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# A Literature Review of RVIN using Various Filters

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***Abstract—In the field of image processing, removal of noise from digital images plays a crucial role. Effective detection of noisy pixel based on median value and a well-organized algorithm for the estimation and replacement of noisy pixel has been carried out in our proposed method in which replacement of noisy pixel is carried out twice, which better preserves the image details. The presence of high performing detection stage for the detecting noisy pixel makes the proposed method suitable in the case of high density random valued impulse noise; the proposed method yields better image quality.***

***Keywords— Mean square error, Peak signal to noise ratio, Median filter, Random valued impulse noise.***

## I. INTRODUCTION

Preservation of digital images during the process of image acquisition or transmission has always been a very cumbersome task for researchers. In the field of image processing, digital images very often get corrupted by several kinds of noise during the process of image acquisition. The basic reasons are malfunctioning of pixels in camera sensors, faulty memory locations in hardware, or transmission in a noisy channel [1]. Images are often corrupted by the impulse noise, Gaussian noise, shot noise, speckle noise, etc. Preservation of image details and suppression of noise are the two important aspects of image processing. Generally impulse noise is classified into two types: the salt-and-pepper noise also known as the fixed valued impulse noise and the random-valued impulse noise. Here in this paper, we focus on random valued impulse noise. Random valued impulse noise generates impulses whose gray level value lie within a specific range. The random value impulse noise lies between 0 and 255 and it is very difficult to remove this noise. Salt and pepper noise is also known as fixed valued impulse noise producing two gray level values 0 and 255. Where 0 values belong to black and 255 belongs to white on the gray scale. It is generally reflected by pixels having minimum and maximum value in a gray scale image. Generally the basic idea behind image de-noising is the detection stage, which identifies the noisy and noise free pixels of the corrupted image, after that noise removal part removes the noise from the corrupted image under process while preserving the other important detail of image.

There are two types of filters in spatial domain: linear filter and non-linear filter. Linear filters are like wiener filter, mean filter. Here we propose a nonlinear median filter which removes random valued noise and preserves the edges of the image.

Initially standard median filter was used, but later on switching based median filters were developed which provides better results. any other result oriented standard median filters were developed, like weighted median filter, SDROM filter [8], rank conditioned rank selection filter [12], centre weighted median filter [14], adaptive median filter, and many other improved filters. The consequences of median filter also depend on the size of filtering window. Larger window has the great noise suppression capability, but image details (edges, corners, fine lines) preservation is limited, while a smaller window preserves the details but it will cause the reduction in noise suppression. Noise detection is a vital part of a filter, so it is necessary to detect whether the pixel is noisy or noise free. Only noisy pixels are subject to de-noising and noise free pixels remains untouched.

## II. NOISE MODEL

Two common types of the impulse noise are the Fixed-Valued Impulse Noise (FVIN), also known as Salt and-Pepper Noise (SPN), and the Random-Valued Impulse Noise (RVIN). They differ in the possible values which noisy pixels can take [6]. The FVIN is commonly modelled by

$$(Y_{ij}) = \begin{cases} X_{i,j} \; with\ probabilty \quad p \\ (0,255)\; with\ probabilty \quad 1-p \end{cases} \qquad \text{.............(1)}$$

Where x(i,j) and y(i,j) denote the intensity value of the original and corrupted images at coordinate (i,j), respectively and p is the noise density. This model implies that the pixels are randomly corrupted by two fixed extreme values, 0 and 255 (for 8-bit grey-scale images), with the same probability.

A model is considered as below:

$$(Y_{ij}) = \begin{cases} (0, m) & \text{with probabilty} \quad p1 \\ X_{i,j} & \text{with probabilty} \quad 1-p \\ (255-m, 255) & \text{with probabilty} \quad p2 \end{cases} \quad \text{............(2)}$$

Where p = p1 + p2. We refer to this model as Random valued Impulse Noise (RVIN).

## III. RELATED WORK

### *A. Mean Filter*

In the 1998 Scott E Umbaugh, Computer Vision and Image Processing, Prentice Hall PTR, New Jersey, A mean filter act on an image by smoothing it; that is, it reduces the intensity variation between adjacent pixels. The mean filter is nothing but a simple sliding window spatial filter that replaces the center value in the window with the average of all the neighbouring pixel values including it. By doing this, it replaces pixels that are unrepresentative of their surroundings. It is implemented with a convolution mask, which provides a result that is a weighted sum of the values of a pixel and its neighbours. It is also called a linear filter. The mask or kernel is a square. Often a 3× 3 square kernel is used. If the coefficients of the mask sum up to one, then the average brightness of the image are not changed. If the coefficients sum to zero, the average brightness are lost, and it returns a dark image. The mean or average filter works on the shift-multiply-sum principle [12].

### *B. Median Filter*

In the spatial domain the most basic nonlinear filter is the standard median filter (MF) [5]. Standard median filter replaces each pixel in the image by the median value of the corresponding filtering window. The standard median filter works effectively for low noise densities but at the cost of blurring the image.

Consider that the pixel values in a neighbourhood are taken in to sequence M1, M2, M3………... Mn.

