Survey of De-noising of High Density Impulse Noise using Threshold Filter

Vivek Kumar Singh[1], Prof. Satyarth Tiwari[2], Prof. Suresh. S. Gawande[3]

[1]*M. Tech. Scholar,* [2]*Guide,* [3]*Co-guide*

Department of Electronics and Communication, Bhabha Engineering Research Institute, Bhopal

Abstract—Impulse noise often corrupts the images in the procedures of image acquisition and transmission. Denoising of image corrupted by impulse noise is a prominent research area in Image Processing. To carry out noise suppression many denoising schemes introduced which uses standard median filter or its modifications. However, these approaches might blur the image since both noisy and noise-free pixels are modified. An studied denoising scheme called threshold filter and its VLSI architecture introduced to avoid the damage on noise-free pixels and also for the removal of high density impulse noise. Decision Tree Based Denoising method is performed as two phase process—a detection phase and a filtering phase. Noisy pixels will be detected by decision-tree-based impulse noise detector followed by a direction oriented edge-preserving median filter. Based on the probability distribution function of noise and SNR information obtained from the image, the filter uses selection of filtering window of size 3X3 to perform de-noising. The filtering technique has been implemented on MRI images. The efficiency of the proposed filtering technique is verified with a study of the PSNR characteristic of the de-noised and noisy image with respect to the true image. The proposed de-noising technique shows an improvement in the contrast ratio and PSNR of the noisy image.

Index Terms— Impulse Noise, Median Filter, De-noising.

I. INTRODUCTION

A straightforward middle channel [1] works pleasantly to denoising rash commotion of low thickness and is anything but difficult to execute. Yet, the cost paid for it is twists edges and fine subtle elements of a picture. The contortion increment as the sifting window size is expanded to smother high thickness commotion. Middle Filter is a nonlinear sifting procedure broadly utilized for expulsion of motivation commotion [2]. In spite of its adequacy in smoothing commotion the middle channel tends to evacuate fine subtle elements when it is connected to a picture consistently. Be that as it may, some specific middle channels, for example, Weighted Median Filter [3] and Recursive Weighted Median Filter RWMF [4], Center Weighted Median Filter are proposed in writing to enhance the execution of the middle channel by giving more weight to some chose pixels in the sifting window.

The area images processing the two principal applications are the improvement of pictorial information for human interpretations. The way toward getting and investigating visual data by advanced PCs is called computerized picture preparing. A picture might be depicted as a two dimensional capacity f(p, q) where p and q are spatial directions. Sufficiency off at any combine of co-ordinates (p, q) is known as the force or dim level of the picture by then. The picture made out of a limited number of components each of which has a specific area and qualities. That implies the components of picture are pixels. Pixel is the term most broadly used to mean the components of computerized picture.

Performing some mechanical operation (robot motion) is the goal of the Image processing. In the Figure 1 typical blocks diagram of image processing system. This consists of the center part is the computer system, one image acquisition, image processing software, storage devices, transmitters and display devices. Advanced picture preparing has many preferences over simple picture handling. It permits a much more extensive scope of calculations to be connected to the info information, and can stay away from issues, for example, the development of clamor and flag contortion amid preparing [5].

