iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 5 **Issue:** I **Month of publication:** January 2017

**DOI:**

Volume 5 Issue I, January 2017
ISSN: 2321-9653


**International Journal for Research in Applied Science & Engineering Technology (IJRASET**

# High Density Impulse Noise Removal of Color Image Using Bilateral Filter

Arti Rani[1], Pankaj Gupta[2]

*[1]Research Scholar, [2]Assistant Professor*

*Department Computer Sc Glaxy Institute of Technology and Management Kurukshetra University Kurukshetra*

***Abstract: Generally, image restoration is an important task in any image processing system. In many image-processing applications, observed images are contaminated by a non stationary noise and no a priori information on noise dependence on local mean or about local properties of noise statistics is available. In order to remove such a noise, a locally various filter has to be applied.Impulse noise reduction or removal is a very active research area of image processing.Denoising of an image is an essential step in many image processing applications. The purpose of image denoising is to get a clear version of a noisy image.***

***Index term: Image processing, Noising, Denoising ,Filtering Technique***

## I. INTRODUCTION

Noise reduction [1] in digital images, despite many years active research, still remains a challenging problem. The rapid proliferation of portable image capturing devices, combined with the smallness of the imaging sensors and increasing data throughput capacity of communication channels, results in the need to create novel fast and efficient denoising algorithms. Color images are very often corrupted by precipitate noise, which is introduced into the image by faulty pixels in the camera sensors, transmission errors in noisy channels, poor lighting conditions and aging of the storage material .The containment of the disturbances introduce by the impulsive noise is crucial for the success of further stages of the image dispensation pipeline. The images used for testing purposes in this thesis are all gray-scale images. They contain no colour information. They signify the intensity of the image. This image contain 8 bits/pixel data, which way it can have up to 256 (0-255) different absorption levels. A 0'represents black and '255' denotes white. In side by values from 1 to 254 represent the dissimilar gray levels. As they contain the power information, they are also referred to as amount images. Colour images are consider as three band unbiased images, where each band is of a different colour. Each band provides the intensity information of the matching spectral band. Typical colour images are red, green and blue images and are also referred to as RGB images. This is a 24 bits/pixel image. Noise is unnecessary but ever-present in any signal and so is the case with image signal. Noise creep in images during its accomplishment, signal condition storage, broadcast, etc. Once image is dishonored by noise, not only its visual quality is lost, but also some imperative features get hidden in the image. Re-establishment of image quality is an necessary process for any application and end custom of image. Modern digital cameras are constructed using CCD which generate noise due to non-ideal presentation of the electronic devices in it. Such noise is regularly modeled as Gaussian as well as impulse. Noises of this types are said to be preservative as the noise can be suspicious as an adding term to the original image. There exist many modalities of production of medical images such as Magnetic Resonance Images (MRI), Ultrasound (US) images, Computed Tomography (CT) images, etc. Due to imperfect operation of such devices, a noise modeled as Speckle noise gets introduce in such images. This noise is said to be multiplicative, as the noisy image can be considered as the unique image and a multiplicative noise term. It is a signal needy noise and is also seen in Synthetic Aperture Radar (SAR) images.

## II. RELATED WORK

Moni R.S [2] proposed a new multiresolution de-noising method. Implementation of MSVD is discussed. De-noising strategy is analogous to that of wavelet decomposition in addition to thresholding. Gaussian noise, salt & pepper noise, and speckle noise are practical to different images. De-noising using MSVD is implemented inMATLAB. Subjective and Objective assessment of results obviously show the power of the planned method for denoising. PSNR, CC and SSIM are evaluated for representative cases and

International Journal for Research in Applied Science & Engineering Technology (IJRASET

are tabulated. The method is in addition applied to an RGB color image. Result in this admiration is also good. Good visual quality inherent with the multi resolution processing can be seen in the consequences, particularly for low density of noise.

Aleksey Rubel [3] proposed the efficient denoising is not provided by the considered DCT-based filters for texture images. Meanwhile, the used local DCT and nonlocal BM3D filters provide noise suppression efficiency close to values determined by the Milanfar bound, i.e., to potential limit for non-local move toward to filtering grayscale images. Visual quality of denoised images is also not significantly improved than for the original ones even if noise is intensive. This means that, probably, it is reasonable to avoid filtering texture images (or texture fragments of images). One step towards this can arrangement with using prediction of denoising efficiency discussed in this paper. At the same time, additional expectations work with reference to filtering texture images, calculation of its efficiency and design of new approaches is obviously needed.

