Murali. M "Classification and Analysis of Morphological Edge Detectors" Global Journal of Computer Science and Technology Volume 13 Issue 5 Version 1.0 Year 2013

[17] Sivappriya T, Muthukumaran K "Cancer Cell Detection using Mathematical Morphology" Intrnational Journal of Innovative Research in Computer and Communication Engineering vol.2 1 march 2014.

[18] M.I. Rajab, M.S. Woolfson, and S.P. Morgan, "Application of region-based segmentation and neural network edge detection inlesions, computerized Medical Imaging and Graphics, vol. 28, pp.61–68, 2004.

[19] H. Tang, E.X. Wu, Q.Y. Ma, D. Gallagher, G. M. Perera, and T. Zhuang, "MRI brain image segmentation by multi-resolution edge detection and region selection," Computerized Medical Imaging and Graphics, vol 24, pp. 349–357, 2000.

[20] Huertas, A. and Medioni, G., "Detection of intensity changes with sub pixel accuracy using Laplacian-Gaussian masks," IEEE Trans. On Pattern Analysis and Machine Intelligence, PAMI, vol. 8, pp.651–664, 1986.

All rights reserved by *www.ijsrd.com*