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Comparative Study of Noise Removal Techniques with Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF)

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Abstract: ***In digital image processing, sometimes images contain noisy pixels, so they are not clear. Salt & pepper noise directly effect to images. This problem was increasing day by day in digital image field. So many noise removal techniques are available like MF (Median filter), Adaptive Median Filter (AMF), Adaptive switching weighted median filter (ASWMF), Modified decision based unsymmetric trimmed median filter (MDBUMF). In this paper, we discuss to the noise removal techniques and deep analysis about MDBUMF. And we also shows how MDBUMF different from some other noise removal techniques. MDBUMF gives better result as of other noise removal techniques. It can remove noise up to 70% from corrupted image in proficient manner.***

Index terms: Median Filter (MF), MDBUMF, ASWMF, Salt & Pepper noise(S&P).

I. INTRODUCTION

Digital image processing is a process of applying computer algorithms and methods on digital image for performing image processing .In this, main of digital image processing is that enhance picture quality, removing bit errors, solving problem of impulsive noise and at last creating 'best image' according to human interpretation. Many reasons are possible for occurring noise in the image like Random variation of brightness, Image sensor may be effected by environmental condition during image attainment[1], Due to not enough light/brightness, Quality of scanner may be not good, Dust particle are present on the scanner screen[2], etc. These elements are responsible for creating noise in the image. Many types of noises occur in the image-:

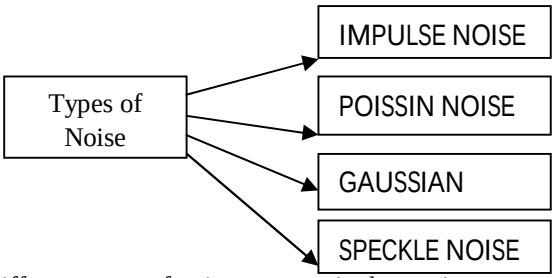
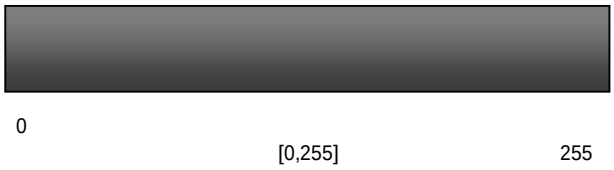


Fig 1: different types of noises present in the image

Among these noises, we discuss about impulsive noise. In the image two types of impulsive noise occurs first is Salt and Pepper noise (SPN) and other Random value impulse noise (RVIN). Both are different from each other. In case of SPN noise pixels belongs to either 0 or 255 [0,255] gray values for 8-bit image and in case of RVIN pixels belongs to range in (0~255) [3]. So it is clear that removing noise from RVIN is complex than SPN.

(a)



(b)

Fig 2: Representation of (a) Salt & pepper noise and (b) Random value impulse noise

II. VARIOUS IMPULSIVE NOISE REMOVAL TECHNIQUES

In world of image processing existing various types of noises due to various regions and also various types of noise removal techniques existing for removing and resolving these existing noises in the image processing without losing any information and also preserving edge information of the images. So, we discuss various type of noise removal techniques are as follows:

A. Median filter (MF)

Median filter is very widely used in digital image processing. It is a non- linear filtering technique. This filtering technique removes the noise from the image in digital image processing. MF preventing the edge details and maintains the quality of image. But main disadvantage of this technique is when noise density was high then MF lose the details of edge and not given appropriate noise-free image or denoisy image.

Working steps of median filter are as follows:

1) Firstly we consider 3×3 matrix from given image pixels. A= $\begin{bmatrix} 2 & 6 & 2 \\ 3 & 7 & 5 \\ 4 & 9 & 6 \end{bmatrix}$

2) Now find median value of this matrix. So median =5.

3) Then, all the noisy pixels (0 and 255) replace with this median value. If pixels become non-noisy then value of pixels remains unchanged.

4) These steps repeated for all the values in the input matrix.

B. Adaptive Median Filter (AMF)

Adaptive median filter is also a non-linear filtering technique. AMF apply the operations on the noisy pixels in the image in very special manner. In this, AMF consider two steps for filtering the image in image processing. Firstly, identify the noisy pixels in image with the help of comparing each pixel in the image to its surrounding neighbor pixels [4][5]. This technique is work on majority. If majority of pixels is same then it means no noisy pixel exists in image but if a pixel is different from a majority of its neighbor pixel is not structurally aligned with those pixels then this pixel is noisy pixel and replacing it with median value of pixels in image. This filtering technique is very useful because of smoothing the non impulsive noise.

