International Journal of Engineering Technology and Applied Science
(ISSN: 2395 3853), Vol. 1 Issue 6 December 2015

Advancement in Removal of Fixed Valued Impulse Noise: A Review

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ABSTRACT:- The aim of image de-noising is to provide a clean version of a given noisy image, utilizing prior knowledge of the statistics of natural images. The problem has been studied intensively with considerable progress made in recent years. The new proposed algorithm has been proposed to deal with the problems, namely, poor image enhancement at high noise density, which is frequently enhanced in the Improved Mean filter (IMF). In this paper Improved Mean Filtering is used for enhancing the peak signal to noise ratio (PSNR) and image enhancement factor (IEF) both. The performances of proposed 'Improved Mean Filter' (IMF) are quantitatively vies as well as the visual and human perception views shows better result in both conditions as compared to other existing filters. Results reveal that the proposed filter exhibits better performance in comparison with MF, AMF, DBA, MDBA, MDBUTMF, MNF filters in terms of higher PSNR and IEF. The performance of the proposed method has to be tested at low, medium and high noise densities on gray scales. Infect at high noise density levels the new proposed algorithm is suppose to give better performance as compare with other existing de-noising filters.

KEYWORDS:- Improved Mean Filter, PSNR, MF, MDBA, MDBUTMF, MNF, IEF

I. INTRODUCTION

Digital images play an important role both in daily life applications such as satellite television, magnetic resonance imaging, computer tomography as well as in areas of research and technology such as geographical information systems and astronomy. Data sets collected by image sensors are generally contaminated by noise. Imperfect instruments, problems with the data acquisition process, and interfering with natural phenomena can all degrade the data of interest. Furthermore, noise can be introduced by transmission errors and compression. Thus, de-noising is often a necessary and the first step to be taken before the image data is analyzed. It is necessary to apply an efficient de-noising technique to compensate for such data corruption. In De-noising tasks, a crucial research is how to filter noise caused by the nature, system and processing of transfers and so on. Image de-noising has been one of the most important and widely studied problems in image processing and computer vision. The need to have a very good image quality is increasingly required with the advent of the new technologies in a various areas such as multimedia, medical image analysis, aerospace, video systems and others. Indeed, the acquired image is often marred by noise which may have a multiple origin such as: thermal fluctuations; quantify the effects and properties of communication channels. It affects the perceptual quality of the image, decreasing not only the appreciation of the image but also the performance of the task for which the image has been intended. The challenge is to design methods, which can selectively smooth a degraded image without altering edges, losing significant features and producing reliable results [12].

Image de-noising is an important image processing task, both as a process itself, and as a component in other processes. There are many ways to de-noise an image or a set of data exists. The main properties of a good image de-noising model are that it will remove noise while preserving edges. Traditionally, linear models have been used. Image de-noising can be considered as a component of processing [19] or as a process itself. In the first case, the image de-noising is used to improve the accuracy of various image processing algorithms such as registration or segmentation. In the second case, the noise removal aims at improving the image quality for visual inspection. The preservation of relevant image information is important, especially in a medical context. Image de-noising is a classical problem of particular interest to image processing researchers, not only for its practical value, but also because it provides an excellent test bed for image modeling, representation and estimation theories.

The de-noising method aims to attenuate noise through two phases namely Noise detection and Noise removal. The noise detection is a process in which, we check the image's pixel is noise or noise free. After this, noise removal replaces the corrupted pixels of the input image by the appropriate values which are computed from the specified values. Several image processing methods have been developed for the enhancement, restoration and filtering of digital images. Greyscale image processing has been explored a lot and is a quite mature type of field, while very less work has been performed for color image processing. The intensity aspects of the color image are only processed in color image processing.

It can be divided into two parts [16]: full-color image processing and pseudo-color image processing. Full-color image processing is used to enhance the color images where color images are defined using number of color models, while pseudo-color image processing is used to operate on monochrome images in other words it is used to enhance grayscale image using color.

