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An Improved Modified Decision Based Filter to Remove High Density Impulse Noise

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Abstract*— Image filtering attempts to remove the noise from an image while maintaining its perceived visual quality. Noise can be consistent noise, Gaussian noise, salt and pepper noise, gamma noise. The study concentrates on the salt and pepper noise by using improved modified decision based switching median filter. The salt and pepper noise occurs when the pixel value is either 0 or 255.The algorithm will evaluate the centre pixel's value i.e. whether or not it is equals to 0 and 255.If centre pixel is having value 0 or 255 then find out the alternative noise free value for the centre pixel. The quality metrics are used to evaluate the performance for image enhancement using anticipated algorithm: root mean square (RMS),bit error rate(BER). The processed pixel is checked weather it is noisy or noise free. If the processing pixel lies between maximum and minimum gray values then it is noise free pixel and remains unchanged. If the processing pixel takes maximum or minimum gray level than it is noisy pixel. Which is processed by improved decision based switching median filter using global mean for highly corrupted images. Most of the filters fails when the noise density is very high. The improved modified decision based filter works when the noise density is very high. . The proposed method preserves edges than available method..

Keywords*—Consistent noise, Gaussian noise, salt and pepper noise, gamma noise, improved modified decision based switching median filter.

I. INTRODUCTION

In image processing, noise reduction and restoration of image is expected to improve the qualitative inspection of an image and the performance measures of quantitative image analysis techniques. Digital image is inclined to a variety of noise which affects the quality of image. The main purpose of de-noising the image is to restore the detail of original image as much as possible. The measures of the noise removal dilemma depend on the noise type by which the image is corrupting. In the field of diminishing the image noise several types of linear and non linear filtering techniques have been proposed. Different accesses for reduction of noise and image enhancement [1] have been considered, each of which has their own limitation and advantages. Filtering in an image processing is a basis function that is used to achieve many tasks such as noise reduction [2], interpolation, and re-sampling. Filtering image data is a elementary process used in almost all image processing systems. The choice of filter is determined by the nature of the task performed by filter and behavior and type of the data. Filters are used to remove noise from digital image while keeping the details of image conserved is a necessary part of image processing. Filters can be described by different categories

1. Spatial Domain Filtering

2. Frequency Domain Filtering

Spatial Domain is a domain (the plane) where a digital image is defined by spatial coordinates of its pixels. The spatial domain processes can be represented by the following expression g(x, y) =T [f(x, y)] where f(x, y) is the input image, g(x, y) is the output image and T is an operator defined over a local neighbourhood of pixel with the coordinates(x, y). . Frequency Domain Filtering based on modifying the spectral transform of an image. It transforms the image to its frequency representation and performs image processing and after that it computes inverse transform back to the spatial domain. High frequencies correspond to pixel values that change rapidly across the image (e. g. text, texture, leaves, etc.). Strong low frequency components correspond to large scale characteristics in the image (e. g. a single, homogenous object that dominates the image). Frequency domain which operate on the Fourier transform of an image [1].

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II. RELATED WORK

The Noisy Pixels are detected during detection stage. After detection stage the pixels are passed through the filtering stage. This filter removes the Salt and Pepper Noise and at the same time it preserving the image details and texture. The occurrence of salt & pepper noise can severely damage the information data embedded in the original image[1]. The proposed filter is best in preserving the edge details. The detection stage only detects the corrupted pixels then the corrupted pixels are filtered in filtered stage only noisy pixel in the window is changed. The noise free pixels remain unchanged. The salt and pepper noise are special case of impulse noise. Introduces a new filter to restore radiographic images corrupted by impulsive noise is proposed. It is based on a switching scheme where all the pulses are first detected

and then corrected through a median filter[2]. The pulse detector is based on the hypothesis that the major contribution to image noise is given by the photon counting process, with some pixels corrupted by impulsive noise. Such statistics is described by an adequate mixture model. The filter is also able to reliably estimate the sensor gain. Its operation has been verified on both synthetic and real images. the noisy pixels are either replaced by Mean or Median of Non Noisy Pixel[3]. This algorithm is used for Restoring the gray scale Images as well as the colour Images. In this firstly the Noisy Pixel are Identified then window size of 3*3 Pixel are taken. If the Pixel having value[4]. In between 0 and 255 then replace it with mean or median. It will give better PSNR, MSE Value. The proposed algorithm replaces the noisy pixel by a value which is either a mean or a median of all other non-noisy pixels in the selected window. The proposed algorithm also adaptively controls the window size depending on the relative amount of noisy pixels compared to non-noisy pixels in the selected window[5]. The processing pixel is checked whether it is noisy or noise free. Defines a technique for removal of salt and pepper noise. In this K fill algorithm and Median filter is used having 3*3 and 5*5 window size. This scheme works well for gray scale Image, colour Images etc. The scheme cans significantly Increase PSNR of colour and gray level Images. The goal of this technique is to increase the PSNR of picture images and improve the quality this method is fast and can be used effectively on binary, gray scale and colour images, with considerably less blurring than other methods and at the same time preserving useful details in the image[6].

