



## An Efficient Image Restoration and Denoising approach using Unsymmetric based Trimmed Mean Bilateral Filter (UBTMF)

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**Abstract**— One of the most fundamental processes in image processing is image denoising. The aim of image denoising is remove noise from an image without destroying object boundaries. There are mainly two noise models: additive Gaussian noise and impulsive noise which can represent the most of noises captured. As mobile phone camera is widely applied in actual life because of its convenience, people's requirement of it is becoming higher and higher. Image denoising algorithm has always been a hotspot in the field of image processing. To improve the quality of mobile image, the edge of the image shouldn't be blurred while denoising. In this paper a new algorithm for the removal of impulse noise from the gray scale images. This new algorithm is named as Unsymmetric Based Trimmed Mean Bilateral Filter (UBTMF). The purposed filter is capable of removing very high density impulse noise from images and it also preserves the important details of image during denoising.

**Keywords**—Digital Image, Filter, UBTMF, Sensor, Noise, De-noise

### I. INTRODUCTION

A variety of methods for images noise reduction has been developed so far. Most of them successfully remove noise but their edge preserving capabilities are weak. Therefore bilateral image filter was helpful to deal with this problem. Nevertheless, their performances depend on spatial and photometric parameters which are chosen by user. Conventionally, the geometric weight was calculated by means of distance of neighboring pixels and the photometric weight was calculated by means of color components of neighboring pixels. The range of weights was between zero and one. Geometric weights were estimated by fuzzy metrics and photometric weights are estimated by using fuzzy rule based system which does not require any predefined parameter. Experimental results of conventional, fuzzy bilateral filter and this approach have been included. A novel hybrid bilateral filter, which requires only single parameter rather than two parameters like in conventional filter, has been proposed by Sara. The geometric weights were calculated by fuzzy metric and they depend on some parameters. The photometric similarity of pixels was estimated by means of fuzzy rules and it has dominant effect on performance of bilateral filter. Larger values of spatial parameters and mask size decrease performance of filter. Employment of fuzzy metric and fuzzy similarity to estimate the geometric and photometric parameters makes hybrid bilateral filter more appropriate for practical applications than conventional ones [1].

Xue Han proposed a method to satisfy people's increasing requirement of mobile phone images, remove the image noise and prevent the edge from blurred, edge detection based anisotropic denoising method for mobile phone image was proposed by Xue. To begin with, wavelet transform edge detection and threshold segmentation are adopted to extract the outline of the image. Then anisotropic diffusion denoising algorithm was applied to remove noise on the edge of the image while average filter was used in the smooth area. Finally the denoised image was grayed to further eliminate color noise, so as to improve the denoising effect. Simulation and actual experimental results show that this method can effectively smooth noise preserve image edge and remove the color noise, consequently obtain the ideal denoising effect. It was competitive with the existing methods both in terms of peak signal-to-noise ratio (PSNR) and in structural similarity index measure (SSIM). Based on the existing wavelet denoising algorithms, they adopt wavelet transform algorithm and threshold segmentation to extract image edge. Different denoising methods are used in the edge and smooth areas. In combination of anisotropic diffusion denoising method, they put forward the graying color denoising method, to smooth the image further. As verified by the simulation results and the actual phone image denoising results, this anisotropic denoising method based on wavelet transform can effectively remove the noise, preserve the edge, smooth color noise and achieve ideal denoising effect [2].

Dubok Park proposed a novel framework for enhancing under water images captured by digital camera embedded into underwater diving mask. Their approach adjusts the color balance using biasness and average of luminance. Then, scene visibility is enhanced based on underwater image model. Magnified noise in enhanced images is alleviated by Non-local means (NLM) denoising. The final enhanced images are characterized by improved visibility while retaining color fidelity and reduced noise. Their method does not require specialized hardware or prior knowledge about the underwater environment. An effective framework was proposed to enhance the underwater image. Finally, magnified noise was

reduced by NLM denoising. This method was validated using real data and shown appropriate for applying to consumer electronic products such as UDCM for personal scuba-diving pleasure and for analyzing underwater environment [4].