II. RELATED WORK

In this section, literature surveys of various papers that provide basic concepts and knowledge for this thesis have been done. Image noise suppression is a highly demanded approach in digital imaging systems design. Impulsive noise is frequently encountered during the processes of acquisition, transmission and storage and retrieval. In the area of image de-noising many filters are proposed in the literature. The main steps in this process are classier (detection) and reconstruction (filtering). Classification is used to separate encrypted pixels from corrupted pixels. Reconstruction involves replacing the corrupted pixels by an estimation technique.
There are various filters existing in literature, which are used for filtering salt- and-pepper impulse noise. There are some special types of filters which are used for suppressing salt-and-pepper noise. In this chapter, some well-known, standard and benchmark filters, which are available in the literature, are studied. Novel filters, designed and developed in this research work, are compared against these filters in subsequent chapters. Therefore, attempts are made here for detailed and critical analysis of these existing filters. Classification of various noise removal filters are given below.

2.1 Spatial Filtering

A traditional way to remove noise from image data is to employ spatial filters. Spatial filters can be further classified into non-linear and linear filters. Linear filtering using mean filter and Least Mean Square (LMS) adaptive filter and nonlinear filtering based on median filter are discussed in this section. We also discussed some other important filters that are frequently used in image de-noising methods.

Non-Linear Filters: With non-linear filters, the noise is removed without any attempts to explicitly identify it. Spatial filters employ a low pass filtering on groups of pixels with the assumption that the noise occupies the higher region of frequency spectrum. Generally spatial filters remove noise to a reasonable extent but at the cost of blurring images which in turn makes the edges in pictures invisible. In recent years, a variety of nonlinear median type filters such as weighted median, rank conditioned rank selection, and relaxed median have been developed to overcome this drawback.

Linear Filters: A mean filter is the optimal linear filter for Gaussian noise in the sense of mean square error. Linear filters too tend to blur sharp edges, destroy lines and other fine image details, and perform poorly in the presence of signal-dependent noise. The wiener filtering method requires the information about the spectra of the noise and the original signal and it works well only if the underlying signal is smooth. Wiener method implements spatial smoothing and its model complexity control correspond to choosing the window size. To overcome the weakness of the Wiener filtering, Donoho and Johnstone proposed the wavelet based de-noising scheme in de-noising by soft-thresholding. Our proposed work focused on the spatial domain filter designing that why we will more focus spatial domain Linear and Nonlinear areas.

2.2 Description of Different Image De-noising Filter

There are many different types of linear and nonlinear filter that are used for removal of fixed and random valued impulse noise. Here in this section we will discuss about the last 20 years frequently used filters.

2.2.1 Median Filter (M.F.):

In the year 1989 A.K. Jain introduced a “Fundamentals of Digital Image Processing”. In this paper first of used the median filter is one of the most popular nonlinear filters. It is very simple to implement and much efficient as well. The median filter, especially with a larger window size destroys the fine image details due to its rank ordering process. It acts like a low pass filter which blocks all high frequency components of the image like edges and noise, thus blurs the image. As the noise density increases, the filtering window size is increased to have a sufficient number of encrypted pixels in the neighborhood. Depending upon the sliding window mask, there may be many variations of median filters. In this thesis, Median filter with sliding window (3×3), (5×5) and (7×7) are reviewed. A centre pixel, irrespective of either being noisy or not, is replaced with the median value. Due to this, its results are disappointing in many cases. Applications of the median filter require caution because median filtering tends to remove image details such as thin lines and corners while reducing noise [6].

2.2.2 Mean Filter (M.F.):

In the 1998 Scott E Umbaugh, *Computer Vision and Image Processing,* Prentice Hall PTR, New Jersey, A mean filter acts on an image by smoothing it that is, it reduces the intensity variation between adjacent pixels. The mean filter is nothing but a simple sliding window spatial filter that replaces the center value in the window with the average of all the neighboring pixel values including it. By doing this, it replaces pixels that are unrepresentative of their surroundings. It is implemented with a convolution mask, which provides a result that is a weighted sum of the values of a pixel and its neighbors. It is also called a linear filter. The mask or kernel is a square. Often a 3× 3 square kernel is used. If the coefficients of the mask sum up to one, then the average brightness of the image is not changed. If the coefficients sum to zero, the average brightness is lost, and it returns a dark image. The mean or average filter works on the shift-multiply-sum principle [7].

