An Alternative Approach to Remove Impulse Noise from Digital Images to Reduce Execution Time

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ABSTRACT
Noise is impulse on images due to several factors like malfunctioning in pixels due to camera sensor, transmission of images in noisy channel, hardware problem etc. This paper surveys various techniques for removal of impulse noise. To reduce the impulse noise level in Digital images various filters were introduced amongst which (SAM) Simple Adaptive Median is one of the method, which uses hybrid technique of adaptive median filter and switching median filter. Based on Local noise level on digital images size of filter is changed i.e. square filter technique is used basically in SAM. SAM was compared with three derivatives namely Weighted SAM (WSAM), Circular SAM (CSAM) and Weighted CSAM (WCSAM) and images were restored maximum of impulse noise, but as Circular filter has complicated implementation that resulted in increase of execution time. This paper investigate the effect of shape and weight on digital images using SAM filter and restore all the digital images impulse with noise with reducing execution time for all three derivatives.

Keywords—
Salt-pepper, impulse, noise, distortion.

1. INTRODUCTION
Conventional median filter is a technique to remove impulse noise from corrupted images [1, 2] .But the drawback with conventional method is that, it does not differentiate between noise free and noisy pixels [3]. Due to which all pixels in the images are given same priority and which result in loss of useful details like borders, lines and images are blurred or distorted [4]. After variety of improvement Median filter was introduced. Median filter is a filter which calculates the median value from surrounding neighborhood pixel and replaces the pixel with the median value and the corrupted images is restored. Another subdivision of Median filter known as Adaptive median filter, which Compares the median with a threshold and decides whether the pixel is noisy pixel or noise free pixel either to replace it or increase the neighborhood size and recalculate. In Adaptive median filter the pixel in which noise is determined or noisy pixel are affected. This method is good for low or high noise densities [5]. Noise detection and Noise cancellation are the two main steps in filtering any digital images. Noise detection detect noisy pixels which are caused by analog to digital converter, errors in transmission, transmission of images in noisy channel, hardware problem etc.

2. RELATED WORK
Digital image processing is the technique in which input is a corrupted image, which is then processed through algorithm and the output provided is free from variety of distortion, pepper, salt, noise etc.

Much wider range of algorithms is provided to filter the digital images from the impulse noise. Here in this Survey paper we study various algorithms provided by the authors to remove impulse noise [6].

2.1 Center Weighted Median Filters: CWM is a filtering technique in which filter gives more weight only to the central value of a window, and thus it is easier to design and implement than general WM filters [7].

2.2 Adaptive Median Filters: Adaptive median filter has flexible window size for removal of impulse noise It Compares the median with a threshold and decides whether the pixel is noisy-pixel or noise free pixel either to replace it or increase the neighborhood size and recalculate.

2.3 Median filter: It is a filter which calculates the median value from surrounding neighborhood pixel and replaces the pixel with the median value and the corrupted images is restored [8].

2.4 Simple Adaptive Median: Working of SAM is divided in two stages.

In first stage Noisy pixel and noise free pixel are identified. In second stage Noisy pixel are processed and noise free pixel are copied to output image [9].

3. PROBLEM IDENTIFICATION
SAM is a technique which is used to filter the input corrupted images by comparing with WSAM, CSAM and WCSAM to restore the images, but as Circular filter has complicated implementation that resulted in increase of execution time. The reason behind increase in execution time is the calculation of filter windows at each iteration. As the Filter windows are calculated every time for each image at each iteration this reduces the quality of the algorithm. We proposed a system such that the value comes from the lookup table which would be much efficient and will finally reduce the execution time [10].

4. METHODOLOGY

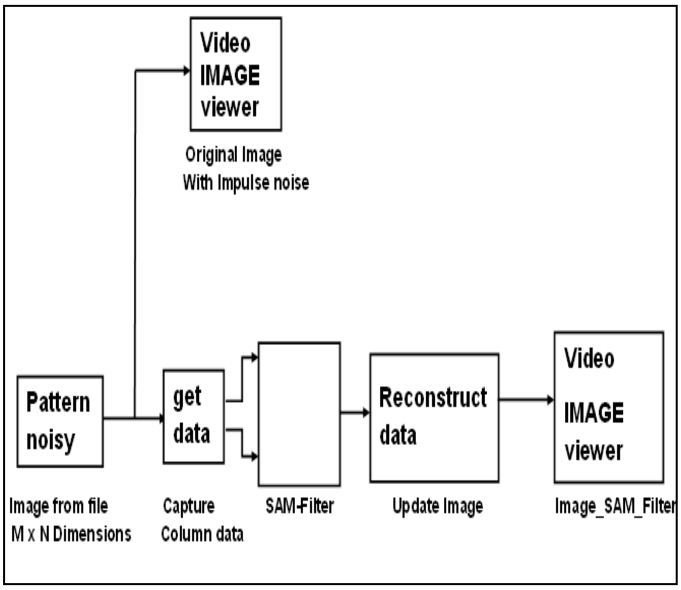

Figure 1: Proposed block diagram of SAM Filter

4.1 Proposed Algorithm

The algorithm works on two steps:

4.1.1 Detection of Noisy pixels

An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. Due to this reason images that are impulse with salt and pepper noise appear as white and black dots.