Ngai Li proposed an image denoising algorithm for 3D demosaicked images. Each color component of the 3D stereo images was processed for noise reduction by identifying the stereo correspondences between two stereo images at subpixel accuracy. Using this method, it has been experimentally shown that there was visual improvement in the demosaicked output images using a realistic signal-dependent noise model with demonstration of a higher signal-to-noise ratio (SNR). Author presents a novel method for denoising a pair of noisy stereo CFA images after demosaicking. The technique was to identify the stereo correspondences for each pixel location in the stereo images at subpixel accuracy. A novel denoising algorithm for a pair of 3D noisy CFA images has been proposed by Ngai. With the interpolated green channel, pair of disparity maps for the left and right images was used to identify the stereo correspondence of each point in the reference image with subpixel accuracy. Their experimental results have shown that this method was able to improve the SNR by around 2.5dB for various types of noise in 3D images using a more accurate signal-dependent noise model. Moreover, it has been demonstrated that this method outperforms the other denoising algorithms by around 1dB [5]. Histogram based Watermarking using Entropy and DWT with PSO in Digital Images are proposed in [6], Facial Skin Segmentation using BFO and PSO [7], Hyper Spectral Image Restoration Approach using LRMR and LDA [8], Face Recognition with Decision Tree using SVM and SURF [9] and Finger Vein Biometric Authentication Scheme using Repeated Line Tracking and DWPT based Scheme [10]. Multimodal biometric system is an emerging field in which an enhanced version of the images are used for human recognition and identification [11] - [16].

## II. PROPOSED WORK

UNTMF uses trimmed mean of noisy image for the calculation of range filter weights  $W_{TMSR}(s,t)$  hence only noise free pixels are processed during the range filter calculation. Due to which the computational time of proposed UBTMF algorithm is less as compared to SBF method because SBF requires the processing of all noisy and noise free pixels to calculate range filter  $WSR_{s,t}$ . Different steps for proposed work is shown in figure 1.

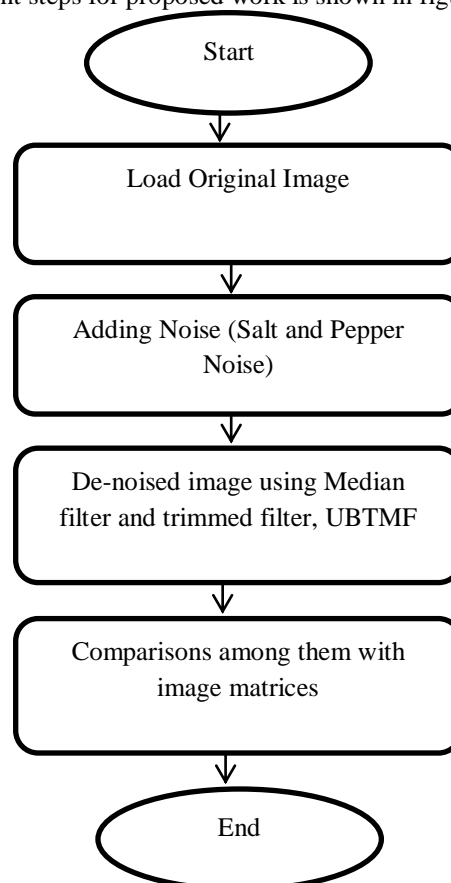


Figure 1: Flow chart of proposed work

### A. Calculation of Trimmed Mean:

To calculate the trimmed mean from a given set of values usually we neglect the lowest and the highest value and then take the average of remaining values. Now in the case of images which are corrupted by salt and pepper noise we have noise in the form of lowest and highest pixel values (0 and 255). Hence we can remove these noisy pixels by taking the trimmed mean of image. The computation of trimmed mean can be explained by following steps: i) Check the condition  $0 < (x,y) < 255$  for the input noisy image, where  $f(x,y)$  is the center pixel value. ii) If the selected window has no noisy pixel then take the average otherwise remove the noisy pixels and take the average of remaining pixels. iii) Thus computed value is called trimmed mean TM.