2.2.3 LMS Adaptive Filter (LMSAF):

In July 1993 J.N. Lin, X. Nie, and R. Unbehauen, introduced a new filter that is-"Two-Dimensional LMS Adaptive Filter Incorporating a Local-Mean Estimator for Image Processing," IEEE Transactions on Circuits and Systems-II. An adaptive filter does a better job of de-noising images compared to the averaging filter. The fundamental difference between the mean filter and the adaptive filter lies in the fact that the weight matrix varies after each iteration in the adaptive filter while it remains constant throughout the iterations in the mean filter. Adaptive filters are capable of de-noising non-stationary images, that is, images that have abrupt changes in intensity. Compared to other adaptive filters, the Least Mean Square (LMS) adaptive filter is known for its simplicity in computation and implementation. The basic model is a linear combination of a stationary low-pass image and a non-stationary high-pass component through a weighting function [8]. Thus, the function provides a compromise between resolution of genuine features and suppression of noise.

2.2.4 Center Weighted Median Filter (CWM):

In 1991 S-J Ko and Y.H. Lee introduced a new filter that is "Center Weighted Median Filter and their application to Image Enhancement" The center weighted median (CWM) [9] filter is a special case of weighted median (WM) filters. This filter gives more weight only to the central pixel of a window and thus it is easy to design and implement. CWM filter preserves more details at the expense of less noise suppression like other non-adaptive detail preserving filters.

2.2.5 Adaptive Median Filters (AMF):

In 1995, H. Hwang and R.A. Haddad introduced a new filter that is –"Adaptive Median filter: New Algorithm and Results ". For good impulse classification it is preferred to remove the positive and negative impulse noise one after another. There are a number of algorithms which resolve this problem, but they are more complex. This algorithm is simple and better performing in removing a high density of impulse noise as well as non-impulse noise while preserving fine details. The size of the filtering window of median filter is adjusted based on noise density. This algorithm is based on two level tests. The maximum filtering window size token is 11×11 if the noise density is of the order of 70% [10].

2.2.6 Progressive Switching Median (PSM):

In 1999 Z. Wang and D.Zhang introduced a new method that is –"Progressive switching median filter for removal of impulse noise form highly corrupted image". This filter is median based filter is median based filter [6]. It consists of two points (i) switching scheme – an impulse detection algorithm is used before filtering; thus only noisy pixels are filtered and (ii) progressive methods – both impulse detection and progressive filtering are applied through several iterations one after the other Hence, it is referred as PSM filter. The noisy pixels processed in the current iteration are used to help the process of the other pixels in the subsequent iterations. Therefore, better restoration results are expected, even under high noise density conditions [11].

2.2.7 Selective Switching Median Filter (SSMF):

In 2006, Krishnan Nallaperumal, Senior Member IEEE, Justin Varghese, Student Member, IEEE, S.Saudia, Student Member, IEEE, R.K.Selvakumar, Member IEEE, K.Krishnaveni, Member IEEE, S.S. Vinsley, Member IEEE "Selective Switching Median Filter (SSMF) for the Removal of Salt & Pepper Impulse Noise". In this paper, a new median based filtering algorithm is presented for the removal of impulse noise from digital images. A good analysis of the limitations of the top ranking median filters, the Progressive Switching Median Filter, PSMF and the Rank-order based Adaptive Median Filter, RAMF is made and are overcome very effectively by the proposed filter which cleans the impulse corruptions of a digital image in two distinct phases of impulse detection and impulse correction.

