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An Efficient Noise Removing Technique Using Mdbut Filter in Images

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Abstract**:** *It is important to remove or minimize the degradations, noises in valuable ancient blurred color images. The traditional available filtering methodologies are applicable for fixed window dimensions only these are not applicable for varying scale images. In our project we propose a new technique for digital image restoration, in this the noise free and noisy pixels are classified based on empirical multiple threshold values. Then the median filtering technique is applied. So that noise free pixels are getting preserved and only noisy pixels get restored.*

In this papert, an Adaptive median filter, called the Decision based filter (MDBUT) filter, is proposed to restore images corrupted by salt-pepper impulse noise. The filter is based on a detection-estimation strategy. The impulse detection algorithm is used before the filtering process, and therefore only the noise-corrupted pixels are replaced with the estimated central noise-free ordered mean value in the current filter window. The new impulse detector, which uses multiple thresholds with multiple neighborhood information of the signal in the filter window, is very precise, while avoiding an undue increase in computational complexity. For impulse noise suppression without smearing fine details and edges in the image, extensive experimental results demonstrate that our scheme performs significantly better than many existing, well-accepted decision-based methods.

Keywords: *meanfilter, medianfilter, mdbut filter*

I. Introduction

Images are often corrupted by impulse noise when they are recorded by noisy sensors or sent over noisy transmission channels. Many impulse noise removal techniques have been developed to suppress impulse noise while preserving image details. The median filter, the most popular kind of nonlinear filter, has been extensively used for the removal of impulse noise due to its simplicity. However, the median filter tends to blur fine details and lines in many cases. To avoid damage to good pixels, decision-based median filters realized by thresholding operations have been introduced in some recently published works. In general, the decision-based filtering procedure consists of the following two steps: an impulse detector that classifies the input pixels as either noise-corrupted or noise-free, and a noise reduction filter that modifies only those pixels that are classified as noise-corrupted.

In general, the main issue concerning the design of the decision-based median filter focuses on how to extract features from the local information and establish the decision rule, in such a way to distinguish noise-free pixels from contaminated ones as precisely as possible. In addition, to achieve high noise reduction with fine detail preservation, it is also crucial to apply the optimal threshold value to the local signal statistics. Usually a trade-off exists between noise reduction and detail preservation. In this paper, we propose a novel decision-based filter, named the multiple thresholds switching (MTS) filter, to overcome the drawbacks of the above methods. Basically, the proposed filter takes a new impulse detection strategy to build the decision rule and practice the threshold function.

The new impulse detection approach based on multiple thresholds considers multiple neighborhood information of the filter window to judge whether impulse noise exists. The new impulse detector is very precise

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Without, while avoiding an increase in computational complexity. The impulse detection algorithm is used before the filtering process starts, and therefore only the noise-corrupted pixels are replaced with the estimated central noise-free ordered mean value in the current filter window. Extensive experimental results demonstrate that the new filter is capable of preserving more details while effectively suppressing impulse noise in corrupted images.

One of the most intriguing questions in image processing is the problem of recovering the desired or perfect image from a degraded version. In many instances one has the feeling that the degradations in the image are such that relevant information is close to being recognizable, if only the image could be sharpened just a little. Blurring is a form of bandwidth reduction of the image due to imperfect image formation process. It can be caused by relative motion between the camera and the original scene, or by optical system, which is out of focus.

II. Existing Method

1. Meanfilter

1.1brief description

Mean filtering is a simple, intuitive and easy to implement method of smoothing images, i.e. reducing the amount of intensity variation between one pixel and the next. It is often used to reduce noise in images.

1.2how it works

A similar - but not identical - effect as a single pass with a large kernel.) The idea of mean filtering is simply to replace each pixel value in an image with the mean (`average') value of its neighbours, including itself. This has the effect of eliminating pixel values which are unrepresentative of their surroundings. Mean filtering is usually thought of as a convolution filter. Like other convolutions it is based around a kernel, which represents the shape and size of the neighbourhood to be sampled when calculating the mean. Often a 3×3 square kernel is used, as shown in Figure 1, although larger kernels (e.g. 5×5 squares) can be used for more severe smoothing. (Note that a small kernel can be applied more than once in order to produce

$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

Fig 1: 3×3 averaging often used in mean filtering

Computing the straightforward convolution of an image with this kernel carries out the mean filtering process.