To estimate, the median value of pixels, first all pixels are sorted either in ascending or descending order. After sorting these pixels, the sequence will be Mi1≤Mi2≤Mi3≤................Min in ascending order and $Mi1 \geq Mi2 \geq Mi3 \geq$ ................Min, in descending order.

Thus, mathematically median is expressed as:

$$\text{Median}(M) = \text{Med}\{Mi\}$$
$$= \begin{cases} Mi(n+1)/2, & \text{n is odd} \\ ½[Mi(n/2) + Mi(n/2)+1], & \text{n is even} \end{cases}$$

'n' is generally odd.\

### *C. Adaptive Median Filter (AMF)*

In 2008, S.Saudia, Justin Varghese, Krishnan Nallaperumal, Santhosh.P.Mathew, Angelin J Robin, S.Kavitha, Proposes a new adaptive 2D spatial filter operator for the restoration of salt & pepper impulse corrupted digital images name as - "Salt & Pepper Impulse Detection and Median based Regularization using Adaptive Median Filter", The Adaptive Impulse Filter effectively identifies the impulsive positions with a valid impulse noise detector and replaces them by a reliable signal determined from an appropriate neighborhood. Experimental results in terms of objective metrics and visual analysis show that the proposed algorithm performs better than many of the prominent median filtering techniques reported in terms of retaining the fidelity of even highly impulse corrupted images.

### *D. Signal-Dependent Rank Ordered Mean Filter (SD-ROM)*

It is an efficient nonlinear algorithm to suppress impulse noise from highly corrupted images while preserving image details and features [8]. The method is applicable to all impulse noise models, including fixed valued (equal height or salt and pepper) impulses and random valued (unequal height) impulses, covering the whole dynamic range. The filter effectively suppresses the noise, and preserves the details and edges without unnecessary increase in computational complexity.

### *E. Rank Conditioned Rank Section Filter (RCRS)*

The RCRS filters are proposed in the general structure of rank selection filters. The information utilized by RCRS filters is the ranks of selected input samples; hence the name rank conditioned rank selection filters [12].The number of input sample rank used in this decision is referred to as the order of RCRS filter. The order ranges from zero to the number of samples in the observation window, giving the filters valuable flexibility. Low-order filters can give good performance and are relatively simple to optimize and implement.

### *F. Progressive Switching Median Filter (PSM)*

It is a median-based progressive switching median (PSM) filter, proposed for the Removal of Impulse Noise from Highly Corrupted Images.[9] The filtering method is based on the following two main schemes: (1) Switching scheme : An impulse detection scheme is used before filtering, thus only a fraction of all the pixels will be subjected to filtering process and (2) Progressive methods : Both the impulse detection and the noise filtering procedures are progressively applied through a number of iterations. The main advantage of this method is that some impulse pixels located in the middle of large noise blotches can also be properly detected and filtered, which results in better restoration, especially for the cases where the images are highly corrupted.

### *G. In 2007Yiqiu Dong and Shufang Xu [6], Proposed a New Impulse Detector*

This utilizes the differences between the current pixel and its neighbours aligned with four foremost directions. After impulse detection, the filter simply do not replace noisy pixels identified by outputs of median filter, but continue to make use of the information of the four directions to weight the pixels in the window so as to preserve the details of image.

### *H. In 2011Image De-noising by Dual Threshold Median Filtering for Random Valued Impulse noise*

The proposed method gives better PSNR values than other filters. The proposed filter has proved that it is very efficient for random valued impulse noise because practically noise is not uniform over the channel. We have used the concept of maximum and minimum threshold to detect both positive and negative noise. It produces very good PSNR (Peak Signal to Noise Ratio) and very small MSE (Mean Square Error) for highly corrupted images, especially for more than 50% noise density. This method has the following advantages:

- The median value is more accurate than other filters.
- Two thresholds used and the threshold values can adaptively change according to the noise density.
- It does require separate calculation for median value and threshold values, so it reduces the delay and enhance the processing speed of the filter with the help of parallel processing.

### *I. In 2013 Image Noise Removal with Detail Preservation for Random Valued Impulse Noise*

In this method dual median filtering is used for improving peak signal to noise ratio (PSNR) and reducing mean square error (MSE) values. This method is proposed for the removal of random valued noise from the gray scale images. The algorithm consists of two stages. In the first stage detection of noisy pixel is carried out and in second stage noisy pixel is replaced by median value using dual median filtering. The noisy pixels are detected with reference to three different conditions which results in effective detection. The experimental results show the proposed scheme performs better than other previous schemes.

However; further lessening in computational complexity is desired. Here we proposed a method with computational simplicity which makes it enable to restore images at faster rate.

## IV. CONCLUSIONS

In this paper, we have discussed different methods for impulse noise detection and removal. In this review we have see that there are different methods for image de-noising but also want to enhance the quality of images. In the case of digital image processing removal of impulse noise is important but also focuses on image enhancements like edge preservation and other quality of images. Further we will proposed a new method for a removal of impulse noise as well as enhance the quality of images also.

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