**B. Unsymmetric Based trimmed median filter (UBTMF):**

In the proposed UBTMF method we modify the switching bilateral filter, as we select the filter parameters in a new manner. We take the value of domain parameter ( $\sigma_d$ ) between 1 and 4. The value of  $\sigma_d$  is selected according to the density of noise ( $n$ ) present in the image. As shown in results in next section that the value of  $\sigma_d$  is 1 for noise density 10% to 50%, 2 for noise density 60% to 70% and 3 and 4 values of  $\sigma_d$  are taken for noise density of 80% and 90% respectively.

**III. RESULT AND ANALYSIS**

The Original Color Image is Leena which uses Salt & Pepper noise and De-noised image using Median filter, Trimmed filter, UBTMF Filter comparisons among them. Firstly we load the original and distorted images to analyse the quality of distorted images by taking original images as reference. There are six steps are used for complete the proposed research work. All the steps are explained in figure 2 to figure 7.

*Step1: Load the original color image of Leena:*

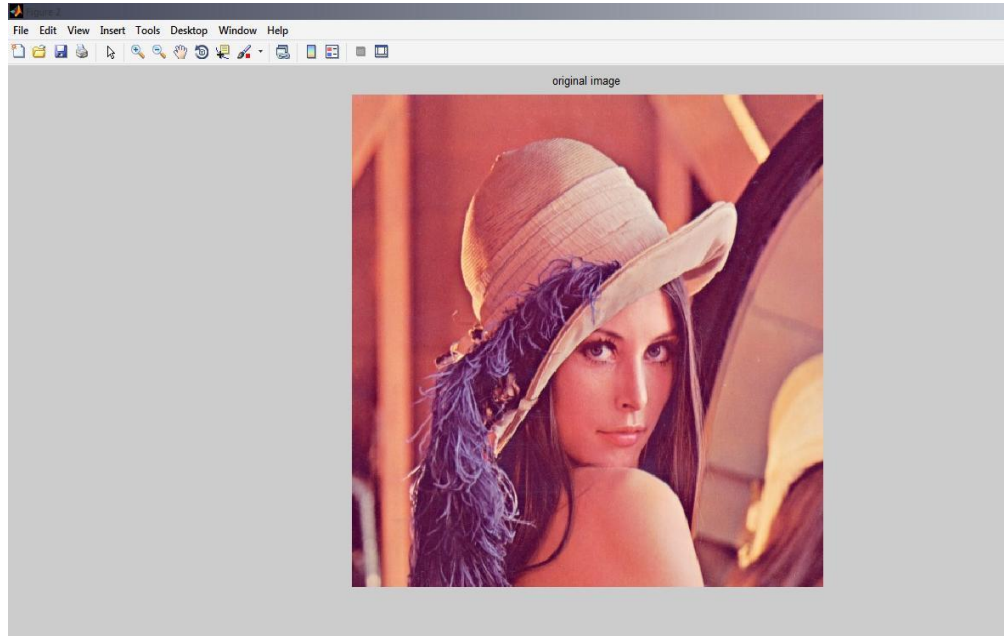


Figure 2: Original image of Leena

*Step 2: Separate the three plane of color of color image i.e. red-green-blue plane.*

