Elimination of Impulse Noise using Enhanced Mean Median Filter for Image Enhancement

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ABSTRACT
In this paper, we've got introduced a new technique for the improvement of gray scale images, when images are corrupted by salt and pepper noise that's additionally referred to as an impulse noise. Our suggested phenomena shows a better output for Medium density impulse noise as compare to the opposite renowned filters like standard Median Filter (SMF), a decision based mostly Median Filter (DBMF) and modified decision based Median Filter (MDBMF), Nonlinear filter (NLF) and so on. Our projected technique worked on two steps, within the beginning is that the detection of noisy pixels and within the second step is that the removal of noisy pixels. For detection of noisy constituent apply condition pixels values lies in between 0 to 255 it noisy it's noisy free pixels. In our second step that's the removal of noisy pixel recommended technique that's replaces the noisy pixel by alpha trimmed mean median value. Different grayscale pictures are tested via proposed technique. The experimental result shows higher Peak Signal to Noise ratio (PSNR) values and with higher visual and human perception.

Keywords—Gray Scale, Impulse Noise, Trimmed Mean, Median, Unsymmetricness.

I. INTRODUCTION
In the field of image process, digital pictures are typically corrupted by many forms of noise throughout the method of image acquisition malfunctioning images pixels in sensors, damaged memory location in a device and when we communicate a image in high noise channel. These are the most reason of generation of the impulse noise in our digital world. In the field of image processing, digital pictures or images corrupted by the impulse noise. For the last decades, researchers are concerned within the field of image de-noising to find out an efficient technique that preserves the image details and reduces the noise of digital images and also attempt to improve the standard of the image. Image quality measurement is principally done some image parameters like peak in single noise quantitative relation, mean square error, image enhancement issue, however just in case of image processing another issue is vital that's human perception. Impulse noise is one the foremost severe noise that sometimes affects the images. So, the researchers specialize in the removal of impulse noise, whereas minimizing the loss of details as low as potential. There are two varieties of impulse noise, namely, the salt-and-pepper noise also called the fixed valued impulse noise and the random-valued impulse noise. Here in this paper, we tend to specialize in salt and pepper noise. The salt and pepper noise corrupted picture elements of image take either most or minimum pixel value Salt and pepper noise. Fixed valued impulse noise are producing two gray level values zero and 255. Random valued impulse noise will produce impulses whose gray level value lies within a predetermined range. The random value impulse noise in between 0 and 255.

A two-dimensional digital image can be represented as a 2-dimensional array of data is (x, y), where (x, y) represents the pixel location. The pixel value corresponds to the brightness of the image at location (x, y). Some of the most frequently used image types are binary, grayscale and color images. Binary images are the simplest type of images and can attain only two discrete values, black and white. Black is represented by the value ‘0’ while white with ‘1’. Normally a binary image is generally created from a grayscale image. A binary image finds applications in computer vision areas where the
general shape or outline information of the image is needed. They are also referred to as 1 bit/pixel images.

The goal of image de-noising is to evaluation a clear version of a given corrupted image, utilizing previous information of the data of natural and standard images. The matter has been studied intensively with goodly progress created in recent years. The challenge of estimating such restrictions is that constructing correct models of natural image statistics are an extended standing and nevertheless unsolved drawback. Here the question is arises that is the error rates of current de-noising algorithms can be reduced of additional. At the more difficult cases of terribly very patch sizes or vary noise levels, we tend to only get a edge on the most effective potential de-noising error.

II. METHODOLOGY

Noise Model-
Salt-and-pepper noise is one common noise type of digital image processing. The noisy image \( y \) can be modeled as:

\[
(X_{ij}) = \begin{cases} 
Y_{ij} \text{ with probability } 1-p \\
Z_{ij} \text{ with probability } p
\end{cases}
\]

Where \( j \) is the 2D pixel position vector, \( x_{ij} \) is the \( j \)th pixel Value in the clean image \( x \) and \( z_{ij} \) the \( j \)th pixel value in the noise image, which is usually an iid random process with the binary value range of \( /0, v_{\text{max}}(255)/ \) with \( P(x_{ij} = v_{\text{max}}) = q \) for \( q \in [0, 1] \). Although in practice more noise types are present, in this paper, we will work only the salt and pepper noise modal.

Impulse noise is modeled as salt-and-pepper noise. Pixels are randomly corrupted by two fixed values, 0 and 255 generated with the equal probability. We can mathematically represent salt-and-pepper impulse noise as:

\[
N(x) = \begin{cases} 
1-B & \text{for } x = W(i,j) \\
B & \text{for } x = 0 or 255
\end{cases}
\]

Where \( W_{ij} \) is the gray level value of the noisy pixel

Classification of De-noising Algorithms-
On the basis of obvious that there are two basic approaches of image de-noising, spatial filtering methods and transform domain filtering methods.