2.2.8 Switching Median Filter (SMF):

In 2007, Krishnan Nallaperumal, Justin Varghese, S.Saudia, K.Krishnaveni, Santhosh.P.Mathew, P.Kumar, "An efficient Switching Median Filter for Salt & Pepper Impulse Noise Reduction", An impulse detector which is proposed for switching median filter is based on the minimum absolute value of four convolutions obtained using one-dimensional Laplacian operators. The input image is first convolved with a set of convolution kernels are used, each of which is sensitive to edges in a different orientation. An improved impulse noise reduction filter that gives an acceptable and recognizable restoration of images corrupted at all noise levels to about 96%. While most other median filters develop many impulse patches making the restored image difficult to recognize at higher noise levels, the proposed Switching Median Filter yields recognizable, patches free restoration with a little degradation in fidelity [13].

2.2.9 Adaptive Switching Median Filter (ASMF):

In 2007, Krishnan Nallaperumal, Senior Member, IEEE, Justin Varghese, Student Member, IEEE, S.Saudia, Student Member, IEEE, K.Arulmozhi, Member, IEEE, K.Velu, S.Annam, Student Member, IEEE, on "Salt & Pepper Impulse Noise Removal using Adaptive Switching Median Filter", An effective median filter for salt & pepper impulse noise removal is presented. This computationally efficient filtering technique is implemented by a two pass algorithm: In the first pass, identification of corrupted pixels that are to be filtered are perfectly detected into a flag image using a variable sized detection window approach; In the second pass, using the detected flag image, the pixels to be modified are identified and corrected by a more suitable median.

2.2.10 Adaptive Weighted Median Filtering (AWMF):

In 2008 International Symposium on Information Science and Engineering, DENG Xiuqin, XIONG, Yong PENG Hong, has developed "A new kind of weighted median filtering algorithm used for image Processing", Aimed at the excellence and shortcoming of the traditional median filtering algorithm, this paper proposes a new adaptive weighted median filtering (AWMF) algorithm. The new algorithm first determines noise points in image through noise detection, then adjusts the size of filtering window adaptively according to number of noise points in window, the pixel points in the filtering window are grouped adaptively by certain rules and gives corresponding weight to each group of pixel points according to similar it, finally the noise detected are filtering treated by means of weighted median filtering algorithm.

2.2.11 Adaptive Median Filter (AMF):

In 2008, S.Saudia, Justin Varghese, Krishnan Nallaperumal, Santhosh. P.Mathew, Angelin J Robin, S.Kavitha, Proposes a new adaptive 2D spatial filter operator for the restoration of salt & pepper impulse corrupted digital images name as - "Salt & Pepper Impulse Detection and Median based Regularization using Adaptive Median Filter", The Adaptive Impulse Filter effectively identifies the impulsive positions with a valid impulse noise detector and replaces them by a reliable signal determined from an appropriate neighborhood. Experimental results in terms of objective metrics and visual analysis show that the proposed algorithm performs better than many of the prominent median filtering techniques reported in terms of retaining the fidelity of even highly impulse corrupted images. High objectiveness and visual reliability is provided by the new restoration algorithm at lower quantum of impulse noise also.

2.3 Decision Based Algorithms

In 2009, S. Balasubramanian, S. Kalishwaran, R. Muthuraj, D. Ebenezer, V. Jayaraj presented "An Efficient Non-linear Cascade Filtering Algorithm for Removal of High Density Salt and Pepper Noise in Image and Video sequence", in which an efficient non-linear cascade filter for the removal of high density salt and pepper noise in image and video is proposed. The proposed method consists of two stages to enhance the filtering. The first stage is the Decision based Median Filter (DMF), which is used to identify pixels likely to be contaminated by salt and pepper noise and replaces them by the median value. The second stage is the

Unsymmetrical Trimmed Filter, either Mean Filter (UTMF) or Midpoint Filter (UTMP) which is used to trim the noisy pixels in an unsymmetrical. The existing non-linear filters such as Standard Median Filter (SMF), Adaptive Median Filter (AMF), Weighted Median Filter (WMF), Recursive Weighted Median Filter (RWMF) performs well only for low and medium noise densities. The recently proposed Decision Based Algorithm (DBA) shows better results up to 70% noise density and at high noise densities, the restored image quality is poor. The proposed algorithm shows better image and video quality in terms of visual appearance and quantitative measures [18].

