www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3, Issue 11 November, 2014 Page No. 9088-9092

Decision Tree Based Denoising And Enhancement In Images

***Remya P V*[1]*, Anoop T R*[2]**
M.tech ,VLSI and Embedded System [1]
ECE department, SNGCE [1]
Kadayiruppu, kolenchery[1]
Email: pvremya89@gmail.com[1]
Assistant Professor [2]
ECE department, SNGCE [2]
Kadayiruppu, kolenchery[2]
Email: anooptr234@gmail.com[2]

Abstract: ***Images are often corrupted by noises in the procedures of image acquisition and transmission. In this paper, an efficient denoising scheme and it's VLSI architecture for the removal of noises is proposed. To achieve the goal of low complexity, a decision tree based impulse noise detector to detect the noisy pixels and an edge preserving filter to reconstruct the intensity values of noisy pixels is used. Furthermore histogram equalization is used to enhance the quality of images. The performance will be comparable to the higher complexity methods and the design requires only low computational complexity and suitable to be applied to many real time applications So final architecture consists of denoising and Image enhancement. Then this method is applied for different types of noises and compare results of image corrupted by impulses and equalized image using peak signal to noise ratio, mean square error, structural content.***

Keywords: Image denoising, Noises, impulse detector, Histogram**.**

1. INTRODUCTION

Image processing techniques is widely used in so many applications, such as medical imaging, scanning techniques, printing skills and so on. Images are corrupted by noises in the procedures of image transmission and reception. The noise may seriously affect the performance of images and reduce clarity[4]. Hence, an efficient denoising technique becomes a very important in image processing[1]-[8]. Today, in many practical applications, the denoising process is used, so a good lower-complexity denoising and enhancement technique, which is simple and suitable for VLSI implementation is necessary. In this, focus only on the lower complexity denoising techniques[1]because of its simplicity and easy implementation with the VLSI techniques. Clarity of the image is being improved using histogram equalization. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. There have been several methods using decision tree to deal with noises and some of them perform well. Based on above basic concepts, decision-tree-based denoising and enhancement method and its VLSI architecture for removing noises is used.

2. DECISION-TREE-BASED DENOISING AND IMAGE ENHANCEMENT

The architectural overview of proposed methodology is shown in figure. The proposed system is to be implemented in two parts. The first part is to accomplish the decision architecture for noisy image, the second part is histogram equalization. Noisy image is applied to decision tree based impulse detector .

3. ARCHITECTURE OVERVIEW

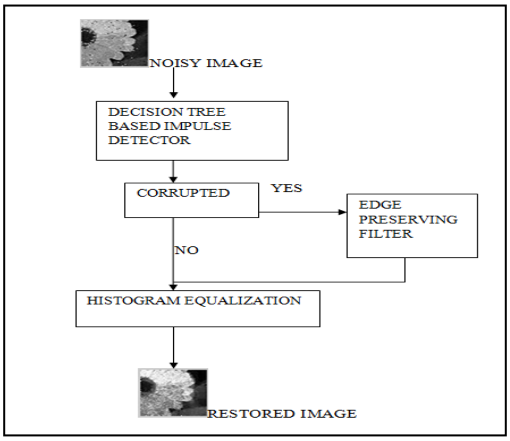

Figure 1. Architecture of denoising and image enhancement

Decision tree based impulse detector consists of two components:decision-tree-based impulse detector,edge-preserving image filter. The detector determines whether pixel is a noisy pixel and it is based on the correlation between pixel and its neighboring pixels. If the result is found to be positive, edge preserving image filter generates the correct value. Otherwise, the value will remain unchanged. The decision tree is a binary tree and can determine the correct pixel value for noisy pixels. Consider a, b,c,d,e,f,g,h,fij pixels for an image.

3.1 Isolation Module

Isolation module will check whether a pixel is noisy or noise free. It is based on the architecture shown below. Decision II determines whether pixel is noisy or noise free.

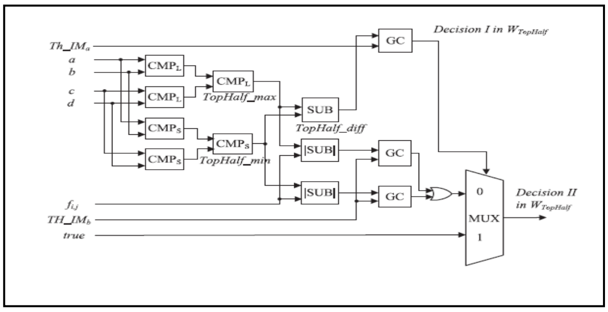

Figure 2. Architecture of isolation module

3.2 Fringe Module

In order to conclude that a pixel is noisy or situated on an edge, fringe module is used. Define four directions, E1 to E4. By calculating the difference between fi,j and the other two pixel values, fringe module determine whether there is an edge or not for an image.