A. 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.

1. Nonlinear 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 ranked selection, and relaxed median have been developed to overcome this drawback.

2. 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.

B. Transform Domain Filtering
The transform domain filtering methods can be subdivided according to the choice of the basic functions. The basic functions can be further classified as data adaptive and non-adaptive. Non-adaptive transforms are discussed first since they are more popular.

1. Spatial-Frequency Filtering
Spatial-frequency filtering refers use of low pass filters using Fast Fourier Transform (FFT). In frequency smoothing methods the removal of the noise is achieved by designing a frequency domain filter and adapting a cut-off frequency when the noise components are decor related from the useful signal in the frequency domain. These methods are time consuming and depend on the cut-off frequency and the filter function behavior. Furthermore, they may produce artificial frequencies in the processed image.

III. PRIOR APPROACH

Literature Survey and Related Work-
In the 1998 Scott E Umbaugh, computer Vision and Image process, beginner Hall PTR, New Jersey. A mean filter acts on a picture by smoothing it; that's, it reduces the intensity variation between adjacent pixels. The mean filter is nothing however a straightforward window abstraction filter that replaces the middle value within the window with the common of all the neighboring component values together with it. By doing this, it replaces pixels that are atypical of their surroundings, it's enforced with a convolution mask, that provides a result that's a weighted add of the values of a component and its neighbors. It's conjointly known as a linear filter. The mask or kernel may be a sq., usually a 3 x 3 square kernel is
higher than ninetieth. The present non-linear filters like low, medium and high noise densities even cascaded filter, as a whole is incredibly appropriate for helping to extend the noise suppression. Hence, the planned stage is lesser at high noise densities, the second stage plan is that, tho’ the amount of de-noising within the first Filter (UTMF) or point Filter (UTMP) that is employed to stage is that the Unsymmetrical cut Filter, either Mean pepper noise and replaces them by the median. The second based Median Filter (DMF), that is employed to reinforce the filtering. The primary stage is that the call plan based mostly algorithmic rule (DBA) shows higher results up to seventieth noise density and at high noise densities, the fixed up image quality is poor. The planned algorithmic rule shows higher image and video quality in terms of visual look and quantitative measures. In 2009 an improved version of DBA is employed to avoid streaks in pictures that typically occur in DBA because of recurrent replacement of the yell ing element with neighborhood pixels, just in case of MDBA yelling pixels square measure replaced by the median of uneven cut output. downside of MDBA is that underneath high noise densities the pixels may well be all zero’s or all 255’s or a mixture of each 0 and 255. Replacement with cut median isn’t attainable then. In 2010 K. Aiswarya, V. Jayaraj, and D. Ebenezer, planned a brand new technique for removal of high density salt and pepper noise (SNP) that’s – “A new and economical formula for the removal of high density salt and pepper noise in images and videos,” in Second Int. Conf. computer Modeling and Simulation. to beat the higher than downside, call primarily based formula (DBA) is planned. In this, image is de-noised by employing a 3x3 window. If the process component price is zero or 255 it’s processed alternatively it’s left unchanged. At high noise density the median are zero or 255 that is droning. In such case, neighboring component is employed for replacement. This recurrent replacement of neighboring component produces streaking impact so as to avoid this downside, call primarily based world organisation bilaterally symmetrical cut Median Filter (DBUTMF) is planned. In 2011 S. Esakkirajan, T. Veerakumar, Adabala N. Subramanyam, and C. H. Prem Chand planned a brand new technique for removal of high density salt and pepper noise (SNP) that’s – “Removal of High Density Salt and Pepper Noise through changed call primarily based Un-symmetric cut Median Filter”. changed call primarily based Un-symmetric cut Median Filter (MDBUTMF) could be a nonlinear filter which will perform higher in SAP noise removal even below high noise densities. MDBUTMF is employed for the noise detection and removal method during this thesis. The filtering method consists of at first detective work droning pixels, every and each component of the image is checked for the presence of salt and pepper noise. The process component is checked whether or not it's droning or noise free. That is, if the process component lies between most and minimum grey level values (between zero and 255) then it's noise free component, it's left unchanged. If the process component takes the utmost or minimum grey level (0 or 255) then it's droning component that is processed by MDBUTMF.

IV. OUR APPROACH

**Proposed Method**

The proposed method Enhanced Mean Median Filter (EMMF). In this method first detecting the noisy pixels in the corrupted image. For detection of noisy pixels
verifying the condition whether targeted pixel lies. If pixels are between maximum [255] and minimum [0] gray level values, then it is a noise free pixel, else pixel is said to be corrupted or noisy. Now we have processed only with the corrupted pixels to restore with noise free pixels. Further un-corrupted pixels are left unaffected.