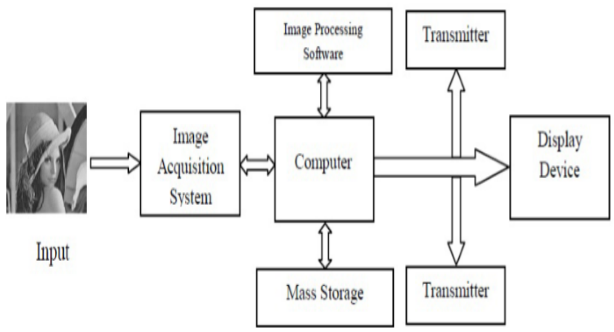

Figure 1: Typical Image Processing System

II. LITERATURE REVIEW

Anitha S, Laxminarayana Kola, Sushma P and Archana S, "Analysis of Filtering and Novel Technique for Noise Removal in MRI and CT Images", International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), IEEE 2017 [1], for the study of anatomical structure and image processing of MRI medical images techniques of noise removal have become an important practice in medical imaging application. In medical image processing, precise images need to be obtained to get accurate observations for the given application. The goal of any de-noising technique is to remove noise from an image which is the first step in any image processing. The noise removal method should be applied watchful manner otherwise artefacts can be introduced which may blur the image .In this paper, performance evaluation of the of MRI image de-noising techniques is provided. The techniques used are namely the median and Gaussian filter. All the above filters are applied on MRI brain and spinal cord images and the results are noted. A new method is proposed which modifies the existing median filter by adding features. The experimental result of the proposed method is then analyzed with the other three image filtering algorithms. The output image efficiency is measured by the statistical parameters like root mean square error (RMSE), signal-to-noise ratio (SNR), peak signal-to-noise ratio (PSNR).

Neela Chithirala, Natasha. B, Rubini. N and Anisha Radhakrishnan, "Weighted Mean Filter for Removal of High Density Salt and Pepper Noise", 3rd International Conference on Advanced Computing and Communication Systems (ICACCS -2016), Jan. 22 – 23, 2016 [2], the basic limitation on the information pictures to any PC vision innovation is its quality. Obtaining clamor free computerized pictures is a test as it relies upon a few factors. Developing calculations to evacuate commotion is one approach to enhance the picture quality. Salt and pepper commotion debases the picture. The test here is to reestablish the lost data without mutilating the edges. This paper presents another calculation that lessens high thickness salt and pepper commotion from pictures. Rebuilding is finished by figuring the weighted mean of the adjacent pixels. Weights are doled out unsymmetrically to preprocessed and natural pixels. The quality was judged in light of the PSNR esteem. The calculation reestablishes data for very debased pictures. Salt and pepper clamor are typically sifted with variations of the middle channel. This paper gives a substitute method to commotion lessening.

Tian Bai1 and Jieqing Tan, "Automatic detection and removal of high-density impulse noises", 162 & The Institution of Engineering and Technology 2015 IET Image Processing, Vol. 9, Iss. 2, pp. 162–172, 2015 [3], this investigation displays a novel strategy for programmed recognition and expulsion of high-thickness motivation commotions. The technique comprises of two sections: the drive identification part and the motivation commotion expulsion part. In motivation location section, a programmed locator in view of nearby mean and fluctuation (LMVD) is introduced, which can consequently select boisterous picture from enormous pictures and yield ruined dark levels. The locator uses LMVD of the area of debased pixels to reenact the intellectual procedures of human watching uproarious picture. In drive commotion evacuation part, the Newton– Thiele channel (NTF) rather than middle channel is connected to expel motivation clamor. The procedure to develop NTF can be separated into two stages: setting up the network and building the Newton– Thiele's levelheaded interjection on the framework. Initial, eight nearby pixels of the tainted focus pixel are utilized to build the two-dimensional framework. On the off chance that a pixel in the lattice is adulterated, a four-heading straight interjection calculation will be performed to give a harsh gauge to the undermined pixel. Second, the defiled focus pixel esteem will be refreshed by Newton– Thiele's balanced addition on the network. The NTF has preferred strength over existing channels since it doesn't have to alter window estimate or different parameters. Reenactments uncover that the proposed indicator and channel have consummate execution regarding both quantitative assessment and visual quality, particularly it can evacuate the motivation clamor viably even at 90% commotion level.