2.3.1 Modified Decision Based Algorithm (MDBA):

In 2009 an improved version of DBA is used to avoid streaks in images that usually occur in DBA due to repeated replacement of the noisy pixel with neighborhood pixels. In case of MDBA noisy pixels are replaced by the median of unsymmetric trimmed output. Drawback of MDBA is that under high noise densities the pixels could be all 0's or all 255's or a combination of both 0 and 255. Replacement with trimmed median value is not possible then [18].

2.3.2 Decision Based Unsymmetrical Trimmed Mean Filter (DBUTMF):

In 2010 K. Aiswarya, V. Jayaraj, and D. Ebenezer, proposed a new method for removal of high density salt and pepper noise (SNP) that is – "A new and efficient algorithm for the removal of high density salt and pepper noise in images and videos," in Second Int. Conf. Computer Modeling and Simulation. To overcome the above drawback, Decision Based Algorithm (DBA) is proposed. In this, image is de-noised by using a 3x3 window. If the processing pixel value is 0 or 255 it is processed or else it is left unchanged. In order to avoid this drawback, Decision Based Unsymmetric Trimmed Median Filter (DBUTMF) is proposed [19].

2.3.3 Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF):

In 2011 S. Esakkirajan, T. Veerakumar, Adabala N. Subramanyam, and C. H. PremChand proposed a new method for removal of high density salt and pepper noise (SNP) that is –"Removal of High Density Salt and Pepper Noise through Modified Decision Based Unsymmetric Trimmed Median Filter". Various filters discussed in above are inadequate for the salt and pepper noise removal under high noise densities. Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) is a non linear filter that can perform better in SAP noise removal even under high noise densities. MDBUTMF is used for the noise detection and removal process in this thesis. If the processing pixel takes the maximum or minimum gray level (0 or 255) then it is noisy pixel which is processed by MDBUTMF [20]. To enhance the result of MDBUTMF a new algorithm was proposed FONDBMF [21]. This is base paper for my proposed method. This algorithm considers the first order neighborhood pixels of the detected noisy pixel. Then the mean and trimmed median value is calculated for replacing the noisy pixel. This algorithm also performs well at low densities but at high densities this does not provide better results.

2.3.4 Modified Non-Linear Filter (MNLF):

In 2013 T. Sunil Kumar, A. Srinivas, M. Eswar Reddy and G. Ramachandra Reddy proposed a new new method that is - "Removal of high density impulse noise through modified non-linear filter". Various filters are discussed in this paper for removal of noise from gray scale and color images. The values for the comparison of different filters are taken from this paper as a reference. But if the all the pixel value are 0 or 255 then this method increases the window size and then trimmed median value is calculated and noisy pixel is replaced [22].

III. PROPOSED WORK

3.1 Alpha Trimmed Mean Filtering (ATMF):

The idea behind a trimmed filter is to reject the noisy pixel of the selected 3x 3 window. Alpha Trimmed Mean Filtering (ATMF) is a symmetrical filter where the trimming is symmetric at either end. In this procedure, even the uncorrupted pixels are also trimmed. Alpha-trimmed mean filter is a window fitter of nonlinear class, by its nature is hybrid of the mean and median filters. The basic idea behind the filter is for any element of the signal (image) look at its neighborhood, discard the most atypical elements and calculate mean value using the rest of them. Alpha you can see in the name of the filter is indeed parameter responsible for the number of trimmed elements.

