Impulse Noise Removal in Different Types of Color Image using DWT and Threshold Filter

[1]Praveen Bhargava, [2]Rakesh Kumar Bhujade, [3]Shruti Choubey

Ph.D. Research Scholar, CA Department, Mandsaur University, Mandsaur, Madhya Pradesh, India

Assistant Professor, CSE Department, Mandsaur University, Mandsaur, Madhya Pradesh, India[2]

Associate Professor, ECE Department, Sreenidhi Institute of Science & Technology, Hyderabad, India[3]

Abstract: - Images are often corrupted by impulse noise in the procedures of image acquisition and transmission. In this paper, we propose an efficient denoising scheme for the removal of random-valued impulse noise. We employ 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. Furthermore, an adaptive technology is used to enhance the effects of removal of impulse noise. Noise elimination is the main constraint in digital image processing and sometimes it is very difficult to find out the origin of the noise. We have employed a novel thresholding rule based on wavelet transform for impulse noise reduction from color images. The wavelet transform performs multiscale analysis of the given image by treating different frequency components present in an image separately. The wavelet transform decomposes the given image into detail and approximation sub-band. It is assumed that approximation sub-band contains significant structures whereas detail sub-band may contain noise. So, the filtering process is used more for detail sub-band and less in approximation sub-band. It is observed that the proposed hybrid method gives better results for impulse noise reduction, edge preservation and feature preservation for color images.

Keywords:- Impulse Noise, Threshold Filter, Discrete Wavelet Transform (DWT), PSNR, MSE

I. INTRODUCTION

Presently multi day, a large portion of the data in Computer preparing is taken care of on the web. This online data is either graphical or pictorial in nature, and the capacity and correspondence prerequisites are tremendous. Thus technique for packing the information before capacity and transmission are of critical useful and business intrigue. Picture pressure implies diminishing the repetitive measure of information required to speak to an advanced picture. The Digital picture pressure in numerical structure can be characterized as change of a 2-D pixel exhibit by picture, into a factually uncorrelated informational collection. The change is connected on picture before capacity and transmission of Digital Image Data. The packed picture is recreated into unique picture by the procedure of Decompression. Decompressed picture can be a unique picture or estimation of it. Picture pressure is the innovation for dealing

with the expanded spatial goals of the present imaging sensors and developing communicate TV norms. Picture pressure assumes an essential job in numerous critical and assorted applications including tele video conferencing, remote detecting, archive and medicinal imaging, copy transmission and the control of remotely guided vehicles in military, space, and risky waste administration applications. The application list is consistently developing the effective control stockpiling and transmission of various kinds of computerized picture, for example, paired pictures, dim scale pictures, and shading pictures and so forth [1], [2] The Internet, still in its youth; keeps on prospering and effect on our own and expert lives. Regular to these and numerous different applications is the prerequisite of immense extra room and correspondence transmission capacity for computerized pictures. Subsequently computerized media is persuaded by creative techniques for pressure of advanced pictures for productive use of extra room and correspondence data transfer capacity [3], [4]. As a rule setting, the picture talking pressure systems can be partitioned into two expansive classes: lossless pressure and lossy pressure plans. Lossless Compression (Information protecting): As the name suggests, this procedure includes no loss of information. The first information can be recuperated precisely from the compacted information.