1.3process

It checks for the pixels that are noisy in input image i.e. pixels with the values 0 or 255 are to be considered. For each such noisy pixel P, a window size of 3x3 neighbouring the pixel P is taken. Find the absolute differences between the pixel P and the neighbouring pixels of P. The value of each pixel is compared with the threshold value to detect whether the pixel P is signal pixel or corrupted by noise. If it is corrupted the arithmetic mean of differences for a given pixel is calculated with respect to its neighbouring pixels. Otherwise the pixel P is considered as signal pixel.This process may cause blurring effect.

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2. Medianfilter

2.1brief description

The median filter is normally used to reduce noise in an image, somewhat like the mean filter. However, it often does a better job than the mean filter of preserving useful detail in the image.

2.2how it works

Like the mean filter, the median filter considers each pixel in the image in turn and looks at its nearby neighbours to decide whether or not it is representative of its surroundings. Instead of simply replacing the pixel value with the mean of neighbouring pixel values, it replaces it with the median of those values. The median is calculated by first sorting all the pixel values from the surrounding neighbourhood into numerical order and then replacing the pixel being considered with the middle pixel value. (If the neighbourhood under consideration contains an even number of pixels, the average of the two middle pixel values is used.) Figure 1 illustrates an example calculation.

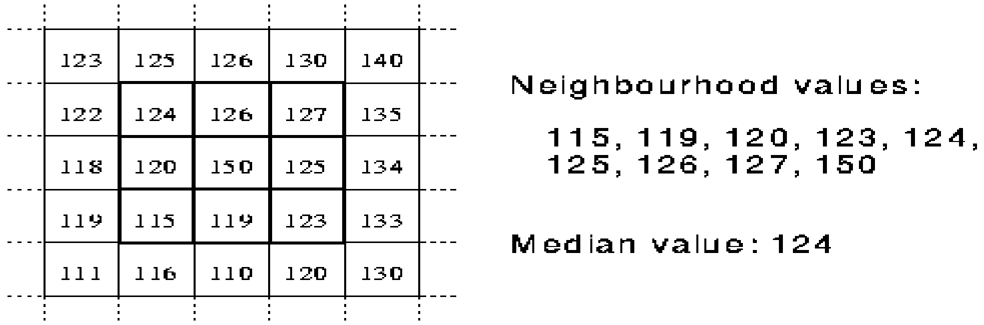

Fig 2: Calculating the median value of a pixel neighbourhood. As can be seen the central pixel value of 150 is rather unrepresentative of the surrounding pixels and is replaced with the median value: 124. A 3×3 square neighbourhood is used here **---** larger neighborhoods will produce more severe smoothing.

2.3Process

Noise is detected by the noise detection algorithm mentioned above.
Filtering is applied only at those pixels that were detected as noisy.
Once a given pixel P is found to be noisy the following steps are applied
A 3x3 mask is centred at the pixel P and founds if there exists at least one signal pixel around the pixel P.
If found, the pixel P is replaced by the median of the signal pixels found in 3x3 neighbourhood of P.
The above steps are repeated if noise still there in the output image for better results.

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III. Proposed Method

3.1mdbut filter

The proposed Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) 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 MDBUTMF. Unsymmetric Trimmed Median Filter (MDBUTMF) algorithm removes this drawback at high noise density.

If the processing pixel value is 0 or 255 it is processed or else it is left unchanged. At high noise density the median value will be 0 or 255 which is noisy. In such case, neighboring pixel is used for replacement. This repeated replacement of neighboring pixel produces streaking effect. In order to avoid this drawback, Decision Based Unsymmetric Trimmed Median Filter (DBUTMF) is proposed. At high noise densities, if the selected window contains all 0's or 255's or both then, trimmed median value cannot be obtained. So this algorithm does not give better results at very high noise density that is at 80% to 90%. The proposed Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) algorithm removes this drawback at high noise density.

3.2 mdbut median filter

MDBUT Median Filter can be called as Modified Decision Based Unsymmetrical Trimmed. It processes the corrupted images by first detecting the impulse noise. Whether it is noisy or noisy free can be checked by using the processing pixel. It can say it is noise free pixel if the processing pixel lies between maximum and minimum gray level values otherwise it can say that it is noisy pixel. In many practical cases of image processing, only a noisy image is available. This circumstance is known as the blind condition. Many denoising methods usually require the exact value of the noise distribution as an essential filter parameter.