B. Deepa and Dr. M. G. Sumithra, "Comparative Analysis of Noise Removal Techniques in MRI Brain Images" , IEEE Conference on image processing and system 2015 IEEE [4], commotion evacuation strategies have turned into a fundamental exercise in therapeutic imaging applications, for the investigation of anatomical structures. To address this issue numerous denoising calculations has been proposed both in spatial and recurrence space. Among them, couple of systems in spatial area are crossover middle channel, Weiner channel, reciprocal channel, histogram leveling and in recurrence space are wavelet change, autonomous segment examination were effectively utilized as a part of therapeutic imaging. The most regularly influenced clamors in therapeutic picture are salt and pepper, Gaussian, Speckle and Brownian commotion. In this paper, the medicinal pictures taken for correlation incorporate MRI cerebrum pictures, in dim scale and RGB. The exhibitions of these calculations are investigated for different clamor composes at various commotion levels running from 0 dB to 30 dB. The assessment of these calculations is finished by measures like pinnacle flag to commotion proportion (PSNR), root mean square blunder esteem (RMSE), all-inclusive quality record (UQI) and picture quality scale(PQS). Trial comes about propose that, autonomous part investigation performs better to remove salt and pepper clamor in RGB and dark scale and Gaussian commotion for pictures in RGB. Wavelet change gives prevalent execution for expelling spot and Brownian commotion for pictures in RGB and grayscale, regardless of the clamor level considered. Then again all spatial separating systems give near outcomes at all dB levels in dim scale, which is sub-par compared to recurrence space procedures.

III. VARIOUS SORCES OF NOISE IN IMAGES

Noise is introduced in the image at the time of image acquisition or transmission. Different factors may be responsible for introduction of noise in the image. The number of pixels corrupted in the image will decide the quantification of the noise. The principal sources of noise in the digital image are: a) The imaging sensor may be affected by environmental conditions during image acquisition. b) Insufficient Light levels and sensor temperature may introduce the noise in the image. c) Interference in the transmission channel may also corrupt the image. d) If dust particles are present on the scanner screen, they can also introduce noise in the image.

DIFFERENT NOISE TYPES:-

Noise is the undesirable effects produced in the image. During image acquisition or transmission, several factors are responsible for introducing noise in the image. Depending on the type of disturbance, the noise can affect the image to different extent. Generally our focus is to remove certain kind of noise. So we identify certain kind of noise and apply different algorithms to remove the noise. Image noise can be classified as Impulse noise (Salt-and-pepper noise), Amplifier noise (Gaussian noise), Shot noise, Quantization noise (uniform noise), Film grain, on-isotropic noise, Multiplicative noise (Speckle noise) and Periodic noise.

Impulse Noise (Salt and Pepper Noise) :- The term impulse noise is also used for this type of noise [5]. Other terms are spike noise, random noise or independent noise. Black and white dots appear in the image [6] as a result of this noise and hence salt and pepper noise. This noise arises in the image because of sharp and sudden changes of image signal. Dust particles in the image acquisition source or over heated faulty components can cause this type of noise. Image is corrupted to a small extent due to noise. Show the effect of this noise on the original image (Fig 2).

Figure 2: Original image without noise, Image with salt & pepper noise

Gaussian Noise (Amplifier Noise):- The term normal noise model is the synonym of Gaussian noise. This noise model is additive in nature [7] and follow Gaussian distribution. Meaning that each pixel in the noisy image is the sum of the true pixel value and a random, Gaussian distributed noise value. The noise is independent of intensity of pixel value at each point.

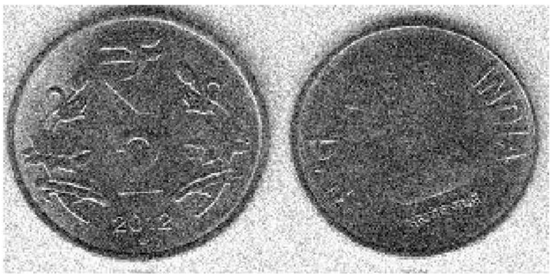

Figure 3: Gaussian noise

Poisson Noise (Photon Noise):-

Poisson or shot photon noise is the noise that can cause, when number of photons sensed by the sensor is not sufficient to provide detectable statistical information [4]. This noise has root mean square value proportional to square root intensity of the image. Different pixels are suffered by independent noise values. At practical grounds the photon noise and other sensor based noise corrupt the signal at different proportions [3].