3.2 Trimmed Median Filters:

This leads to loss of image details and blurring of the image. In order to overcome this drawback, an Unsymmetric Trimmed Median Filter (UTMF) is proposed. In this UTMF, the selected 3 x 3 window elements are arranged in either increasing or decreasing order. Then the pixel values 0's and 255's in the image (i.e., the pixel values responsible for the salt and pepper noise) are removed from the image. Then the median value of the remaining pixels is taken. This median value is used to replace the noisy pixel. This filter is called trimmed median filter because the pixel values 0's and 255's are removed from the selected window. This procedure removes noise in a better way than the ATMF. The main challenge in image enhancement research is to removal of salt and pepper noise as well as preserving the image details without blurring.

3.3 Un-Symmetric Trimmed Median and Mean Filters:

Present the concept of trimmed median and mean filters. Conventionally, Alpha Trimmed Mean Filtering (ATMF) is symmetrical filter. As symmetric at either end even un-corrupted pixels are trimmed. This leads to loss of image details and blurring of the image. In order to overcome this drawback, an Unsymmetric Trimmed Median and Mean Filter is found. In this method, the selected 3 x 3 window elements which contain 0's or 255's or both are removed. Then the median or mean value of remaining pixels is taken. This median or mean value is replaced with a corrupted pixel value. Salt and pepper noise (SAP) removal filters that are widely used today belong to the category of linear and nonlinear filtering techniques. In case of linear filtering, the filtering process is applied to all the pixels of the image without differentiating noisy and non noisy pixels. This causes degradation in the images. The nonlinear filtering process is a two step process. Noisy pixels are detected first and then these detected noisy pixels are corrected. Nonlinear techniques have gotten a better performance in removing salt and pepper noise than linear filters because the filtering process is applied to only noisy pixels.

3.4 First Order Neighborhood Mean Filter Algorithm (FONMF):

The proposed noise removal using First Order Neighbourhood Mean Filter (FONMF) algorithm processes each and every pixel of an image by detecting the noisy pixel in the image. This algorithm is based on windowing technique so a least size window 3 x 3 is taken to reduce the complexity. Here the pixel of interest is the centre pixel known as processing pixel P(i, j). Processing pixel is checked whether it is noisy or noise free by verifying that the pixel lies between maximum (255) and minimum (0) gray level values. If the pixel is in between the range of gray level then the pixel is noise free otherwise the pixel is corrupted pixel and it is processed to be replaced with the noise free pixel value. Uncorrupted pixels that lie in the range are left unchanged. In this work RGB color model is chosen to represent the color image. Noisy color images are formed by adding salt and pepper noise independently to each of these color components.

Input of the FIS: Noise estimation based on adaptive fuzzy switching median filter and low, median, high pass-filters over an intensity image that has been degraded by constant power additive noise.

3.4.1 Steps for the FONMF Algorithm:

Step 1: First we take an initial color image and apply on it fixed valued impulses noise (Salt and Pepper noise). This color image is read as Y.

Step 2: In the second step we will divide the noisy image into 2D image of RGB format. By taking Red, Green and Blue pixels for checking noise.

Step 3: Now in third step the red pixel is read and processed by using the following steps:-

Step 3.1: Firstly check whether the pixels are between 0 to 255 ranges or not, here two cases are generated.

X (i,j) = 0< l(i,j)<255 condition true follow Case1

X (i,j) ≠ 0< l(i,j)<255 condition true follow Case 2

Where X (i,j) is the image size and l (i,j) all image targeted pixels.

Case 1- If Pixels are between 0< l(i,j)<255 then, they are noise free and move to restore the image.

Case 2- If the pixel does not lie in the range then they are moved to step 3.2.

Step 3.2: In the second step we will work on noisy pixel of step3.1 now select a window W(i, j) of size 3 x 3 of image. Assume that the targeted noisy pixels are X (i,j), that is processed in the next step.

Step 3.3: If the preferred window contains not all elements as 0's and 255's. Then remove all the 0's and 255's from the window, and send to restore the image. Now find the mean of the remaining pixels. Replace X (i,j) with the mean value. This noised removed image restores in de-noised image at the last step.

[Cal. Mean remaining (X (i,j)) pixels] = replace by W(i,j).