C. Adaptive Switching Weighted Median Filter (ASWMF)

Adaptive switching weighted median filter is technique of removal of salt & pepper or impulse noise in digital image processing. In this filtering technique required noise detection and noise removal stage foe filtering the image. In noise detection stage, detected the noisy pixels or noise-free pixels from the using local mean value in image. Then noisy pixels replaced with their weighted median value using adaptive switching weighted median filter with in a window size 3×3 or 5×5 [6]. In this filtering technique it's not necessary every min value (0) and max value (L-1) is corrupted. It does depend on the neighbor's correlation. If evaluated value of pixel is nearly same as neighbors' value then value become not noisy [7]. Main advantage of this noise removal technique is no previous knowledge is required and details of edge are prevented.

III. MODIFIED DECISION BASED UNSYMMETRIC TRIMMED MEDIAN FILTER (MDBUTMF)

A modified decision based unsymmetric trimmed median filter algorithm worked for salt & pepper noise and random valued impulsive noise. This algorithm is removing the noisy pixels from gray scale and color image. Its decision based algorithm because of in detection stage of noisy pixels from the 3×3 window finding the noisy pixels and noise-free pixels. If in selected window value

of pixels are reaches minimum and maximum gray level value (0 and 255) then pixels are corrupted with salt & pepper noise otherwise pixels are noise-free if this is lies between min and max gray level value. Value of noise-free pixels remains unchanged but noisy pixels replaced by the calculated mean and median value according to condition. Steps of replaced corrupted pixels are as follows: [6]

A. Consider 2D window of size 3×3 or 5×5. Let pixels being processed Cij or centered pixel value of the selected window of image.

B. If 0< Cij <255 it means pixels present in selected window are uncorrupted or noise-free.in this case value is remains unchanged.

C. If Cij=0 and Cij=255 it means pixels are corrupted. In this condition two cases occur: Case1: If the selected window contains all 0's and 255's then replace Cij with mean of the pixel value. Case2: if selected window not contain all 0's and 255's then find median of remaining value in selected window and replaced noisy pixels from median value.

D. Repeat the steps 1 to 3 until all the pixels in the entire image are processed.

Flowchart of these steps is as follows:

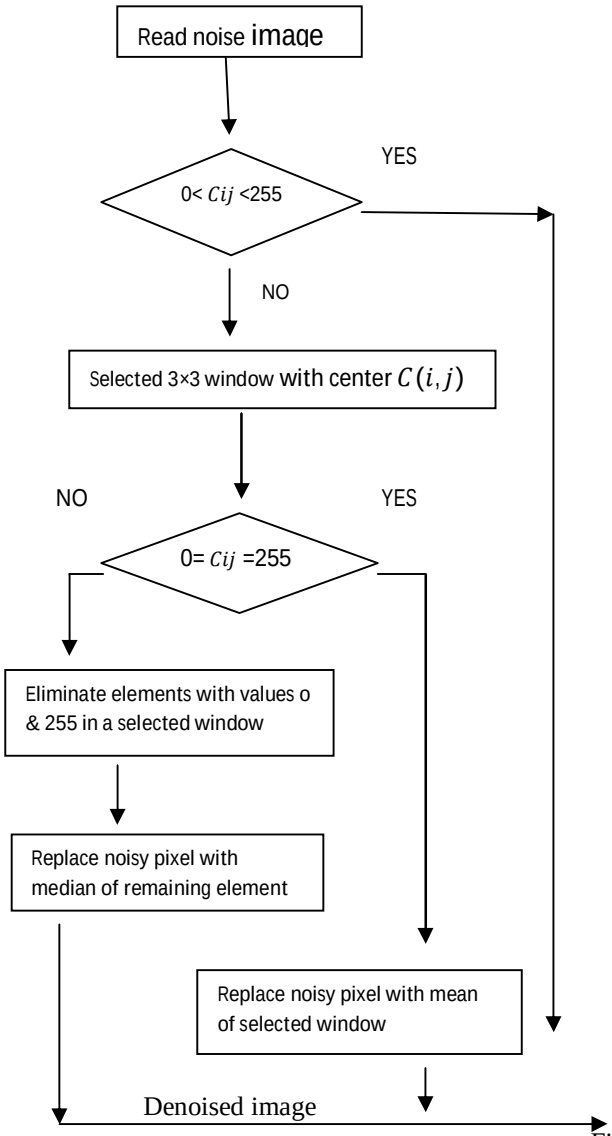


Fig3: Flowchart of MDBUTMF

E. How MDBUTMF is better from other noise removal techniques?

MDBUTMF is perform better operation and gives better result in comparison of other impulsive noise removal techniques like Median Filter (MF), Adaptive Median Filter (AMF), Adaptive Switching Weighted Median Filter (ASWMF) etc. MDBUTMF provide better Peak Signal-to-Noise Ratio (PSNR) and Image Enhancement Factor (IEF). It also preserves the image details and smoothing the edge. When the noise level increase 50% or more, other filtering techniques not filter the image in efficient manner and gives blurring image but MDBUTMF remove the noise up to 70%. and gives better quality image. In same case of window size of the pixels, when window size has to be increased like 5×5, 7×7, 9×9 then MF, AMF, ASWMF has not work properly because of complexity is created in the large window size but modified decision based unsymmetric trimmed median filter (MDBUTMF) perform better process in large size of window [9].