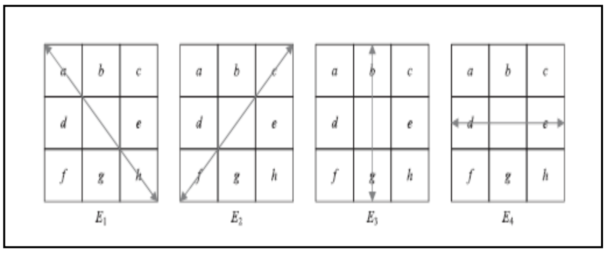

Figure 3. FM directions Fig. shows the architecture of FM. The FM modules, from FM_1 to FM_4, and is used to determine its direction.

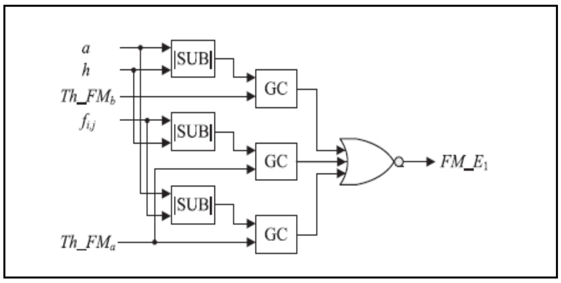

Figure 4. Architecture of FM 1 module.

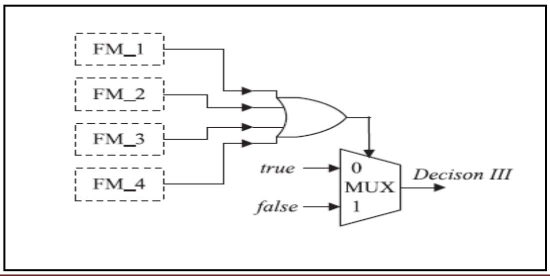

Figure 5. Architecture of FM.

3.3 Similarity Module

In this module, sort nine values in ascending order and obtain the fourth, fifth, and sixth values. Finally, if decision IV is positive, conclude that pi,j is a noise pixel. Three modules decide whether pixel is noisy.

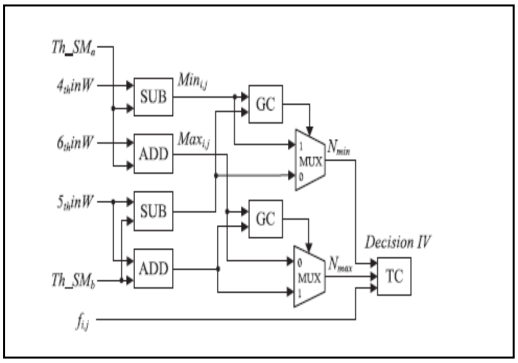

Figure.6. Architecture of SM.

3.4 Edge-Preserving Image Filter

To protect the edge and to produce correct pixel value ,a VLSI circuit is adopted. Here, consider eight directional differences, D1 to D8. Noise-free pixels are taken to avoid misdetection. Directions from D1 to D8 passing through the suspected pixels are eliminated to reduce misdetection. Therefore use Maxij and Minij to determine whether the values of d, e, f, g, and h are corrupted.

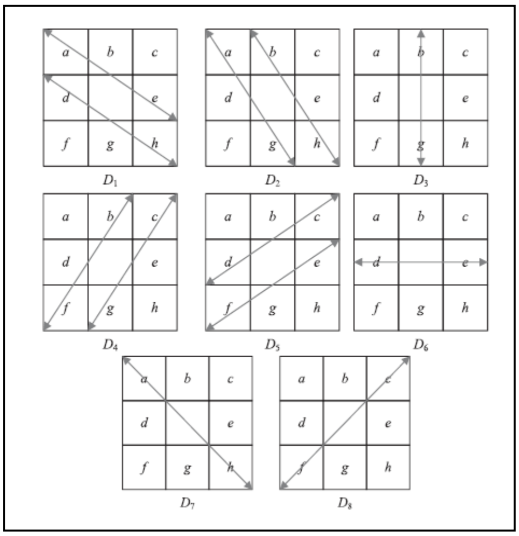

Figure.7. Eight directional differences of DTBDM..