Mikhail Chobanu [4] proposed the dependences between statistics of DCT coefficients in 8x8 pixel blocks and efficiency of image denoising for two powerful filtering techniques are established and studied. It is given away that simple information as P2cr or PVcr allow predicting filtering efficiency through accuracy acceptable for practical applications (such as still image and video denoising in consumer electronic devices). This provides an opportunity to decide it is significance applying filtering or not. Since statistics can be determined rapidly, time of image processing can be saved. The proposed approach to prediction can be especially constructive in processing of multi-component images and video where necessities on dispensation time are strict.

Yanhao Shen proposed[5] a new NLM method for I, in which 2-D NLM is extended to 3-D case, and the mixed SI and SD mixed noise is also considered. The spatial-spectral joint structure is contained in 3-D NLM, which makes the best use of spatial-spectral correlation and nonlocal similarity. The fast implementation based on the easily computed similarity measure and separable scheme significantly decreases the computational complexity of 3-D NLM. The noise distribution of I tends to be the combination of SD and SI components. VST based on the parameter inference of Possion Gaussian noise model, is used to convert the SD Possion- Gaussian noise into SI Gaussian noise, making NLM method suitable for Experimental results on the real I data show the effectiveness of the proposed method.

Minchao Ye[6] proposed the noise distribution of hyperspectral imagery tends to be the combination of signal-dependent and signal-independent components, i.e., mixed Possion-Gaussian distribution. Therefore, most of popular image denoising methods including sparse representation based algorithm cannot be directly applied for hyperspectral imagery. In this paper, VST based on the parameter inference of Possion-Gaussian noise model, is used to transform the signal-dependent Possion-Gaussian noise into signal-independent Gaussian noise, making a large number of denoising methods suitable for hyperspectral imagery. Experimental results on the real hyperspectral data show the power of the proposed method.

## III. NOISING TECHNIQUE

### *A. Impluse noise*

Impulse noise is generally [7] caused by the achievement or broadcast of digital images through sensors or communication channel (e.g., bit errors or mixed spontaneous and Gaussian noise). Image transmission noise is caused by various sources: among others, there are manmade phenomenon, such as car explosion systems, industrial machines in the surrounding area of the receiver, switching transients in power lines, and various unprotected switches. In addition, natural causes, such as lightning in the environment and ice cracking in the glacial region, can also change the broadcast process. Over the last more than a few years,[8] a vast amount of fuzzy-based noise decrease methods were developed, e.g., the histogram adaptive fuzzy filter, the fuzzy impulse noise detection and reduction method, the adaptive fuzzy switching filter, the fuzzy similarity-based filter, the fuzzy random impulse noise reduction method, and so on. These fuzzy filters are for the most part developed for images dishonored with fat-tailed noise like impulse noise. They split rank-order filter schemes (such as the median filter). Although these filters are for the most part developed for grayscale descriptions, they can be used to filter color images by apply them on each color component separately.One of the most important families of nonlinear filters, which take benefit of the theory of robust data, is based on the categorize of vectors in a predefined sliding window. This ordering is realized by a distance or correspondence measure where the lowest ranked vector corresponds to that vector which is neighboring to all the other vectors in a predefined window in terms of the used measure. A vast amount of vector-based impulse noise decrease methods exist. Most of them are based on the vector median filter e.g. The most popular course group of nonlinear vector operators is based on the order statistics, where the output is equal to the vector associated with the smallest accumulated distance to all other vectors in the sliding window or which is most similar to all adjacent pixels. Many of those filters are an enhancement of the classical vector-based filters.All of these methods have the same major drawbacks, i.e., the higher the noise level is the lower the noise lessening capability is in association to the component-wise approaches and they tend to cluster the noise into a larger array, which makes it even more difficult to decrease. Salt and pepper noise is also known as impulse noise. Sharp and sudden disturbances in the image signal cause this noise. Its appearance is randomly sprinkled white or black (or both) pixel over the image.