A CT check are on sort of unique x-beam tests which is produce cross-sectional pictures of the body utilizing PC and x-beams it connects a noteworthy job diagnosing medicinal infections, it is utilized to know subtleties of human body like chest, paunch, pelvis, arm, leg, by utilizing CT filter pictures of organ like liver, pancreas, digestive system, kidney, bladder, adrenal organ, lung and heart, and so on. The MRI is a systems to get a reasonable picture of organs by utilizing extensive measure of attractive and radio waves. It uses to analyze an assortment of conditions from tendons to tumors and will be utilized to think about mind and spinal line. In restorative picture handling De-noising of pictures assumes an imperative job to get exact and precise pictures for further finding. Therapeutic pictures are gathered by various sensors and they are likewise oppressed wide assortment of mutilation, stockpiling, pressure, procurement, preparing, propagation And transmission which makes them get defiled by various kinds of clamors are evacuated utilizing channels as they can create best outcomes relying on its parameters. The determination of channels rely on they kind of commotion on the grounds that distinctive sort of clamor can be evacuated utilizing diverse kinds of commotions. In this paper a noised picture is considered and it is sifted utilizing Median and Wiener channel and the outcome is looked at on different parameters. Middle channel and Wiener channel calculation will be changed. Different clamors and like salt and pepper commotion are included. Wiener channel and middle channel are actualized to evacuate added substance commotion which is available in MRI and CT filters which likewise capable to include thickness step by step. Superconductive scanner contains refrigeration framework and fluid helium siphon which is in charge of "pound" sound, which is additionally aggravate patient and leads brief hoop misfortune.

The higher-complexity approaches require long computational time as well as full frame buffer. Today in many practical real-time applications, the denoising process is included in end-user equipment, so there appears an increasing need of a good lower complexity demolishing technique, which is simple and suitable for low-cost VLSI implementation. Low cost is a very important consideration in purchasing consumer electronic products. To achieve the goal of low cost, less memory and easier computations are indispensable. In this paper, we focus only on the lower-complexity denoising techniques because of its simplicity and easy implementation with the VLSI circuit.

II. TYPES OF NOISE

Commotion is included inside the image at the season of photo obtaining or transmission. Diverse variables might be responsible for presentation of clamor inside the photograph. The wide assortment of pixels tainted in the image will choose the measurement of the commotion. The central resources of commotion inside the virtual picture are:

a) The imaging sensor might be stricken by ecological conditions at some phase in picture obtaining.

b) Inadequate mellow degrees and sensor temperature may furthermore present the commotion in the image.

c) Interference in the transmission channel may likewise degenerate the photograph.

d) If earth flotsam and jetsam is blessing at the scanner show screen, they additionally can present commotion inside the photo.

Commotion is the bothersome outcomes delivered inside the image. For the span of photograph procurement or transmission, various components are chargeable for presenting commotion in the photograph. Depending at the kind of unsettling influence, the commotion can affect the image to exceptional volume. Usually our discernment is to push off beyond any doubt sort of commotion.

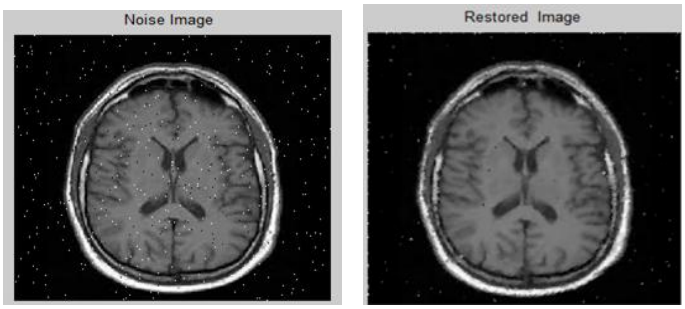


Figure 1: Salt and Pepper noise and original image

So we become mindful of beyond any doubt sort of upheaval and apply unique computation to dispose of the fuss. Picture tumult can be arranged as Impulse fuss (Salt-and-pepper clatter).

Gaussian Noise

Gaussian dispersion which is otherwise called typical circulation whose Probability Density Function is equivalent to factual clamor known as Gaussian Noise. This clamor is expelled from the computerized pictures by smoothening of the picture pixels which helps in lessening the force of the commotion present in the picture which is caused because of securing however the outcome perhaps at some point bothersome and furthermore which can bring about obscuring edges of the astounding pictures [2].