So, the noise estimation methods in the spatial domain use the variance or standard deviation to estimate the actual added noise distribution. But it is found that the mean deviation provides better results than the variance or standard deviation to estimate the noise distribution. The advantage of this approach is that the mean deviation is actually more efficient than the standard deviation in practical situations. The standard deviation emphasizes a larger deviation; squaring the values makes each unit of distance from the mean exponentially (rather than additively) larger. The larger deviation will cause overestimation or underestimation of the noise. So, we assume that use of the mean deviation may contribute to more accurate noise estimation. Keeping these points in view, the authors have used the mean deviation parameter in deciding the noise pixel and replaced the central pixel by its mean deviation instead of its mean. The steps in the proposed algorithm are given below.

3.3Process

Select 2-D window of size 3x3.
If this pixel value lies between 15 and 230, pixel. So, no processing is required and its value is left unchanged
If Pij = 0 or 255, it indicates that the pixel is corrupted by salt and pepper noise .
Apply mean to the window containing all 0's and 255's.
If Pij =0 to 15, indicate it as low intensity noise pixels and apply median to it.
If Pij=230 to 255,indicate it as high intensity noise pixels and apply median to it.
Apply the steps 1 to 3 for all the pixels in the image for complete processing.
If the selected window contains salt/pepper noise as processing pixel
(i.e., 255/0 pixel value) and neighbouring pixel values contains all pixels that adds salt and pepper noise to the image:

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Table 1: Where 255 is processing pixel P (i,j)

0	255	0
0	255	255
255	0	255

Since all the elements surrounding are 255's & 0's. It will be either 0 or 255 which is again noisy, if one takes the median value. To solve this problem, the processing pixel is replaced by the mean value & the mean of the selected window is found. Here the mean value is 170.Replace the processing pixel by 170.

Case (ii): If the selected window contains salt or pepper noise as processing pixel (i.e., 255/0 pixel value) and neighbouring pixel values contains some pixels that adds salt (i.e., 255 pixel value) and pepper noise to the image:

Table 2: Where 0 is processing pixel P (i, j)

78	90	0
120		255
97	255	73

Now eliminate the salt and pepper noise from the selected window. That is, elimination of 0's and 255's. The 1-D array of the above matrix is [78 90 0 120 0 255 97 255 73]. After elimination of 0's and 255's the pixel values in the selected Window will be [78 90 120 97 73]. Here the median value is 90. Hence replace the processing pixel by 90.

Case (iii): If the selected window contains a noise free pixel as a processing pixel, it does not require further processing. For example, if the processing pixel is 90 then it is noise free pixel: Since "90" is a noise free pixel it does not require further processing.

Table3

90	95	90
45	65	21
32	90	101

Each and every pixel of the image is checked for the presence of salt and pepper noise. Different cases are illustrated in this Section. If the processing pixel is noisy and all other pixel values are either 0's or 255's is

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illustrated inCase (i). If the processing pixel is noisy pixel that is 0 or255 is illustrated in Case (ii).If the processing pixel is not noisy pixel and its value lies between 0 and 255 is illustrated in Case (iii).

3.4a modified decision based unsymmetrical trimmed median filter

A Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF) is proposed for the restoration of colour images that are highly corrupted by salt and pepper noise. The proposed filter (MDBUTMF) replaces the noisy pixel by trimmed median value when some of the elements with values 0‟s and 255‟s are present in the selected window. If all the pixel values in the selected window are 0‟s and 255‟s means then the noisy pixel is replaced by mean value of all the elements present in that selected window.

In the proposed method first the noisy image is read then based on some decision salt and pepper noise detection takes place. At the end of the detection stage the noisy and noise-free pixels get separated. The noise-free pixel is left unchanged and the noisy pixel is given to the Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF). The MDBUTMF produces an image as its throughput that is a noise removed one.