*B. Gaussian noise*

Gaussian noise is statistical [9] noise following Gaussian probability density and introduce in the image at the time of acquiring of image. As this noise follows Gaussian distribution and hence in general it can be removed by locally averaging operation.Common choice for removing aussian noise is classic linear filter such as Gaussian filter, this is popular method to remove Gaussian noise, however this filter has a tendency to blur edges which may cause information loss in some visually important areas. To solve this problem Tomasi proposed a bilateral filter that uses weights based on spatial and radiometric similarity. The bilateral filter has proven to be very useful but its computational complexity is very high. To overcome this problem Paris. Proposed a fast approximation of the bilateral filter based on a signal processing interpretation. In Buades proposed NL-means algorithm for removal of Gaussian noise, this algorithm is based on non local averaging of all pixels in the image. This algorithm produces better results but takes significant time in its processing and its input parameters have dependency on prior knowledge on amount of noise. The Gaussian noise removal that does not have any dependence on prior-information about amount of noise present in the image.

## IV. IMAGE FILTERING

*A. Adaptive Filtering*

Adaptive Median [10] is a “decision-based” or “switching” filter with the purpose of first identifies possible noisy pixels and then replaces them using the median filter or its variants, though leaving all other pixels unaffected. This filter is good at detecting noise even at a far above the ground noise level. The adaptive structure of this filter ensures with the intention of most of the impulse noises are detected even at a far above the ground noise level provided with the purpose of the window size is large enough. An image-blurring[11] means is modeled as a type of an optical diffusion process in physical phenomena. So an image-sharpening process is described as its inverse diffusion. Any optical image capturing system is significantly accompanied with vague impression as defined by point multiply function. It is often modeled mathematically by the forward Gaussian convolution and then the captured image is sharpened by toward the back Gaussian deconvolution. A great diversity of image sharpening algorithms were developed so far for the inverse diffusion process. Methods such as the linear unsharp masking and Laplacian filter are most widely used for image sharpening. The USM are the Laplacian operator are defined as second-order derivatives and realized as local spatial filters. Although these image sharpening filters are simple and work well in many applications, they have two main drawbacks,

the linear operator is very sensitive to noise, resulting in unpleasant granularity, and

they often enhance too much high contrast areas, resulting in unpleasant overshoot artifacts.

Various approaches were proposed to reduce the noise sensitivity based on the use of nonlinear operators. The improved USM algorithms were mostly applied to monochrome images. The same idea, of course, can be applied to color images.

*B. Median Filtering*

Median filters [12] are especially suitable for reducing “salt & pepper” noise. Median filter is a spatial filtering process, which uses a 2-D mask that is applied to each pixel in the input image. Median filtering preserves sharp edges, whereas linear low-pass filtering blurs such edges. Median filters are very efficient for smoothing of spiky noise. Median filter often blur the image for larger window size and insufficient noise suppression for small window size. Median filters are identified for their capability to remove impulse noise without damaging the edges. Median filters are known for their capability to remove impulse noise as well as preserve the edges. The main drawback of a standard median filter[13] is that it is efficient only for low noise densities. At high noise densities, SMFs frequently exhibit blurring for large window sizes and insufficient noise suppression for small window sizes.

International Journal for Research in Applied Science & Engineering Technology (IJRASET

However, nearly everyone of the median filters operate uniformly across the image and thus tend to modify both noise and noise-free pixels. Accordingly, the effective removal of impulse often leads to images with blurred and distorted features. Ideally, the filtering be supposed to be applied only to corrupted pixels while leaving uncorrupted pixels intact. Applying median filter absolutely across the entire image as practiced in the conventional schemes would certainly modify the intensities and remove the signal details of uncorrupted pixels.

## V. PURPOSED WORK

*A. Trimmed Adaptive Switching Bilateral Filter (TASBF)*

If $W_G(s,t)$ is the domain filter, $\widetilde{W}_{TMSR}(s,t)$is range filter and $f(x+s,y+t)$ is the neighborhood of $f(x,y)$ in the selected $(N \times N)$ window then TASBF output $\hat{u}(x,y)$ is given as follows:

$$\hat{u}(x,y) = \frac{\sum_{s=-N}^{N}\sum_{t=-N}^{N} W_G(s,t)\widetilde{W}_{TMSR}(s,t) f(x+s,y+t)}{\sum_{s=-N}^{N}\sum_{t=-N}^{N} W_G(s,t)\widetilde{W}_{TMSR}(s,t)} \quad \text{Eq.(4.1)}$$