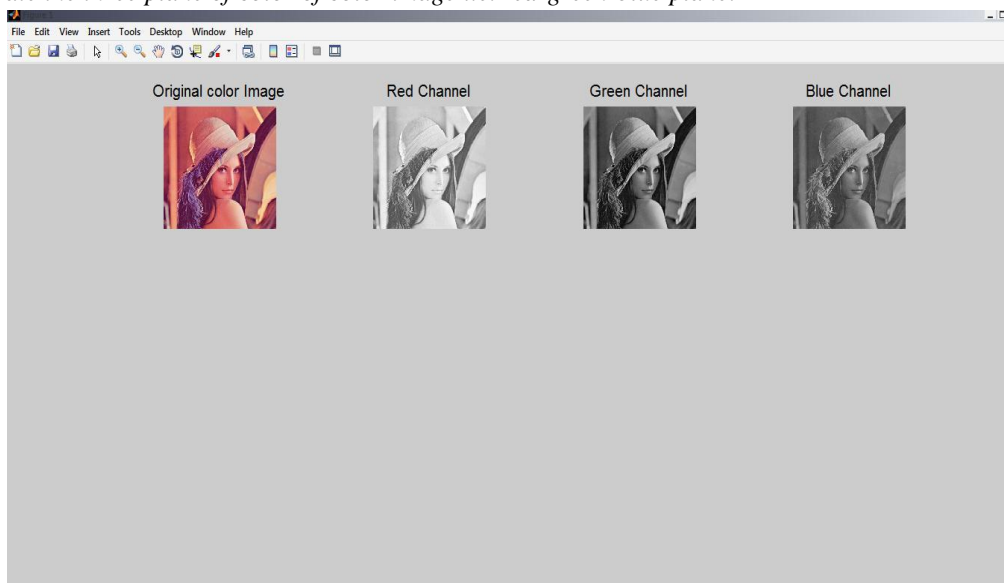


Figure 3: Three plane of color image of Leena

*Step3: Load the Distorted grayscale image of cameraman at the noise density level 0.9, we may include this density level 0.1 to 0.9. In this work we use the maximum density level of noise, through which we easily check the performance of the our filters ,and also calculate the image matrices like, PSNR,IEF,MSE.*