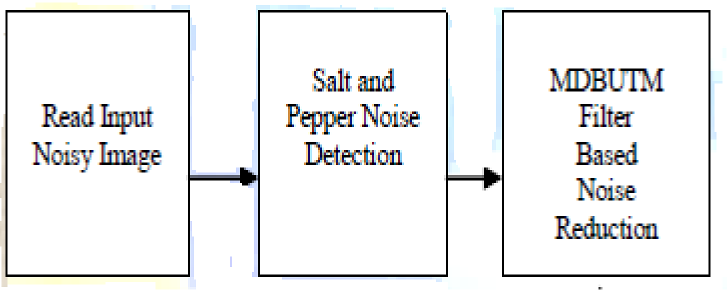


Fig3: Flow of the proposed algorithm

The data flow of the proposed method is shown in Fig.3.4.1. The flow goes in the way that, first the noisy image is given to a noisy image reader. Followed by this is the salt and pepper noise detection. After this, based on the state of the elements the corrupted pixel is either replaced by Type-I or replaced by Type-II.

Type-I): If the selected window contains all the elements as 0‟s and 255‟s means, then replace the processing pixel by the mean value of the elements present in that window. Type-II): If the selected window contains not all elements as 0‟s and 255‟s. Then eliminate 0‟s and 255‟s and find the median value of the remaining elements. Replace the processing pixel with the median value. The clear explanation of Type-I and Type-II with examples is given in this Section. The output images produced by the combination of Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF) contain excellent Result than the existing methods.

The proposed Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF) 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 MDBUTMF.

3.5Algorithm

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

Step 2: If $0 < P_{ij} < 255$ then is an uncorrupted pixel and its value is left unchanged. This is illustrated in Case iii) of Section Illustration of MDBUTM Filter.
Step 3: if 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 P_{ij} 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’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. The pictorial representation of each case of the proposed algorithm is shown in Fig. The detailed description of each case of the flow chart shown in Fig.1 is illustrated through an example in Section Illustration of MDBUT Filter.

3.6Illustration of mdbut filte:

Each and every pixel of the image is checked for the presence of salt and pepper noise. Different cases are illustrated in this Section. If the processing pixel is noisy and all other pixel values are either 0’s or 255’s is illustrated in Case i). If the processing pixel is noisy pixel that is 0 or 255 is illustrated in Case ii). If the processing pixel is not noisy pixel and its value lies between 0 and 255 is illustrated in Case iii). Case i): If the selected window contains salt/pepper noise as processing pixel (i.e., 255/0 pixel value) and neighboring pixel values contains all pixels that adds salt and pepper noise to the image:

$$\begin{bmatrix} 0 & 255 & 0 \\ 0 & \langle 255 \rangle & 255 \\ 255 & 0 & 255 \end{bmatrix}$$

Where "255" is processing pixel, i.e., . (P_{ij})

Since all the elements surrounding (P_{ij}) are 0's and 255's. If one takes the median value it will be either 0 or 255 which is again noisy. To solve this problem, the mean of the selected window is found and the processing pixel is replaced by the mean value. Here the mean value is 170. Replace the processing pixel by 170.

Case ii): If the selected window contains salt or pepper noise as processing pixel (i.e., 255/0 pixel value) and neighbouring pixel values contains some pixels that adds salt (i.e., 255 pixel value) and pepper noise to the image:

$$\begin{bmatrix} 78 & 90 & 0 \\ 120 & \langle 0 \rangle & 255 \\ 97 & 255 & 73 \end{bmatrix}$$

Where "0" is processing pixel, i.e., (P_{ij}). Now eliminate the salt and pepper noise from the selected window. That is, elimination of 0's and 255's. The 1- D array of the above matrix is [78 90 0 120 0 255 97 255 73]. After elimination of 0's and 255's the pixel values in the selected window will be [78 90 120 97 73]. Here the median value is 90. Hence replace the processing pixel by 90. Case iii): If the selected window contains a noise free pixel as a processing pixel, it does not require further processing. For example, if the processing pixel is 90 then it is noise free pixel:

$$\begin{bmatrix} 43 & 67 & 70 \\ 55 & \langle 90 \rangle & 79 \\ 85 & 81 & 66 \end{bmatrix}$$

Where "90" is processing pixel, i.e. (P_{ij}), since "90" is a noise free pixel it does not require further processing