If the pixel is noisy, don't consider the direction of the suspected pixel. If d, e, f, g, and h are all noisy pixels, edge so fi,jcap is equal to the average of three previously denoised pixels and equation is (a + b *2 + c)/4. In other cases, the filter calculates the differences of the different directions and choose the smallest one.

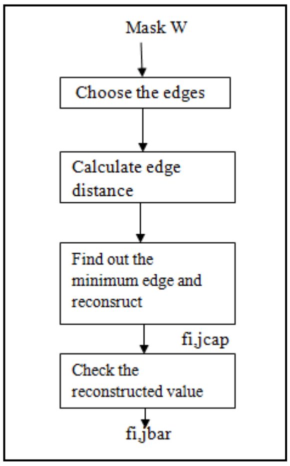

Figure 8. Dataflow of edge-preserving image filter.

The Edge- Filter composed of two modules, minED generator, average generator (AG). Fig. shows the architecture of the minED generator used to determine the the smallest difference. Then mean of the pixels which process the smallest directional difference can be obtained from the average generator. Finally, sort b, d, e, and g in order and the correct pixel value fi,jcap obtained from edge-preserving filter will be compared with the second and third values and the final value fi,jbar is obtained .

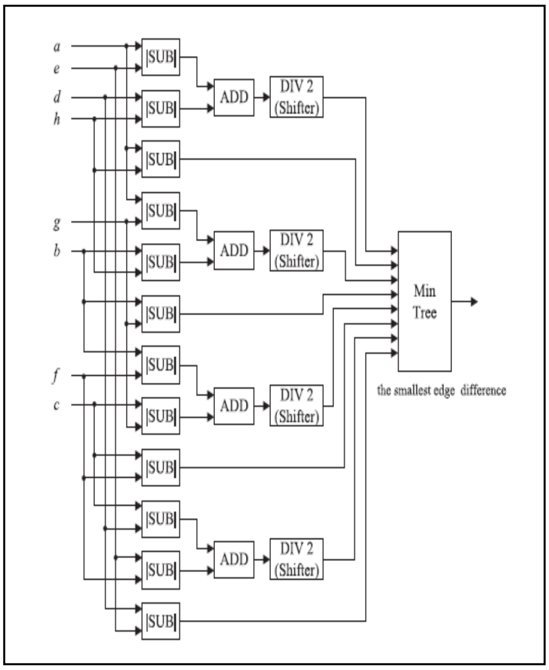

Figure 9. Architecture of minED generator.

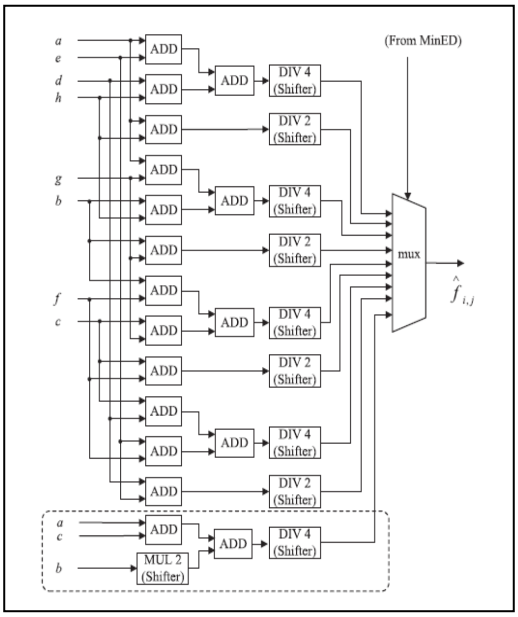

Figure 10. Architecture of average generator.

3.5 **Histogram Equalization**

Image is applied for histogram equalization. Consider a discrete grayscale image {x} and let ni be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is

$$Px(i) = P(x = i) = ni/n \quad (1)$$

L being the total number of gray levels in the image (typically 256), n being the total number of pixels in the image, and Px (i) being in fact the image's histogram for pixel value i, normalized to [0,1].Let us also define the cumulative distribution function corresponding to px as cdfx (i) equal to summation of Px (j) range from j=0 to i. which is also the image's accumulated normalized histogram. Image would have a linearized CDF across the value range, i.e.

$$cdfy(i) = iK \quad (2)$$

for some constant K. where k is in the range [0,L]. The general histogram equalization formula is:

$$h(v) = (cdf(v) – cdfmin/((MxN) –cdfmin) \times (L – 1)) \quad (3)$$

where cdfmin is the minimum non-zero value of the cumulative distribution function, M × N gives the image's number of pixels and L is the number of grey levels used. Then the denoising and enhancement method is applied for different types of noises. Noises taken are : Salt &pepper noise, Gaussian noise, Poisson noise, Speckle noise.