Where,

$$W_G(s,t) = \exp\left(-\frac{(x-s)^2+(y-t)^2}{2\sigma_d^2}\right) \quad \text{Eq.(4.2)}$$

and

$$\widetilde{W}_{TMSR}(s,t) = \exp\left(-\frac{\alpha\sigma_d\,(TM - f(x+s,y+t))^2}{n^2}\right) \quad \text{Eq.(4.3)}$$

The domain filter$W_G(s,t)$ weights in this are calculated in same manner as in conventional bilateral filter as given in Eq. (4.2). The range filter of Trimmed Adaptive Bilateral filter $\widetilde{W}_{TMSR}(s,t)$ is calculated as given in Eq. (4.3), Where TM is the trimmed mean value and $\alpha$ is a predefined parameter whose value is empirically set to .003.

TMASBF uses trimmed mean of noisy image for the calculation of range filter weights$\widetilde{W}_{TMSR}(s,t)$ hence only noise free pixels are processed during the range filter calculation. Due to which the computational time of proposed TASBF algorithm is less as compared to SBF method because SBF requires the processing of all noisy and noise free pixels to calculate range filter $W_{SR}(s,t)$.

Algorithmic Design

Read color noise image.

Separate the three plane of color of color image i.e. red-green-blue plane.

Select either of the planes(R/G/B).

Select 2-D window of size 3×3. Assume that the pixel being processed is $P_{ij.}$

If the processing pixel has values either greater than 0 and less than 255 i.e. $0<P_{ij}<255$ then $P_{ij}$ is an uncorrupted pixel and its value is left unchanged.

If $P_{ij}=0$ or $P_{ij}=255$ then it is a corrupted pixel and further proceeding is based on following conditions

Case i): If the selected window contains all the elements as 0's and 255's. Then replace with the mean of the element of window.

Case ii): If the selected window contains not all elements as 0's and 255's. Then eliminate 255 and 0's and find the median value of the remaining elements. Replace with the median value.

Repeat steps 4 to 6 until all the pixels in the entire plane are processed.

Go to step 3 and Select next plane.

Restored all three de noise plane.

*B. Simulation results*

Firstly we load the original and distorted images to analyse the quality of distorted images by taking original images as reference. The images used are as follows:

Step1 Load the original color image.

Volume 5 Issue I, January 2017 75
ISSN: 2321-9653
**International Journal for Research in Applied Science & Engineering Technology (IJRASET**

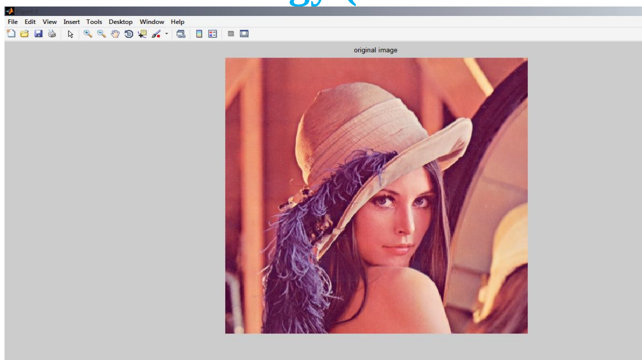


Fig. 5.1 Original Image of Leena

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

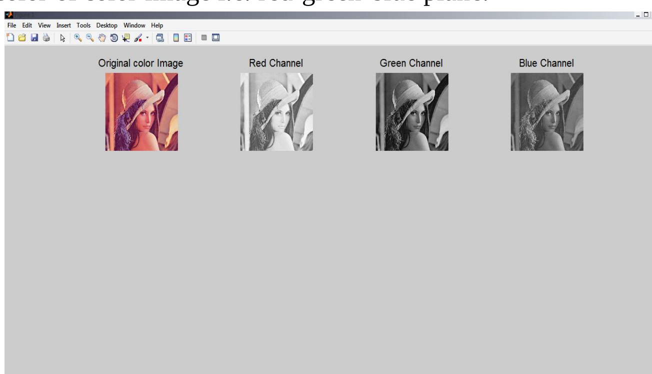


Fig. 5.2 three plane of color Image of Leena

Step3 Load the Distorted grayscale image Leena, of at the nose 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