Figure 4: Image with Poisson noise

Speckle Noise:-

This noise is originated because of coherent processing of back scattered signals from multiple distributed points. In conventional radar system this type of noise is noticed when the returned signal from the object having size less than or equal to a single image processing unit, shows sudden fluctuations.

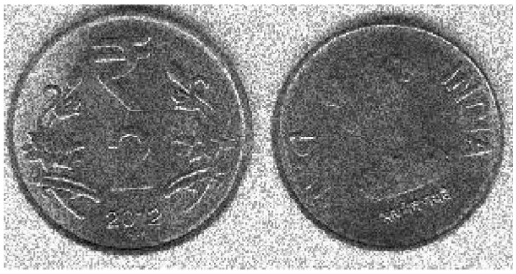

Figure 5: Image with speckle noise

IV. MEDIAN FILTER

In sign processing, it's far often proper that allows you to carry out some type of noise reduction on a photograph or sign. The middle sift through is a nonlinear advanced separating system, every now and again used to evacuate commotion. Such clamor rebate is a normal pre-handling venture to enhance the results of later preparing (for instance, side location on a picture). Middle sifting could be generally utilized as a part of computerized photo processing due to the fact, beneath certain situations, it preserves edges even as doing away with noise (however see dialogue under).

The guideline idea of the middle get out is to gone through the sign section through get to, supplanting every passage with the middle of neighboring passages. The example of colleagues is known as the "window", which slides, access with the guide of access, over the total flag. For 1D sign, the most extreme clear window is essentially the essential couple of past and taking after sections, while for 2d (or higher-dimensional) cautions including photos, more intricate window examples are reasonable (which incorporate "holder" or "go" designs). Know that if the window has an odd wide assortment of passages, then the middle is anything but difficult to characterize: it is essentially the inside esteem after every one of the sections inside the window is sorted numerically. For an even wide assortment of passages, there is several suitable middle, see middle for additional data.

See that, in the case above, in light of the fact that there is no get to past the principal esteem; the essential expense is rehashed, as with a definitive charge, to procure adequate passages to fill the window. This is one method for adapting to lacking window passages at the hindrances of the flag, yet there are diverse plans that have outstanding houses that may be fancied particularly examples:

- Avoid handling the limits, with or without trimming the flag or picture limit a while later,
- Fetching sections from different places in the flag. With pictures for instance, sections from the far flat or vertical limit may be chosen,
- Shrinking the window close to the limits, so that each window is full.

Noise is added inside the picture at the time of photograph acquisition or transmission. Different factors may be accountable for introduction of noise inside the photo. The wide variety of pixels corrupted in the picture will decide the quantification of the noise. The fundamental assets of noise within the virtual image are:

a) The imaging sensor may be stricken by environmental conditions at some stage in picture acquisition.

b) Inadequate mild degrees and sensor temperature may additionally introduce the noise in the picture.

c) Interference in the transmission channel may also corrupt the photo.

d) If dirt debris is gift at the scanner display screen, they also can introduce noise inside the photograph.

Noise is the undesirable results produced within the picture. For the duration of photo acquisition or transmission, numerous elements are chargeable for introducing noise in the photo. Depending at the sort of disturbance, the noise can have an effect on the picture to special volume. Commonly our cognizance is to cast off sure kind of noise.

So we become aware of sure type of commotion and apply one of a kind calculation to get rid of the clamor. Picture commotion can be sorted as Impulse clamor (Salt-and-pepper clamor).

V. METHODOLOGY

Threshold filter has low computational complexity and requires only two line buffers instead of full images, so its cost of VLSI implementation is low. For better timing performance, we adopt the pipelined architecture to produce an output at every clock cycle. In our implementation, the SRAM used to store the image luminance values is generated with the 0.18μm TSMC/Artisan memory compiler, and each of them is 512×8 bits. According to the simulation results obtained from Design Ware of SYNOPSYS, we find that the access time for SRAM is about 5 ns. Hence, we adopt the 7-stage pipelined architecture for Threshold filter. The architecture adopts an adaptive technology and consists of five main blocks: line buffer, register bank, decision tree- based impulse detector, edge-preserving image filter and controller. Each of them is described briefly in the following subsections.