Step 4: Repeat steps 3.1to 3.3 green and blue pixels. For green the noisy pixel are represented by m(i,j) and for blue the noisy pixel are represented by n(i,j). Also the restored image is represented by Y(i,j) and Z(i,j) respectively.

Step 5: Whole process is performed until all pixels red, green and blue in the whole image are processed. And finally the de-noised images are joined to get the final de-noised image.

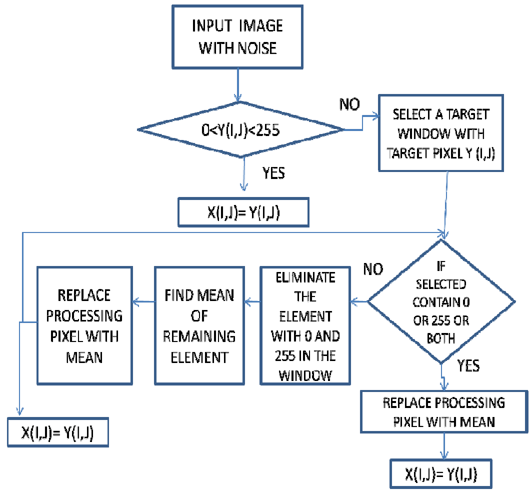

Figure 3.1: Workflow Diagram of proposed algorithm

IV. EXPECTED OUTCOME

The expected result of the proposed method for removal of fixed valued impulse noise is shown in this section. For simulation of proposed method we have to use MATLAB 8.0 software. To perform our new approach we have to take a 'Mandrill', 'Lena' and some other images of size 256x256 as a reference image for testing purpose. The testing images are artificially corrupted by Salt and Pepper impulse noise by using MATLAB and images are corrupted by different noise density varying from 10 to 90 %. The performance of the proposed algorithm will be tested for different gray scale image.

The PSNR is most commonly used as a measure of quality of reconstruction of lossy compression of resulting image. The PSNR value approaches infinity as the MSE approaches zero; this shows that a higher PSNR value provides a higher image quality. At the other end of the scale, a small value of the PSNR implies high numerical differences between images. PSNR is usually expressed in terms of the logarithmic decibel scale. This method is mainly used for high density noise because most of the algorithms produce good results in a low noise density but very poor results at high noise density. Using this method, we have performed image de-noising on Lena and other images of size 256x256 and simulate their results on MATLAB 8.0. For different high noise density levels (10%-90%), the resultant PSNR will cover a a comparative analysis based on this peak signal to noise ratio (PSNR) of de-noised image. De-noising performances are quantitatively measured by the PSNR.

$$PSNR = 10\log_{10}\frac{(255)^2}{MSE} \qquad (5.1)$$

where MSE (Mean square error), is

$$MSE = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\{Y(i,j)-\hat{Y}(i,j)\}^2}{m\ x\ n} \qquad (5.2)$$

And the IEF (Image Enhancement Factor), is

$$IEF = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\{\eta(i,j)-Y(i,j)\}^2}{\sum_{i=1}\sum_{j=1}\{\hat{Y}(i,j)-Y(i,j)\}^2} \qquad (5.3)$$

Where MSE acronym of mean square error, IEF stands for image enhancement factor, M x N is the size of the image, Y denotes the original image, $\hat{Y}$ shows the de-noised image, and η represents the noisy image.

V. CONCLUSION

In this research work, a novel algorithm is used to remove any type of noise from corrupted images. In this paper, the purpose of using both the filters offers well line, edge, detail and texture preservation while, at the same time, effectively removing noise from the given input image. Here, the input images are of any format like JPEG, TIF etc and also take variable size image as input. The mean value is reducing the blurring in restoring image as compared to other filters. Because we are not using simple mean value but use trimmed mean value which gives better results than simple mean. Most of the filtering algorithms used today are not able to remove high density salt and pepper noise. By using a filtering system based on improved trimmed mean filter it is possible to remove noise efficiently with better preservation of image details. It does not require to increase the size of the filtering window in other filtering techniques they are increasing the size of the filtering window. But if the window will process by improving mean filter it gives better result.

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