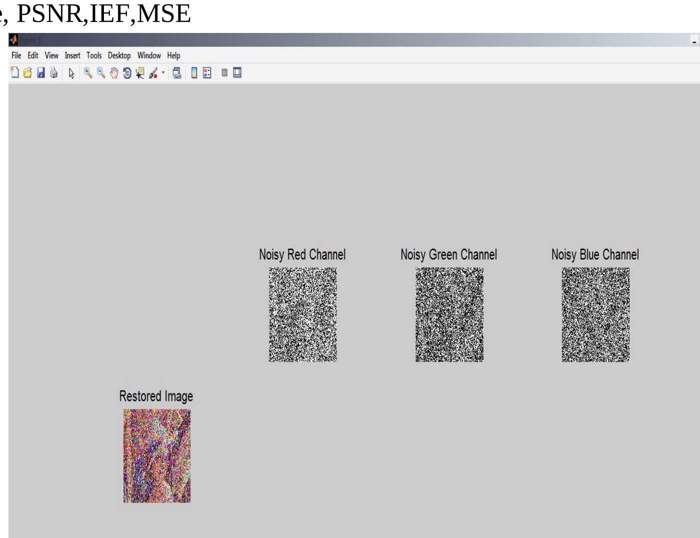


Fig. 5.3 Distorted Image of Lena at density level 0.9 Leena,

As shown in Figure 5.4 PSNR value of different algorithms is compared with the proposed algorithm as a function of noise density for color lena image. shows that the proposed algorithm (TMASBF) outperforms the existing algorithms for noise densities from 0.1 to 0.9 A plot of PSNR values has been presented in Fig.5.4

Volume 5 Issue I, January 2017 76
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET

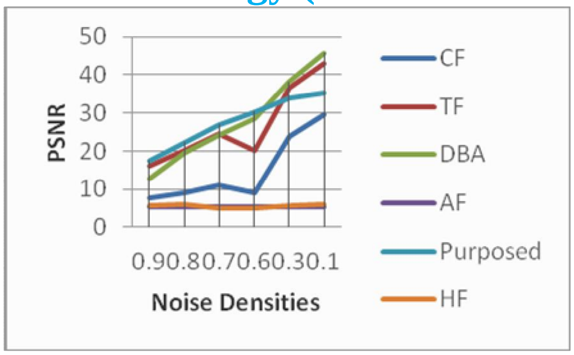


Fig. 5.4 PSNR By lenna Different Filter

Figure 5.5 shows comparison of Image Enhancement factor of different algorithms for color image at different noise densities (0.1 to 0.9). In comparison with the existing algorithms, the
proposed algorithms shows substantial growth in IEF values even at high noise density. From Fig.5.5 it is clear that, at low noise density, this algorithm outperforms the existing ones having high IEF Values.

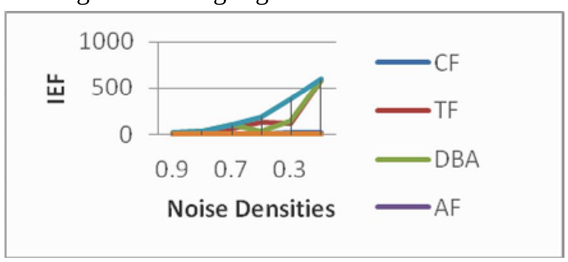


Fig. 5.5 IEF By lena Different Filt

Figure 5.6 shows the mean square error comparison of different algorithms as a function of noise density for leena image. Here as the noise density varied from 0.1 to 0.9 i.e. even at high noise density the proposed algorithm shows minimum MSE values in comparison with the existing algorithms, showing the effectiveness of proposed algorithm.

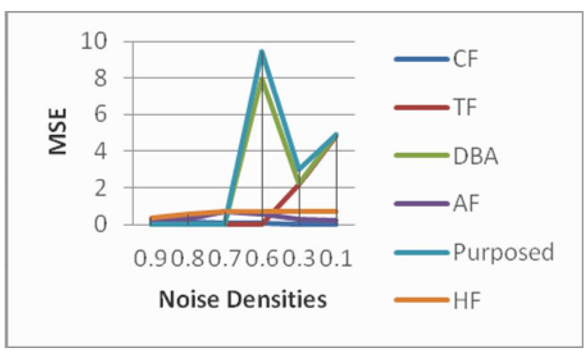


Fig. 5.6 MSE lena By Different Filteter

## V. CONCLUSION

In order to effectively remove random-valued impulse noise superimposed on color images. In the field of digital image processing impulse noise removal from color images is one of the most challenging tasks for researchers**.** We study the denoising algorithm to removes the gaussian noise and salt and pepper noise efficiently.