III. PROBLEM FORMULATION

A. Problems in existing Work

The effect of the global mean in case of all the noisy pixels in a given mask has been ignored.The noisy pixels 0 or 255 are considered in the input set while calculating the median; so centre pixel may be sometimes replaced by the noisy pixel again. Most of the existing research has also neglected the effect of the high density of the noise.

B. Problem Definition

The purpose of denoising is to remove the noise while retaining the edges and other detailed features as much as possible. In this research work we will improve the results of the digital images using relaxed median filter. The proposed algorithm is seems to be justifiable as proposed algorithm has ability to reduce the high density of the noise This dissertation proposes a new approach will use decision tree kind of structure to replace the noisy pixel in given window. The proposed technique seems to be effective as it will replace the noisy pixel with its best suitable alternative. Proposed method is divided into two parts: (1) Algorithm will evaluate the centre pixel's value i.e. whether or not it is equal to 0 or 255 if yes then we will go to find the alternative noise free value for the same else window will switched further. (2) This part will find the neighbourhood pixels of the centre value and see whether all are having 0 or 255 as its value or not. If no then median will be evaluated and replaced with centre value and window will switched further else we will use decision tree to evaluate the value by taking the global mean and recently evaluated median to replace the same. Global mean will be replaced when no median is found recently.

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IV. EXPERIMENTAL SETUP AND PROPOSED ALGORITHM

A. Proposed Algorithm

The proposed algorithm processes the corrupted images by first detecting the impulse noise. The processing pixel is checked whether it is noisy or noisy free. That is, if the processing pixel lies between maximum and minimum gray level values then it is noise free pixel, it is left unchanged. If the processing pixel takes the maximum or minimum gray level then it is noisy pixel which is processed by improved decision based median filter using global mean for highly corrupted images. The steps are elucidated as follows.

Step 1: Select 2-D window of size 3*3. Assume that the pixel being processed is P_{ij}.

Step 2: If $0 < P_{ij} < 255$ then P_{ij} is an uncorrupted pixel and its value is left unchanged.

Step 3: If $P_{ij} = 0 \; or \; P_{ij} = 255$ then is a corrupted pixel then two cases are possible as given in Case i) and ii).

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

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

Step 4: Repeat steps 1 to 3 until all the pixels in the entire image are processed.

V. EXPERIMENTAL SET-UP

In order to implement the proposed algorithm; design and implementation is done in MATLAB using image processing toolbox. In order to do cross validation the proposed algorithm is compared with the existing standard median filter and relaxed median filter. Table 1 is showing the various images which are used in this research work. Images are given along with their format and size. All the images are of different kind and also the filtering evaluation is different for each image.

Table I: Images Table

IMAGE NAME	FORMAT
Image 1	.jpg
Image 2	.jpg
Image 3	.jpg
Image 4	.jpg
Image 5	.jpg

VI. RESULTS

Figure 1 has shown the input image which is passed to the model.

Fig.1 Input image

Figure 2 has shown the noisy image with density = 8. It is clearly shown that the noise has degrades the visibility of the image.

Fig.2 Noisy image

Figure 3 has shown the filtered image using the traditional median filtered image. It is clearly shown that the image is somehow filtered but has not shown the accurate results.

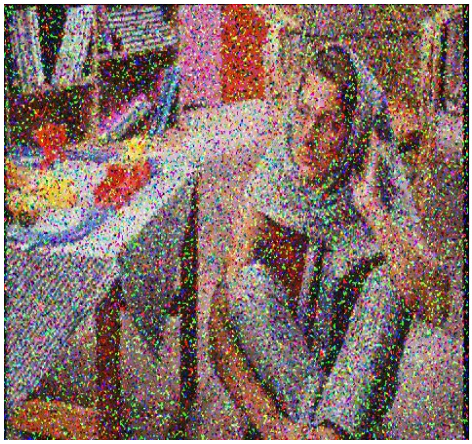

Fig.3 Median filtered image

Figure 4 has shown that the noise has been reduced using the sorted switching median filter but results are not much effective.