Algorithm:

Step 1: Select a 3 x 3 matrix size according to the 2-D window size. Assume that the processing pixel is P_{ij}, which lies at the center of window.

Step 2: If 0 < Pij< 255, then the processing pixel or Pij is uncorrupted and left unchanged.

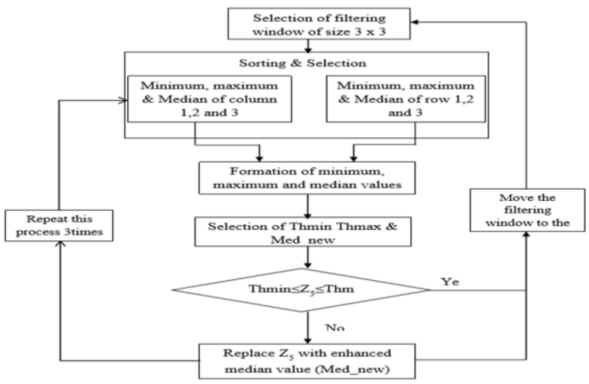

Fig. 6: Block Diagram of Threshold Filter

Step 3: On the off chance that Pij = 0 or Pij = 255, then it is considered as tainted pixel and four cases are conceivable as given underneath.

Case 1: In the event that the chose window has all the pixel esteem as 0, then Pij is supplanted by the Salt clamor (i.e. 255).

Case 2: On the off chance that the chose window contains all the pixel esteem as255, then Pij is supplanted by the pepper commotion (i.e. 0).

Case 3: In the event that the chose window contains all the esteem as 0 and 255 both. At that point the handling pixel is supplanted by mean estimation of the window.

Case 4: On the off chance that the chose window contains not all the component 0 and 255. At that point dispose of 0 and 255 and locate the middle estimation of the rest of the component. Supplant Pij with middle esteem.

Step 4: Rehash step 1 to 3 for the whole picture until the procedure is finished.

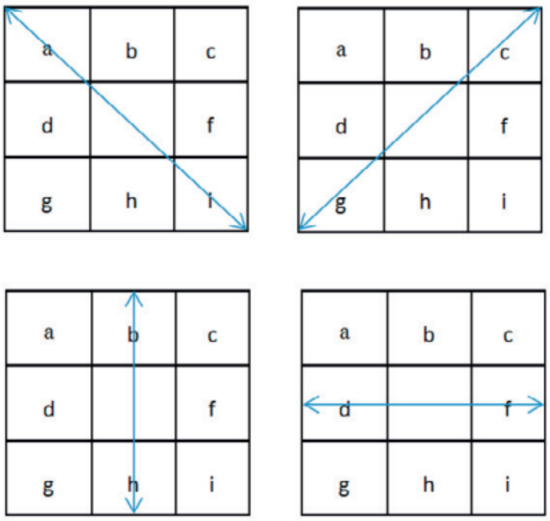

Figure 7: Read the Matrix

VI. SIMULATION RESULT

The proposed calculations are tried utilizing 256x256 8bit/pixel picture bike.jpg. In the reproduction, pictures are tainted by Salt and Pepper commotion. The commotion level shifts from 10% to 90% with augmentation of 10% and the execution is quantitatively measured by Mean square Error (MSE) and Peak Signal to Noise Ratio (PSNR).

Mean Square Error (MSE)

$$= \frac{1}{N_1 N_2} \sum_{j=1}^{N_2} \sum_{i=1}^{N_1} (f(i,j) - g(i,j))^2 \quad (1)$$

Peak Signal to Noise Ratio (PSNR) in dB

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

Where MSE remains for Mean Square Error, PSNR remains for Peak Signal to Noise Ratio.