Then employ the peak signal-to-noise ratio (PSNR), mean square error(MSE),structural content(SC) to illustrate the quantitative quality of the reconstructed images for different types of noises. Tables list the restoration results of test images corrupted by noises. Efficiency of this work is tabulated using PSNR,MSE,SC.

4. SIMULATION RESULT

The different modules used in the functioning of this project are programmed using Verilog HDL, they are verified using a-simulation behaviour model in Xilinx. Image viewed using matlab. After the successful simulation and verification, these programs are loaded into Xilinx ISE Spartan 3E FPGA target device for synthesis. For the given 64x64 size image decision shows 1, the image is found to be noisy. The denoised values are obtained and is applied for histogram equalization .

4.1 Different Types Of Noise In Image

Figure shows the image corrupted by Gaussian, poisson, speckle, salt and pepper noise subjected to denoising and enhancement so that the clarity of image is improved.

*4.1.1*Image having different type of noises

Figure 11. Image having different noises, denoise image equalize image

*4.1.2*Gaussian noise

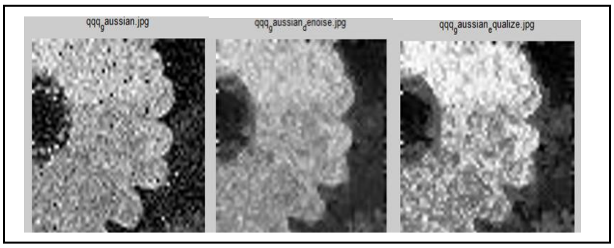

Figure 12. Image having Gaussian noise, denoise and equalize image

*4.1.3*Salt&pepper noise

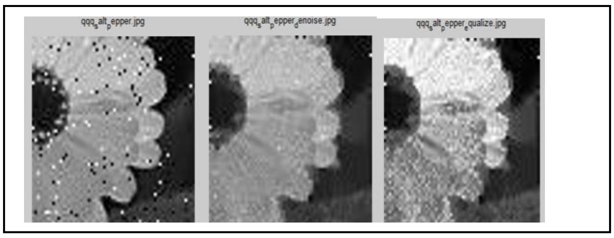

Figure 13. Image having salt &pepper noise, denoise and equalize image

*4.1.4*Speckle noise

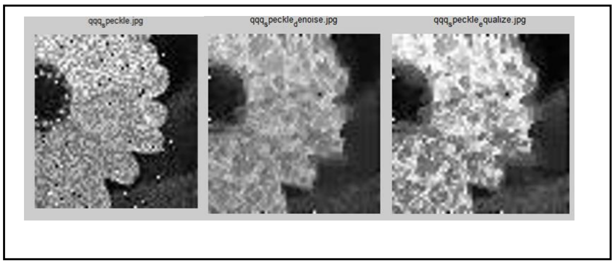

Figure 14. Image having speckle noise, denoise and equalize image

*4.1.5*Poisson noise

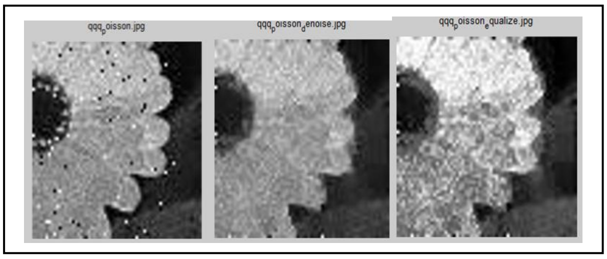

Figure 15. Image having poisson noise, denoise and equalize image

Based on the above work ,a comparative study is done using PSNR,MSE and SC. The result is shown below in table below