ALGORITHM- Step 1: In the first step select a image for image processing than apply preprocessing task in this image by using pre-defind command in MATLAB. The preprosing task are - First convert our traged image into gray scale form. Second convert image into a stamrd image that is 255X255. Now selected image is ready for processing.

Starting- %Start PreprocessingTask
Select a target image - [x] = imread(‘Test image.jpeg’)
Step 2: In the second step apply impulse noise or can say salt and pepper noise in this image with the help MATLAB function. Over all process also known as add-noise on the image.

[y] = imnoise(x,’Salt and Pepper’, Present of noise)
Step 3: In the third step for the preservation of cornor, In this step preserve the cornor we the help of zeros and ones padding in the boundary side of the image.
Step 4: That it thr Noise Removal stage . In this stage first we devide a whole image into a small 3X3 window. Now apply the trimmimg condition. This condition is also known as a Noise identification stage. In this stage check the pixel values.In which region pixels are between 0 to 255 ranges or not. Here two cases are generating.

If

\[ X(ij) = 0<Y(ij)<255 \] / condition true Pixels Noise Free

else

\[ X(ij) \neq 0<Y(ij)<255 \] / condition Pixels are Noise

End

Where X(ij) is the image small 3x3 windows pixels values. And Y(i,j) is the center pixel ot targeted pixel of the small 3X3 window.

Case 1- If Pixels are between 0< Y(ij)<255 then they are noise free and move to restoration image.

Case 2- If the pixels are not lying between in the range then they are moved to step 3.

Step 3: In the step third check the window. Here two cases are arise

1. In a small 3X3 window contain all elements are zeros (0’s) and two fifty five (255’s). In this condition apply mean filter. Take a mean of all pixel in the small 3x3 windows all element aspect center pixel , and replace this value mean value by the targeted pixel.

If

\[ W(ij) = [0] & [255] \] condition true

\{Mean (W (ij)) all pixels\}=Replace by W(ij) (Centravalue)

else

3x3 window pixel values combination of 0’s and 255’s. Now move to the case 2

end

2. In case 2, In a small 3x3 window pixels are the combination of zeros and two fifty five. At this condition apply median filter for this case. Take a median of all zeros and two fifty five and replace this value by centre pixel value.

If

\[ W(ij) = [0’s & 255’s] \] / Combination in a 3X3 window

\{Median(W (ij) of all pixels}=Replace by W (i,j)’s Center pixel value

End

Step 4: Repeat all steps, all pixels in the whole 255X255 image are 65,536 pixels are not processed.Hence a better de-noised image is obtained with improved PSNR MSE MAE and also shows a better image with very low blurring and improved visual and human perception. So, this is the over all process of EEMF, will next part of this paper. Shows the result and simulation.

Simulations and Result-The result of the proposed method for removal of impulse noise is shown in this section. Implementation of proposed method we have to use MATLAB 8.0 software. To perform our new approach we have to take a 'Leena', ‘Mandril’, ‘Boat’, 'Cameraman’, 'Girl’ images of size 256X256 as a reference images for testing purpose. The testing images are artificially corrupted by impulse noise by using MATLAB and images are corrupted by different noise density varying from 10 to 90 %. The performance of the
proposed algorithm is tested for different gray scale a image.

De-noising performances are quantitatively measured by the PSNR and MSE as defined in (1) and (2), respectively:

The PSNR is expressed as:

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

Where MSE (Mean Square Error) is

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

Where MSE acronym of mean square error, for image enhancement, p x q is the size of the image, Y denotes the original image, $\hat{Y}$ shows the de-noised image.

The PSNR values comparison with different filter of the proposed algorithm are comparing with other existing algorithms by variable noise density of 10% to 90% in the Table I. Demonstrations the evaluation of PSNR values of different de-noising methods for Lena image. Here we have compare our proposed method six different methods. They are Median filter (MF), adaptive center weighted median filter (ACWM), adaptive median filter (AMF), decision based algorithm (DBA). Modified decision based Unsymmetric trimmed median filter (MDBUTMF) and the last but not least Non Linear filter (NLF). All these the are very famous filter impulse noise removal. We will clear see that for low and medium range our proposed EEMF filter gives better result as compare non liner filter (NLF) and other famous filter.