The amplitude of the Imposed noise in the image is very high as compared to the original signal strength of the image. Let L be the intensity of the corrupted pixel in the range of two extreme values (minimum and maximum) in the range from 0 or L-1.So at pixel position (x, y) we find the value of β

$$\beta(x,y) = \begin{cases} 1 & : \; z(x,y) = 0 \text{ or } L-1 \\ 0 & : \; \text{otherwise} \end{cases}$$

Where Z denotes the Input image and values 1and 0 represent noisy and noise free pixels.

Here the noise level is detected using lookup table. Median filter is used for noise removal, which requires a median filter mask. This mask is generated from a formula which is too complex in terms of calculations, so we are pre-calculating all terms with this formula and using the same in removing noise with the help of Median Filter.

4.1.2 Removal of Noisy Pixels

By using switching median filter the output image f is obtained.

$$f(x,y) = \begin{cases} z(x,y) : \beta(x,y) = 0 \\ n(x,y) : \text{otherwise} \end{cases}$$

Where n is the median value which is obtained by the following steps:

Initialize the size of the square filter W = 2Rmin + I, where Rmin is an integer value calculated using

$$R_{min} = [0.5\sqrt{7}/(1-\eta)]$$

Where η is the output of the lookup table

Output of the lookup table decides the noise free pixels.

If the number of "noise free pixels" is less than eight pixels, increase the size of the square filter by two (i.e. W= W+2) and return to step 2.

Calculate the value of n(x, y) based on the "noise free pixels" contained in window of size M x N.

Update the value of f(x, y) by using the step (4).

5. PRPOSED MODIFICATION TO SAM

SAM is a filter which calculates the median value from surrounding neighborhood pixel and replaces the pixel with the median value and the corrupted images is restored, i.e. noisy pixel and noise free pixels are identified while noises free are directly copied to output image while noisy pixel are processed.

In this Filtering method Filter windows are calculated every time for each image at each iteration this reduces the quality of the algorithm. We proposed a system (Filtering method) such that the value comes from the lookup table which would be much more efficient, and reduces the execution time.

SAM figure2 is used to filter the input corrupted image in comparison with Weighted SAM (WSAM) figure3, Circular SAM (CSAM) figure4 and Weighted CSAM (WCSAM) figure5 is depicted. The modification on these filters is done on the basis of their shape and weights assigned to them. In SAM filter we use square filters while CSAM use circular filter. The advantage in using circular filter is that it minimizes the errors associated with the square kernel as the corner most pixels are not important in calculating the median value. These two filters SAM and CSAM were further modified to WSAM and WCSAM by including weights in them.

The center most pixels are given more weight as a result it contributes in improved result [10].

1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	0	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

Figure 2: SAM Filter

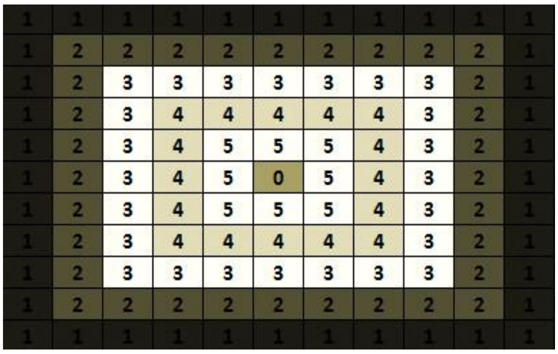

Figure 3: WSAM Filter

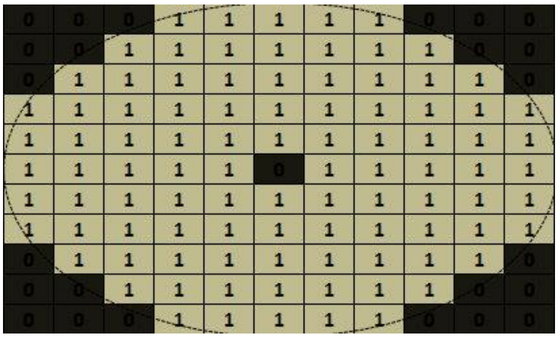

Figure 4: CSAM Filter

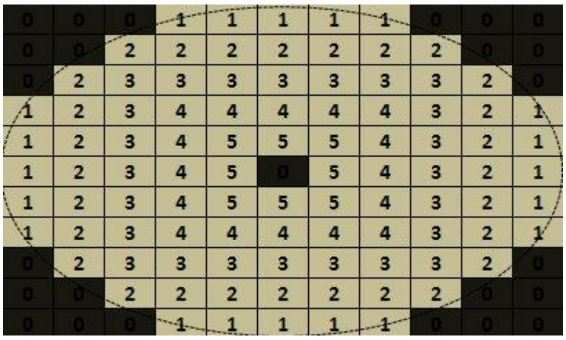

Figure 5: WCSAM Filter

6. CONCLUSION

In this paper, we have studied various techniques for removal of impulse noise compared in terms of MSE value, processing time and by visual inspection. It was found that Circular (CSAM) has longer processing time. We proposed implementation of a look-up table in the algorithm which resulted in reduction of execution time for all the three derivatives.

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