VII. CONCLUSION

A low-cost VLSI architecture for efficient removal of random- valued impulse noise is proposed in this paper. The approach uses the decision-tree-based detector to detect the noisy pixel and employs an effective design to locate the edge. With adaptive skill, the quality of the reconstructed images is notable improved. The proposed filter has proved that it is very efficient for random valued impulse noise because practically noise is not uniform over the channel. In this dissertation is used concept of maximum and minimum threshold to detect both positive and negative noise.

REFERENCES

[1] Anitha S, Laxminarayana Kola, Sushma P and Archana S, “Analysis of Filtering and Novel Technique for Noise Removal in MRI and CT Images”, International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), IEEE 2017.

[2] Neela Chithirala, Natasha. B, Rubini. N and Anisha Radhakrishnan, “Weighted Mean Filter for Removal of High Density Salt and Pepper Noise”, 3rd International Conference on Advanced Computing and Communication Systems, IEEE 2016.

[3] Tian Bai and Jieqing Tan, “Automatic detection and removal of high-density impulse noises”, 162 & The Institution of Engineering and Technology IET Image Processing, Vol. 9, Iss. 2, 2015.

[4] B. Deepa and Dr.M.G.Sumithra, “Comparative Analysis of Noise Removal Techniques in MRI Brain Images”, IEEE Conference on image processing and system, IEEE 2015.

[5] Babu G, Sivakumar R and Praveena , “Design of Spatial Filter for FusedCT and MRI Brain Images ”, 2015 International Conference on Advanced Computing and Communication Systems (ICACCS -2015), Jan. 05 –07, 2015, Coimbatore, INDIA.

[6] Priyanka Punhani and Dr. Naresh, “Noise Removal in MR Images using Non Linear Filters”, 6th ICCCNT - 2015 July 13 - 15, 2015, Denton, U.S.A.

[7] L. Ramya and N. Sasirekha, “A Robust Segmentation Algorithm using Morphological Operators for Detection of Tumor in MRI ”, IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS’15.

[8] Arabinda Dash and Sujaya Kumar Sathua, “High Density Noise Removal by using Cascading Algorithms”, 2015 Fifth International Conference on Advanced Computing &

Communication Technologies 2327-0659/15 $31.00 © 2015 IEEE.

[9] Ashutosh Pattnaik, Sharad Agarwal and Subhasis Chand. "A New and Efficient Method for Removal of High Density Salt and Pepper Noise Through Cascade Decision based Filtering Algorithm" in 2nd International Conference on Communication, Computing & Security, Volume 6, Pages 108-117. ICCCS-2012.

[10] Chauhan, Arjun Singh, and Vineet Sahula. "High density impulsive Noise removal using decision based iterated conditional modes" in Signal Processing, Computing and Control (ISPCC), 2015 International Conference on, pp. 24-29. IEEE, 2015.

[11] Dash, Arabinda, and Sujaya Kumar Sathua. "High Density Noise Removal by Using Cascading Algorithms" in Advanced Computing & Communication Technologies (ACCT), 2015 Fifth International Conference on, pp. 96- 101. IEEE, 2015.

[12] Esakkirajan, S., T. Veerakumar, Adabala N. Subramanyam, and Prem CH Chand. "Removal of high density salt and pepper noise through modified decision based unsymmetric trimmed median filter" in Signal Processing Letters, IEEE 18, no. 5 (2011): 287-290.

[13] Madhu S. Nair and G. Raju. "A new fuzzy-based decision algorithm for high-density impulse noise removal" in Signal, Image and Video Processing, November 2012, Volume 6, Issue 4, pp 579-595.

[14] Raza, Md Tabish, and Suraj Sawant. "High density salt and pepper noise removal through decision based partial trimmed global mean filter" in Engineering (NUiCONE), 2012 Nirma University International Conference on, pp. 1- 5. IEEE, 2012.