Spot Noise

The Speckle Noise is characterized as a commotion which is available in the pictures and which corrupts the nature of a picture. Dot Noise is a marvel that escorts all cognizant imaging modular quality in which pictures are delivered by meddling echoes of a transmitted waveform that start from assorted variety of the considered articles [5].These are the granular commotions

that are in a general sense present in the picture and lessen the nature of the dynamic radar and Synthetic Aperture Radar (SAR) pictures or Magnetic Resonance [6]. Imaging (MRI) pictures is alluded to as Speckle Noise. In the event that Speckle Noise is available in the ordinary radar results from irregular varieties in the arrival motion from an article which is never again picture process flag builds the mean dark dimension in a picture. A Speckle Noise is the cognizant imaging of items in the picture. Indeed, it is caused because of mistakes in information transmission. This sort of commotion influences the ultrasound pictures and MRI pictures.

III. PROPOSED METHODOLOGY

The Modified Median Filter figuring is the time when a picked window contains only 0 and 255 regard then the restored regard is either 0 or 255(again uproarious), drives us to proposed. In this count we picked pixel regard 0 and 255 qualities then the getting ready pixel is replaced by mean estimation of the picked window. The detail of the figuring is given underneath.
To achieve the goal of low cost normally lower complexity techniques are usually prefered. Since it requires use of fixed size local window it can be easily implemented in VLSI architecture. In order to enhance the robustness of the image, the removal of impulse noise is necessary. One of the simple and powerful form of multivariable analysis is decision tree. The complex process is broken into simple form so that solution can be obtained easily.

Algorithm
Stage 1: Select a 3 x 3 grid size as indicated by the 2-D window measure. Expect that the handling pixel is Pij, which lies at the focal point of window.

Stage 2: If $0 < Pij < 255$, at that point the handling pixel or Pij is uncorrupted and left unaltered.

Stage 3: in the unlikely event that $Pij = 0$ or $Pij = 255$, at that point it is considered as corrupted pixel and four cases are possible as given underneath.

Case 1: if the picked window has all the pixel regard as 0, at that point Pij is superseded by the Salt fuss (for example 255).
Case 2: if, despite everything that the picked window contains all the pixel regard as255, at that point Pij is superseded by the pepper upheaval (for example 0).

Case 3: if the picked window contains all the regard as 0 and 255 both. By then the dealing with pixel is superseded by mean estimation of the window.

Case 4: if, despite everything that the picked window contains not all the segment 0 and 255. By then discard 0 and 255 and find the center estimation of the remainder of the part. Displace Pij with center regard.

Stage 4: Rehash stage 1 to 3 for the entire picture until the methodology is done.

Noise Detection Unit:- The pixels from the sliding window are placed into the noise detection unit. The noise detection unit checks for noisy pixels within the window. If the pixels within the window are 0 or 255, then it is considered as salt and pepper noise. The noise detection unit generates output as zero for noisy pixel input. The output of the noise detection unit is fed into

the sorting network.

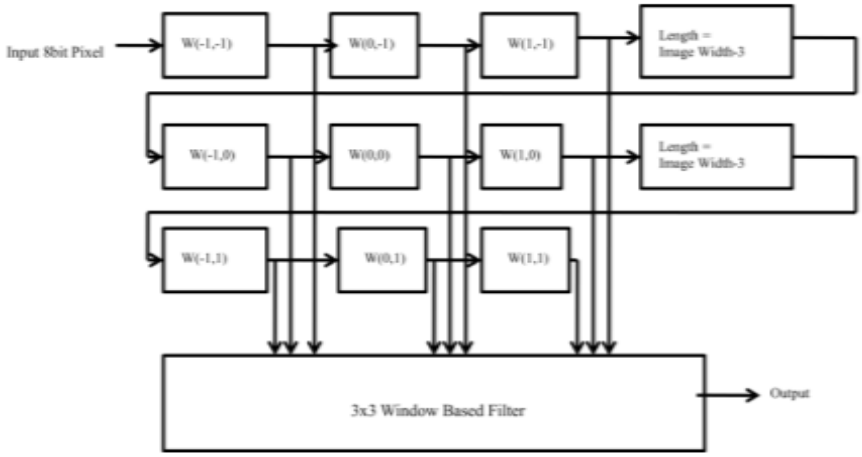


Figure 2: Implementation of 3x3 Filter Window

Sorting Network:- Sorting network consists of compare & swap elements called as comparators, that sorts all input pixels. A compare & swap unit of two elements(A,B)as shown in Fig.4 Compares A and B and exchanges the elements in order to obtain the sorted sequence.