TABLE 1:COMPARATIVE RESULTS OF IMAGE CORRUPTED BY IMPULSES AND DENOISE IMAGE

NOISE	IMAGE	DENOISE	PSNR	MSE	SC
SALT &PEPPER NOISE	salt_pepper.jpg	salt_pepper_denoise.jpg	20.953	830.9324	1.0116
GAUSSIAN NOISE	gaussian.jpg	gaussian_denoise.jpg	19.7535	1.0908e+03	1.0249
POISSON NOISE	poisson.jpg	poisson_denoise.jpg	22.3512	599.7415	1.0093
SPECKLE NOISE	speckle.jpg	speckle_denoise.jpg	19.1040	1.2667e+03	1.0908

color images and can consider different types of noises for further study

TABLE 2:COMPARATIVE RESULTS OF IMAGE CORRUPTED BY IMPULSES AND EQUALIZED IMAGE

NOISE	IMAGE	EQUALIZE	PSNR	MSE	SC
SALT& PEPPER	Salt pepper .jpg	salt_pepper _equalize.jpg	19.5277	1.4465e+03	0.8061
GAUSSIAN	gaussian .jpg	gaussian_equalize.jpg	18.0300	1.6221e+03	0.8276
POISSON	poisson.jpg	poisson_equalize.jpg	19.4420	1.1719e+03	0.8000
SPECKLE	speckle.jpg	speckle_equalize.jpg	18.4670	1.8466e+03	0.8228

Table shows the comparative study. PSNR and MSE shows the quality of image. For the given set of noises, the PSNR and MSE found to be similar.ie from the analysis it is found that the denoising and equalization method is effective for all types of noises. It is because of the filtering done on the adjacent pixel values. SC represents the amount of perceived error in image

5. CONCLUSION

A VLSI architecture for efficient removal of noises and image enhancement is proposed. The approach uses the decision-tree-based detector to detect the noisy pixel and employs an effective design to increase the clarity of image. With adaptive method, the quality of the reconstructed images is improved. Results shows that the performance of proposed technique is better in terms of both quantitative evaluation and visual clarity of image. Final architecture consists of denoising and Image enhancement. This method is applied for different types of noises and compare results of image corrupted by impulses and equalized image using peak signal to noise ratio, mean square error, structural content shows that this method is effective for all types of noises. It's suitable to be applied to many real time applications. Proposed system can applicable in color images and can consider different types of noises for further study

ACKNOWLEDGMENT

I would like to express my heartfelt gratitude and thanks to my beloved guide Ms. Anoop T R, Assistant Professor, Dept. of Electronics and Communication Engineering, SNGCE Kadayiruppu, whose guidance I could complete the thesis work to the level I had planned, for the regular reviews and suggestions. It gives me great pleasure to thank her for the conviction she brought in into selecting the topic of work, and the technical and literary guidance she imparted through the different stages of its execution.

REFERENCES

[1] An Efficient Denoising Architecture For Removal Of Impulse Noise In Images chih-yuan lien, chien-chuan huang, pei-yin chen, member, ieee, and yi-fan lin ieee transactions on computers, vol. 62, no. 4, april 2013.

[2] V. Fischer, R. Lukac, and K. Martin, “Cost-Effective Video Filtering Solution for Real-Time Vision Systems,” EURASIP J. Applied Signal Processing, vol. 13, pp. 2026-2042, 2005.

[3] T. Matsubara, V.G. Moshnyaga, and K. Hashimoto, “A FPGA Implementation of Low-Complexity Noise Removal,” Proc. 17th IEEE Int’l Conf. Electronics, Circuits, and Systems (ICECS ’10), pp. 255-258, Dec. 2010.

[4] P.-Y. Chen, C.-Y. Lien, and H.-M. Chuang, “A Low-Cost VLSI Implementation for Efficient Removal of Impulse Noise,” IEEE Trans. Very Large Scale Integration Systems, vol. 18, no. 3, pp. 473- 481, Mar. 2010.

[5] Z. Xu, H.R. Wu, B. Qiu, and X. Yu, “Geometric Features-Based Filtering for Suppression of Impulse Noise in Color Images,” IEEE Trans. Image Processing, vol. 18, no. 8, pp. 1742-1759, Aug. 2009.

[6] F.J. Gallegos-Funes, V.I. Ponomaryov, S. Sadovnychiy, and L. Nino-de-Rivera, “Median M-Type K-Nearest Neighbour (MMKNN) Filter to Remove Impulse Noise from Corrupted Images,” IEEE Electronics Letters, vol. 38, no. 15, pp. 786-787, July 2002.

[7] I. Aizenberg, C. Butakoff, and D. Paliy, “Impulsive Noise Removal Using Threshold Boolean Filtering Based on the Impulse Detecting Functions,” IEEE Signal Processing Letters, vol. 12, no. 1, pp. 63- 66, Jan. 2005.

[8] Z. Wang and D. Zhang, “Restoration of Impulse Noise Corrupted Images Using Long-Range Correlation,” IEEE Signal Processing Letters, vol. 5, no. 1, pp. 4-7, Jan. 1998.