## REFERENCES

[1] Malini.S "Image Denoising Using Multiresolution Singular value Decomposition Transform" International Conference on Information and Communication Technologies (ICICT 2015)pp;1708-1715.
[2] Moni R S "Image Denoising Using Multiresolution Singular value Decomposition Transform" (ICICT 2014).
[3] Aleksey Rubel "Efficiency of DCT-Based Denoising Techniques Applied to Texture Images" 2014 National Aerospace University named by N.Y. Zhukovsky,

Volume 5 Issue I, January 2017
ISSN: 2321-9653


**International Journal for Research in Applied Science & Engineering Technology (IJRASET**

Department of Receivers, Transmitters and Signal Processing, Chkalova St. 17, 61070, Kharkov, Ukraine PP;261-270.
[4] Igor Djurovic "Prediction of Filtering Efficiency for DCT-based Image Denoising" 2nd Mediterranean Conference on Embedded Computing MECD - 2013.
[5] Yuntao Qian, Yanhao Shen, Minchao Ye "3-D NONLOCAL MEANS FILTER WITH NOISE ESTIMATION FOR HYPERSPECTRAL IMAGERY DENOISING" Institute of Artificial Intelligence, College of Computer Science, Zhejiang University 2012 IEEE pp;1345-1348.
[6] Minchao Ye and Yuntao Qian "MIXED POISSON-GAUSSIAN NOISE MODEL BASED SPARSE DENOISING FOR HYPERSPECTRAL IMAGERY" 2012 4th Workshop on Hyperspectral Image and Signal Processing (WHISPERS) .
[7] Bernardino Roig, Vicente D. Estruch "Localised rank-ordered differences vector filter for suppression of high-density impulse noise in colour images" IET Image Process., 2016, Vol. 10, Iss. 1, pp. 24–33.
[8] Stefan Schulte, Samuel Morillasv "A New Fuzzy Color Correlated Impulse Noise Reduction Method" IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 16, NO. 10, OCTOBER 2007 pp;2565-2575.
[9] Mayank Tiwari "Image Denoising using Spatial Gradient Based Bilateral Filter and Minimum Mean Square Error Filtering"Eleventh International Multi-Conference on Information Processing-2015 (IMCIP-2015) pp; 638 – 645.
[10] K.Aiswarya,V.Jayaraj,D.Ebenezer "A New Switching-Based Median Filtering Scheme and Algorithm for Removal of High Density Salt and Pepper Noise in Images" 2010 Second International Conference on Computer Modeling and Simulation pp;409-413.
[11] Takahiko Horiuchi, Kunio Watanabe "Adaptive Filtering for Color Image Sharpening and Denoising" 14th International Conference of Image Analysis and Processing - Workshops (ICIAPW 2007).
[12] Yanyan Wei, Shi Yan, Ling Yang "An Improved Median Filter for Removing Extensive Salt and Pepper Noise"2014 International Conference on Mechatronics and Control (ICMC) July 3 - 5, 2014, Jinzhou, China pp;897-901.
[13] S. Esakkirajan, T. Veerakumar "Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median Filter" IEEE SIGNAL PROCESSING LETTERS, VOL. 18, NO. 5, MAY 2011 pp;287-290.
[14] Ling Zhong, Yun Zhang "An Ensemble Vector Median Filter For Color Image Denoising" 2010 11th Int. Conf. Control, Automation, Robotics and Vision Singapore, 7-10th December 2010 pp;2485-2490.
[15] Isma Irum" A Nonlinear Hybrid Filter for Salt & Pepper Noise Removal from Color Images" Comsats Institute of Information Technology Vol.13,February 2015 pp;79-86.
[16] Hae-Jong Seo and Milanfar, "Robust flash denoising/deblurring by iterative guided filtering" EURASIP Journal on Advances in Signal Processing 2012 pp;1-19.