IV. CONCLUSION

In this paper, we discussed about various noise filtering techniques MF, AMF, ASWMF and MDBUTMF. In terms of PSNR and IEF MDBUTMF is better from other noise filtering techniques. This algorithm is applicable for both salt & pepper noise and random valued impulse noise. We can also perform the MDBUTMF with double padding for better edge prevention in digital image processing. At high noise density and large window size it can perform efficient manner and gives high quality denoised image.

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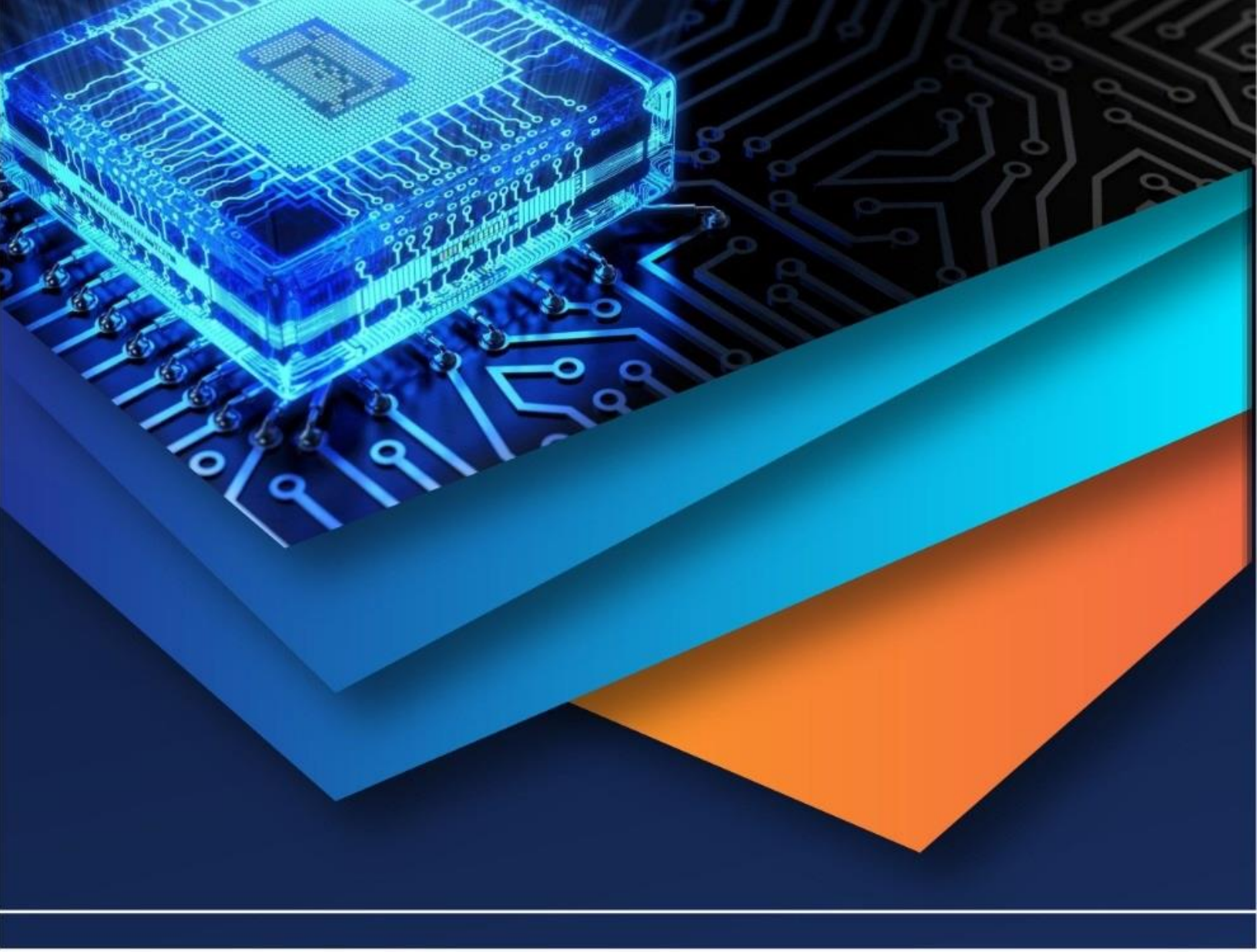

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