### Table 1

<table>
<thead>
<tr>
<th>Noise %</th>
<th>MF</th>
<th>ACWM</th>
<th>AMF</th>
<th>DBA</th>
<th>MDBUTMF</th>
<th>NLF</th>
<th>PA</th>
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<tbody>
<tr>
<td>10</td>
<td>29.0</td>
<td>30.9</td>
<td>33.9</td>
<td>36.33</td>
<td>35.9</td>
<td>36.11</td>
<td>39.8</td>
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<tr>
<td>20</td>
<td>26.4</td>
<td>27.3</td>
<td>31.4</td>
<td>32.88</td>
<td>32.9</td>
<td>33.83</td>
<td>35.7</td>
</tr>
<tr>
<td>30</td>
<td>22.2</td>
<td>22.3</td>
<td>29.8</td>
<td>30.42</td>
<td>30.3</td>
<td>31.72</td>
<td>33.1</td>
</tr>
<tr>
<td>40</td>
<td>18.1</td>
<td>18.5</td>
<td>27.3</td>
<td>27.48</td>
<td>28.69</td>
<td>30.14</td>
<td>31.3</td>
</tr>
<tr>
<td>50</td>
<td>14.6</td>
<td>14.8</td>
<td>24.3</td>
<td>25.83</td>
<td>27.49</td>
<td>28.86</td>
<td>29.0</td>
</tr>
<tr>
<td>60</td>
<td>12</td>
<td>12.1</td>
<td>19.6</td>
<td>23.87</td>
<td>26.34</td>
<td>27.51</td>
<td>27.3</td>
</tr>
<tr>
<td>70</td>
<td>9.65</td>
<td>9.71</td>
<td>15.0</td>
<td>21.82</td>
<td>25.17</td>
<td>25.95</td>
<td>24.5</td>
</tr>
<tr>
<td>80</td>
<td>7.77</td>
<td>7.79</td>
<td>11.5</td>
<td>19.33</td>
<td>23.68</td>
<td>24.52</td>
<td>22.1</td>
</tr>
<tr>
<td>90</td>
<td>6.28</td>
<td>6.31</td>
<td>8.05</td>
<td>16.31</td>
<td>18.66</td>
<td>22.33</td>
<td>18.2</td>
</tr>
</tbody>
</table>

Graphical representation of result of our proposed method is shown in the blow the graph. Here in this plot we have compare with different algorithms they are - median filter (MF), adaptive median filter (AMF), decision based algorithms (DBA), modified decision based unsymmetric trimmed median filter (MDBUTMF), Non-linear Filter algorithm (NLF). This method is tested on the ‘Lena’ image of size 256X256 shown plots of PSNR values of different noise. Our proposed method provide a good result in low and medium noise density. Here compression with different filters against noise densities for Lena image is shown in Figure 1.
In the figure 2 compare our proposed method visual results compare with different algorithms they are - median filter (MF) , adaptive median filter (AMF) , decision based algorithms (DBA) , modified decision based unsymmetric trimmed median filter (MDBUTMF) , Non-linear Filter algorithm (NLF) . This method is tested on the ‘Lena’ image of size 256X256 in the 80% noise density ‘Lena’ image result with our planned algorithm EEMF. shown plots of PSNR values of different noise. Our proposed method provide a good result in low and medium noise density.

The proposed new approach EEMF result with different images with different parameters like Peak signal to noise ratio (PSNR), Mean square error (MSE), Mean abosulate error (MAE) and one of the important “Time” in table II. Here in this table II we have calculate the result for five different images at different noise density that is 20%, 40%, 60% and 80%. Here we have take a standard images and they are -‘Leena’, ‘Mandril’ , ‘Boat’ ,’Cameraman’ ,’Girl’. All images are size 256X256 as a reference size of images and for testing purpose. The
testing images are artificially corrupted by impulse noise by using MATLAB and images are corrupted by different noise density varying 20%, 40%, 60% and 80%

This method is tested on the Lena image of size 256X256 shown in figure 3. The figure 3(a), 3(b), 3(c), 3(d), 3(e) ,3(f) shows the Lena image corrupted by 10%, 30%, 50%, 70%, 80% and 90% respectively and figure 3(g), 3(h), 3(i), 3(j), 3(k) and 3(l) show images De-noised by the proposed method.

(f). 90% Noisy Density image  (l) De-noised image

Figure 3 Experimental Results of Proposed Method for Lena Images at different Noise Density
V. CONCLUSION

A new algorithm has been proposed to deal with the problems, namely, poor image enhancement at low and medium noise density, which is frequently enhanced in the Enhanced Mean Median filter (EMMF). In this paper enhancing the peak signal to noise ratio (PSNR) and Mean square error (MSE) both. The performances of proposed method quantitatively and the visual and human perception vias shows better result in both conditions as compared to other existing filters. The new algorithm uses a small 3x3 window having only eight neighbors of the corrupted pixel that have higher connection; this provides more edge information, more important to better edge preservation as well as more better Human & visual presecption. The New algorithm filter also shows reliable and stable performance across a different range of noise densities varying from 10% - 80%.

REFERENCES