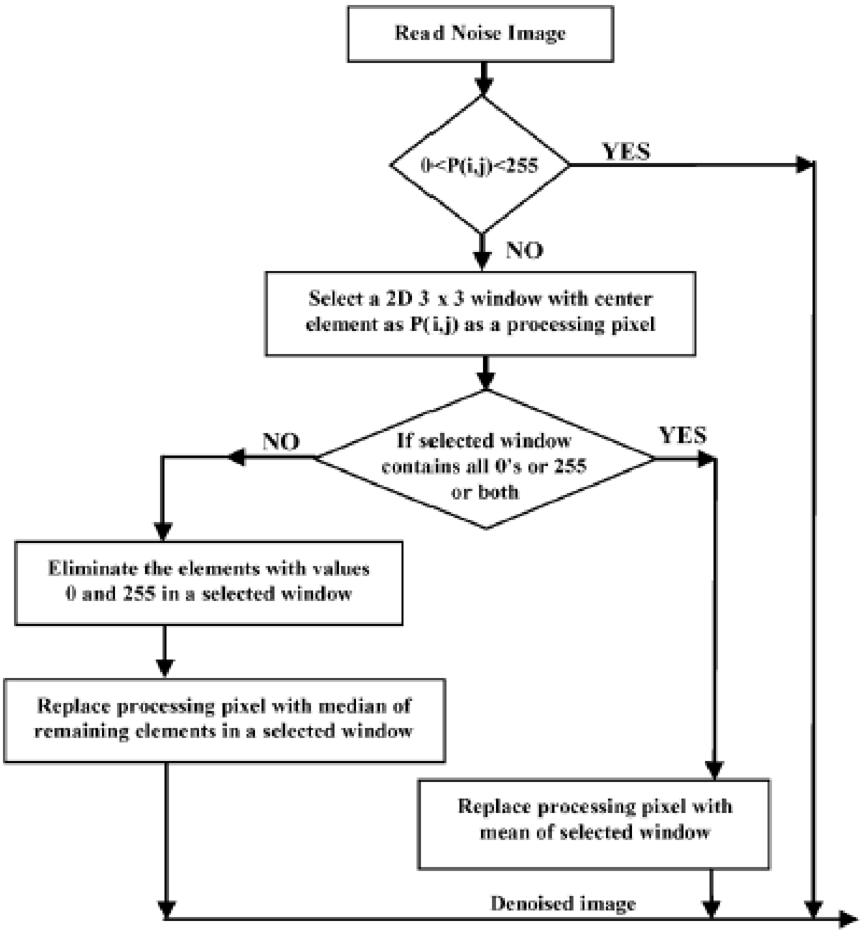


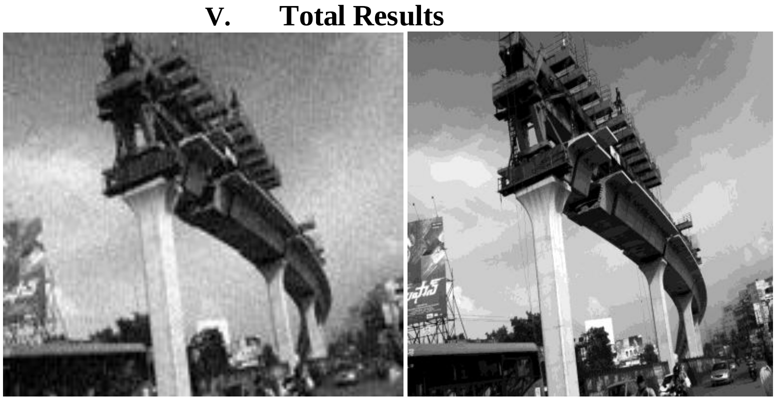
Fig: 2.1.5: flow decision based selection

IV. Conclusion

In this project, we have presented a new efficient decision-based filter, the multiple thresholds switching filter, for image restoration. Because the new impulse detection mechanism can accurately tell where noise is, only the noise-corrupted pixels are replaced with the estimated central noise-free ordered mean value or median value. As a result, the restored images can preserve perceptual details and edges in the image while effectively suppressing impulse noise. The experimental results included in this project have demonstrated that the proposed filter significantly outperforms a number of well-accepted decision- based filters.

The implementation of 128x128 bits image can be extended to 256x256 and so. This can give a wide range of applications in various fields to transfer a noiseless and lossless image even in large size images.

V. Total Results



Noisy image Noise removed image

Fig 8: Image after noise is removed using MDBUT Filter.

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