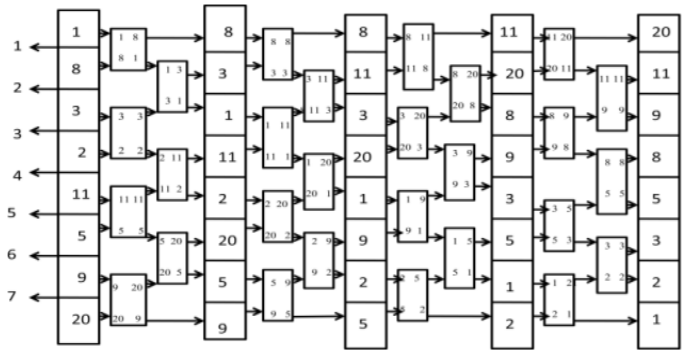


Figure 3: Median Sorter Module

The Modified Median Filter figuring is the time when a picked window contains only 0 and 255 regard then the restored regard is either 0 or 255(again uproarious), drives us to proposed. In this count we picked pixel regard 0 and 255 qualities then the getting ready pixel is replaced by mean estimation of the picked window. The detail of the figuring is given underneath.

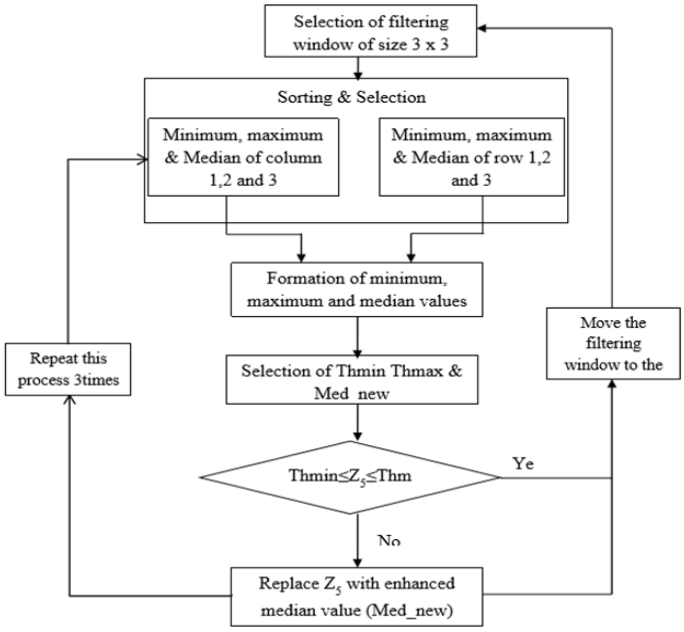


Figure 4: Flow Chart of Proposed Method

Discrete Wavelet Transform

The wavelets are localized waves of very limited time duration, which are used for time-frequency analysis. The wavelets have applications in many different areas of computer science, engineering and scientific research such as analysis of images, audio, video and many other types of signals. The wavelet transform can be used to perform various tasks in image processing such as image compression, image denoising, pattern recognition etc. The wavelet transform provides ability to reduce noise from the given image by converting it into wavelet coefficients. The noise reduction from ultrasound images using wavelets is mainly based on thresholding of wavelet coefficients. The wavelet transform decomposes the given noisy image into detail (HH, LH and HL) and approximation (LL) sub-bands.