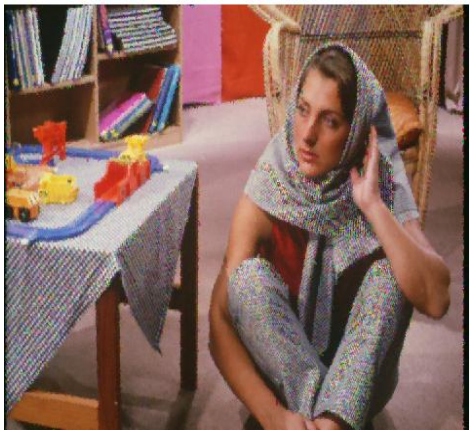

Fig.4 sorted switching median filtered image

Figure 5 has shown that the results are quite effective and has much more better results than the available methods. Thus the proposed algorithm has shown quite significant improvement over the available methods.

Fig.5 Proposed algorithm's filtered image

VII. PERFORMANCE EVALUATION

Table 2 and Figure 6 comparative analysis of the Root Mean Square Error (RMSE). As RMSE need to be minimized; so the main goal is to decrease the RMSE as much as possible. fig 4 has clearly shown that the RMSE is minimum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the available methods

Table II: RMSE Evaluation Table

IMAGE	NOISY IMAGE	MEDIAN FILTER	SSMF	GMF
Image1	124.5913	102.3719	26.3629	25.9037
Image2	132.4500	108.9358	21.0950	19.3391
Image3	133.0489	108.8301	21.8861	20.9523
Image4	126.8385	102.8931	28.2666	27.6586
Image5	125.5110	102.3670	35.7351	34.5398

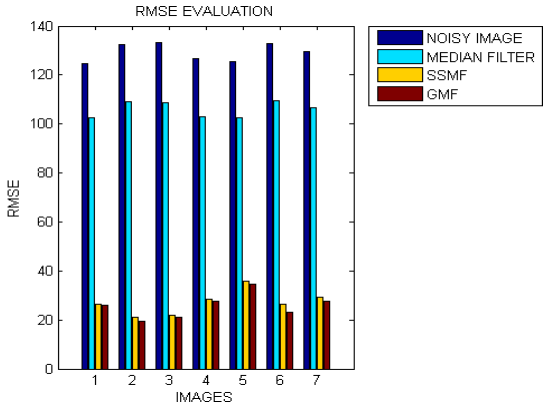

Fig.6 RMSE Evaluation

Table 3 and Figure 7 comparative analysis of the BIT ERROR RATE (BER). As BER need to be minimized; so the main goal is to decrease the BER as much as possible. Table 3 has clearly shown that the BER is minimum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the available methods

Table III : Bit Error Rate

IMAGE	NOISY IMAGE	MEDIAN FILTER	SSMF	GMF
Image1	0.1607	0.1261	0.0507	0.0403
Image2	0.1758	0.1354	0.0462	0.0346
Image3	0.1770	0.1352	0.0469	0.0361
Image4	0.1649	0.1269	0.0523	0.0418
Image5	0.1624	0.1261	0.0286	0.0576

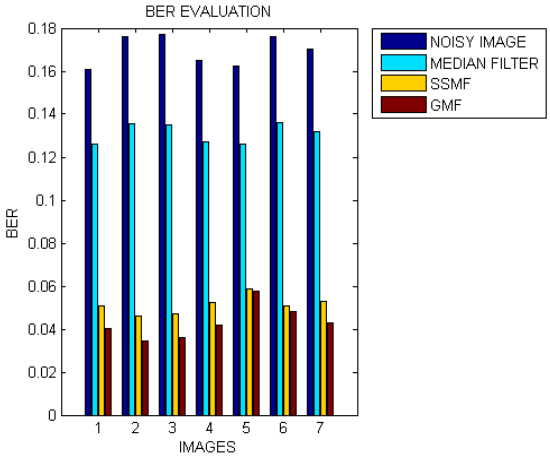

Fig.7 BER Evaluation

VIII. CONCLUSION AND FUTURE WORK

The image enhancement methods using improved modified decision based switching median filter are consider to be more appropriate and time saving in real time system. But it is found that most of existing research focus on the low density impulse noise. The proposed work uses global mean for highly corrupted images. The integrated technique has successfully reduces the limitation of existing enhancement techniques. The assessment for PSNR should be high for better results. Comparative analysis has shown significant improvement over the available methods. In future, for the enhancement purpose, more images can be taken from the different application fields. Other quality metrics can be used to judge the performance of this algorithm. And further improvements can also be done in the algorithm to improve the quality. In future, we need to implement the hybrid scheme that may give much better results. Then results can be tested.

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