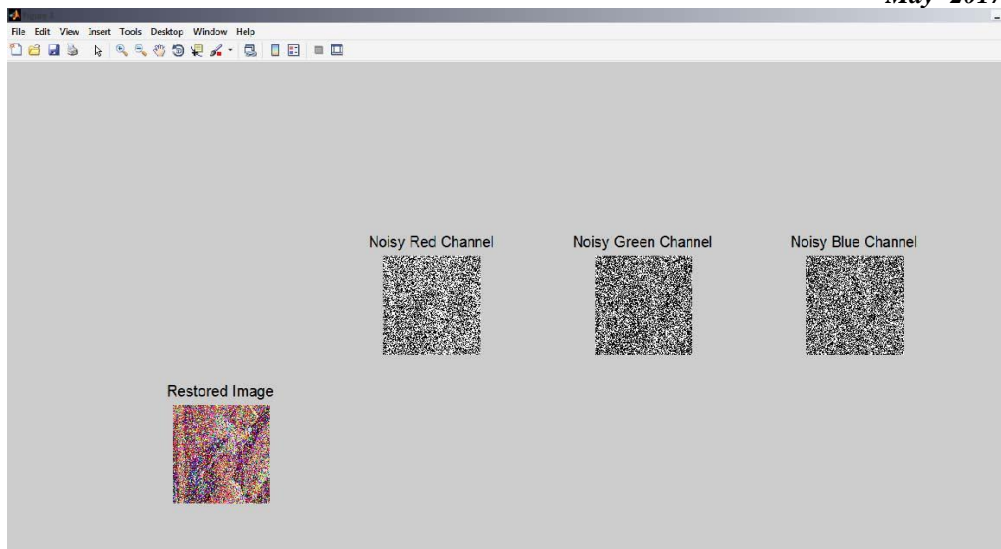


Figure 4: Distorted Image of Lena at density level 0.9

Step 4: filtered image by Median Filter

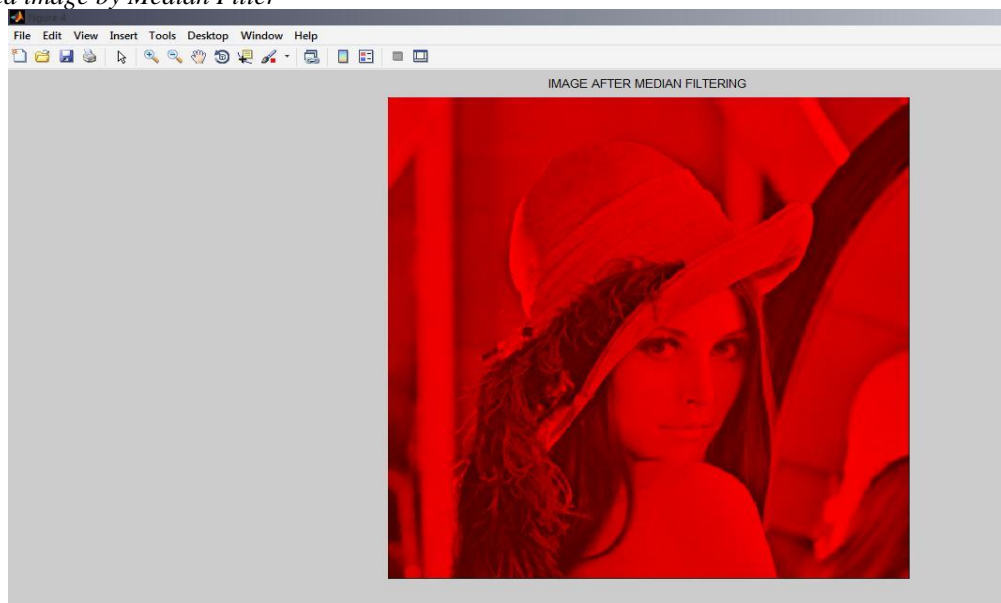


Figure 5: Filtered image by Median filter

Step 5: Filtered image by Trimmed Filter

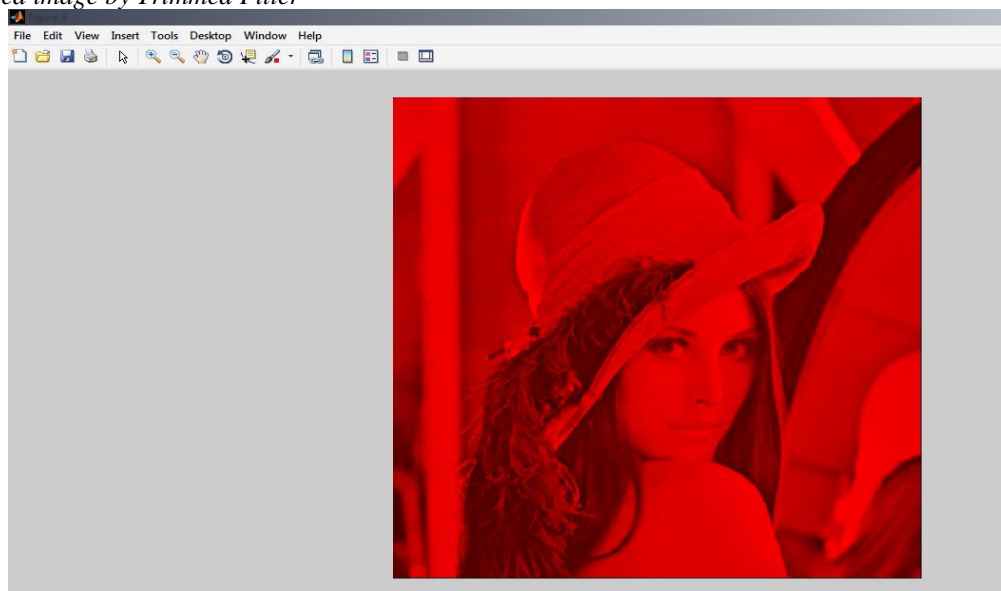


Figure 6 (a): Filtered image by Trimmed Bilateral Filter

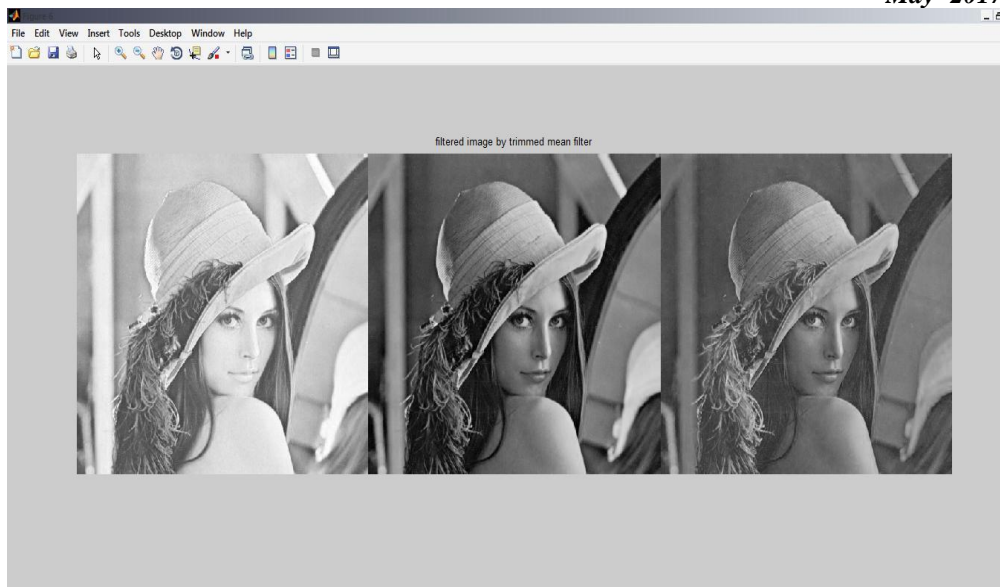


Figure 6 (b): Filtered image by Trimmmed Bilateral Filter

Step 6: Filtered image by Purposed Filter:

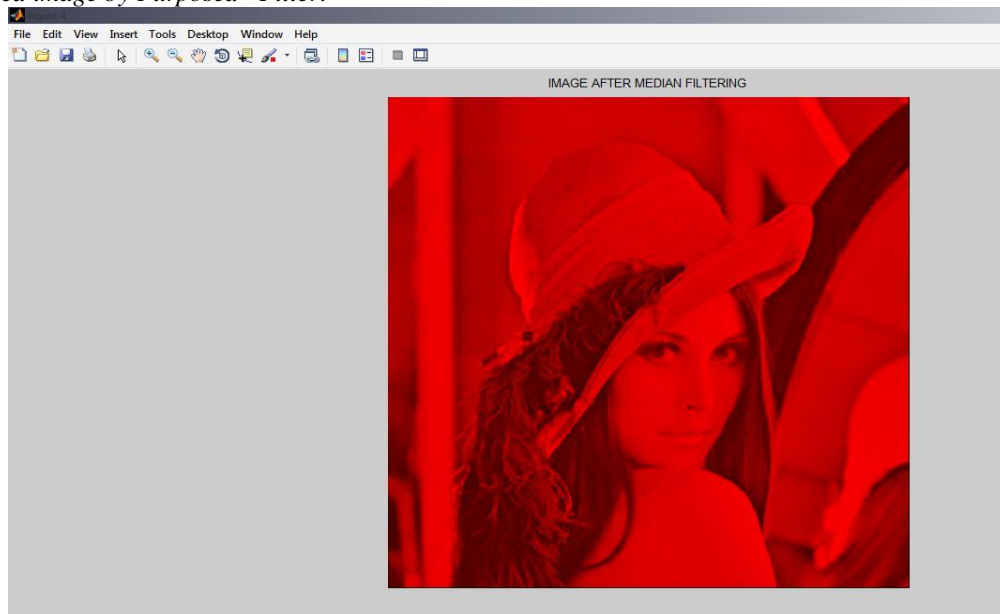


Figure 7: Filtered image by Purposed Filter

#### IV. CONCLUSION AND FUTURE RESEARCH SCOPE

In this paper a new algorithm for the removal of impulse noise from the gray scale images. This new algorithm is named as Unsymmetric Based Trimmmed Mean Bilateral Filter (UBTMF). The purposed filter is capable of removing very high density impulse noise from images and it also preserves the important details of image during denoising.

In future this filter can be further improved by adding more impulse noise detection schemes to it. By using an efficient noise detection technique the thin lines and texture can also be classified differently along with edges in image hence the information contained by thin lines and texture can also be preserved as edges are preserved in this method. All these modifications can make the purposed UBTMF filter more efficient for impulse noise removal.

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