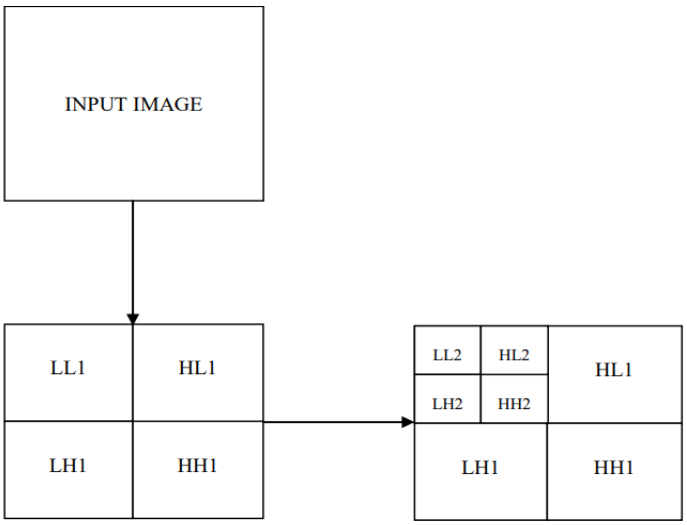


Figure 5: Decomposition upto Second Level

The approximation (LL) sub-band at each level can be further decomposed into next level four sub-bands (LL*, HL*, LH*, HH*) where '*' in (LL*, HL*, LH*, HH*) represents the next level of (LL, HL, LH and HH) sub-bands. The first level and second level sub-band decomposition is given in figure 3.1. The low pass filtering is used to obtain approximation coefficients whereas detail coefficients are obtained by high pass filtering. The process of decomposing approximation (LL) sub-band into next level four sub-bands is iterative. The choice of decomposing level is crucial, as it may affect the de-noising results. Mallat suggested the way to decompose given image into wavelet coefficients of different decomposition level [101]. The decomposition of image into sub-bands is also known as analysis. The decomposition of image includes low pass filtering, high pass filtering and downsampling. The following figure 3.2 represents the process of decomposition using filter bank in which, 'h' describe the low pass filtering and 'g' describes the high pass filtering. The filtering along the rows is applied initially by using low pass filter and high pass filter then it is downsampled by 2. The processed components are again filter with high pass and low pass filters along the columns and again downsampled by 2.

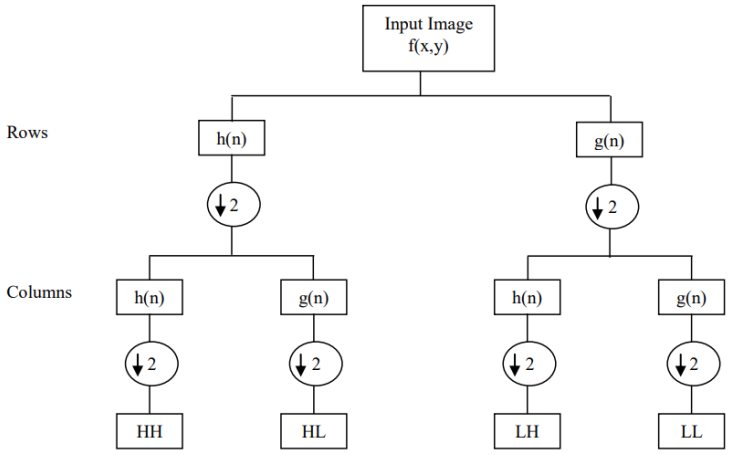


Figure 6: Wavelet Analysis Using Filter Bank

IV. 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).

Normalized Absolute Error (NAE)

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

Mean Square Error (MSE)

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

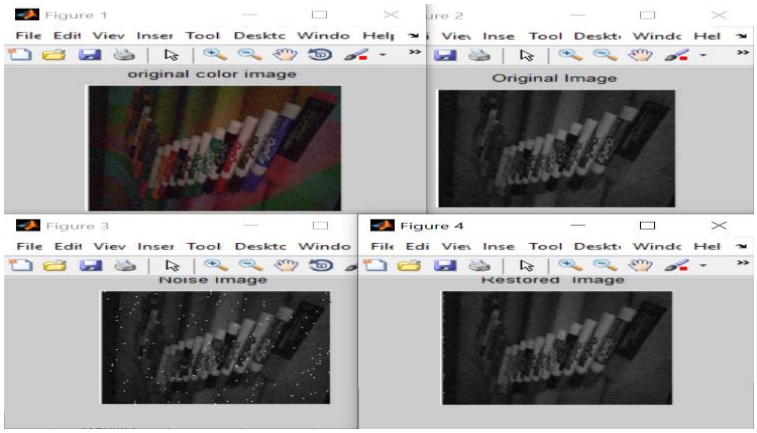
Root Mean Square Error (MSE)

$$= \sqrt{MSE} \quad (3)$$

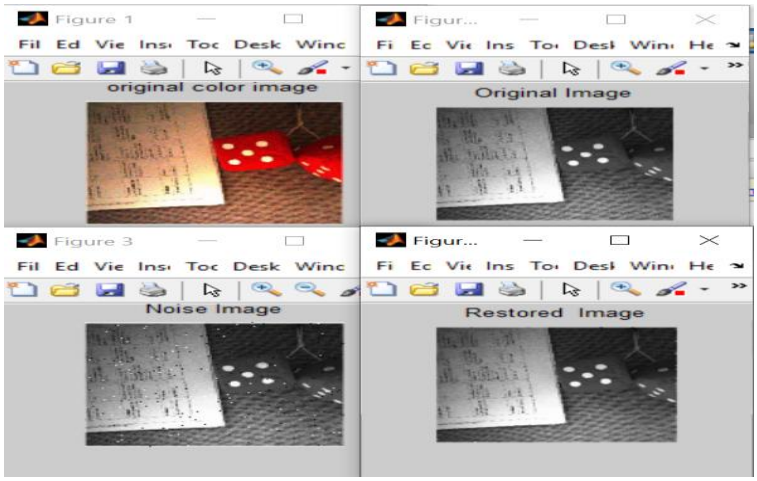
Peak Signal to Noise Ratio (PSNR) in dB

$$= 10 \times \log_{10}\left(\frac{255^2}{MSE}\right) \quad (4)$$

Where MSE remains for Mean Square Error, PSNR remains for Peak Signal to Noise Ratio. From the reproduction result appeared in Table I to II, it is watched that the execution of proposed calculation is enhanced PSNR than the current calculations at medium and high clamor level.



Noise and Restored Image1 with Density 0.01



Noise and Restored Image2 with Density 0.01

Figure 7: Experimental Salt & Pepper Noise Image for 0.01 Noise Density

Table 1: Image1 Simulation Parameter for Different Noise Density

Image Density	NAE	MSE	RMSE	PSNR (dB)
0.01	0.0078	0.0543	0.2331	60.814
0.02	0.0163	0.1125	0.3355	57.651
0.03	0.0289	0.1892	0.3852	53.283
0.04	0.0345	0.2338	0.4835	54.476
0.05	0.0436	0.2957	0.5438	53.455
0.06	0.0573	0.3274	0.5958	52.384
0.07	0.0660	0.4363	0.6606	51.766
0.08	0.0742	0.4892	0.7184	51.026
0.09	0.0875	0.5694	0.7546	50.610

Table 2: Image1 Simulation Parameter for Different Noise Density

Image Density	NAE	MSE	RMSE	PSNR (dB)
0.01	0.0129	0.1073	0.3275	57.859
0.02	0.0263	0.2425	0.4355	54.651
0.03	0.0393	0.3319	0.5761	52.954
0.04	0.0495	0.4338	0.6835	51.476
0.05	0.0685	0.5651	0.7517	50.643
0.06	0.0783	0.6274	0.8958	49.384
0.07	0.0860	0.7363	0.9606	49.066
0.08	0.0982	0.9892	0.9984	48.026
0.09	0.1318	1.0778	1.0382	47.839

V. CONCLUSION

In this work, it can be watched that the execution of the proposed channel is better than the current channels. The fundamental commitment of the paper is a strategy that is fit for reestablishing pictures debased by speckle noise commotion with to a great degree high clamor proportion. Light is additionally tossed on the reasons for these commotions and their real sources. In the second area we introduce the different sifting systems that can be connected to de-commotion the pictures. Trial comes about displayed, demands us to finish up middle channels performed well. Adjusted middle channel is the best decision of expelling the speckle noise commotion. In this paper is utilized changed middle channel and enhanced PSNR and decreased MSE for different color image.

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