Removal of Impulse Noise through Modified Non-Linear Filter

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ABSTRACT: *In our proposed scheme restoratiom or denoising of gray scale and video images that are greatly corrupted by severe impulse noise .our scheme works excellently by replacing every noise pixel by trimmed median value so that other situated pixel values, like zero's (0's) and 255's so thereafter each noise pixel is immediately replaced by the increasing window size and finds trimmed mean among them based on algorithm mentioned. We also had comparative analysis over Standard Median Filter (SMF), Progressive Switched Median Filter (PSMF),Modified Decision Based Median Filter (MDBMF) and Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF).We simulated above images and video by proposed algorithm on Matlab where we achieved better PSNR and less MSE and also good image enhancement factor(IEF).*

Keywords: *Median filter, salt and pepper noise, unsymmetrical trimmed median filter.*

I. INTRODUCTION

We encounter images everywhere in our life. Basically, an image is a projection of a three dimensional (3D) scene into a two dimensional (2D) projection plane. The field of digital image processing refers to the use of computer algorithms to extract useful information from digital images. The entire process of image processing may be divided into three major stages:

(i) Image acquisition: converting 3D visual information into 2D digital form suitable for processing, transmission and storage.

(ii) Processing: improving image quality by enhancement, restoration, etc.

(iii) Analysis: extracting image features; quantifying shapes and recognition [3].

In the first stage, input is an image scene, and output is a corresponding digital image. In the second stage of processing, both input and output are digital images where the output is an improved version of the input.In the final stage, input is still a digital image but the output is description of the contents. A block diagram of different stages is shown in Figure 1.

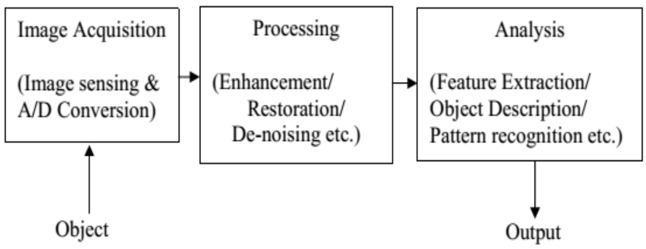

Figure 1.Steps in image processing.

There are numerous specific motivations for image processing but many fall into following two categories: (i) To remove unwanted signals that corrupt the image and (ii). To extract information by rendering it in more useful form. Image de-noising falls into first category and is very important for not only visual enhancement but also to facilitate automatic processing. Digital image enhancement is a field of engineering that studies methods to recover an original scene from degraded observations [1, 3]. Often, the captured image may not be of good quality because of factors such as noise, poor brightness, contrast, blur, or artefacts. Figure.2 shows the block diagram for image degradation and restoration process in which degradation function is noise η(i,j) at the location (i,j) that operates upon image pixel o(i,j) to generate degraded pixel x(i,j).

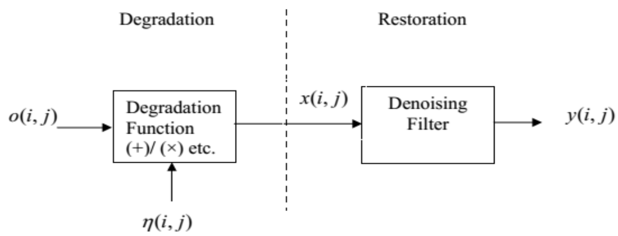

Figure.2: Image degradation and restoration process due to noise only.

The degraded pixel is then processed by a denoising filter to provide an estimate y(i,j) of the original value. In general, the more we know about the degradation functions, the closer will be y (i, j) to o (i, j).

A. Statement of the problem

If the image is degraded only by noise then the restoration can be done by using suitable de-noising algorithm. For this purpose the nature of noise must be known. In an image processing system noise can be divided into three main categories: Gaussian noise (naturally occurring), sensor induced noise (photon counting, speckle etc.) or processing noise (quantization, transmission etc.). Accordingly, the following noise models are used in image processing literature.

(i) Additive, random and independent of image (Amplifier noise).

(ii) Additive, random and dependent on image (Speckle noise).

(iii) Random but not fitting into above two models (Salt & pepper, Random valued impulse noise).

In the present work we focus only on impulse noise removal that fits into third type. Because the performance of the filtering system is primarily governed by the precision with which the system can identify the noisy pixels correctly, the main objective of this work is to develop the impulse noise detectors for fixed valued as well as random valued impulses.

Once the noisy pixel is identified correctly, next goal is to restore its original value. To achieve this objective several algorithms are available for monochrome images which perform satisfactorily. However, for color images most of the algorithms either restore only the intensity or color of the pixel correctly.

To study the existing methods for impulse noise removal including random valued impulse noise, salt and pepper and fixed valued impulses and to analyze their performance and identify the limitations in order to design some new algorithms.

• To develop a suitable method that can effectively detect the presence of fixed valued impulse noise and remove it.

• In case of random valued impulse noise, the difference between the noisy pixels with its neighbors is small due to which noise filtering is difficult. Therefore, the goal is to develop some algorithms which can effectively employ the following strategies to deal with this type of noise.

(i) Widen the gap between pixel under observation and its neighbors.

(ii) Use of neighborhood information extracted in terms of suitable image dependent local features.

• To extend the algorithms developed for impulse detection of monochrome images to color images and further improve their performance by exploiting the correlation among different channels.

• To develop a filter for color images that can correct the noisy components of the color image pixel such that its intensity and color are restored effectively.

II. LITERATURE SURVEY

Several techniques have been proposed over the years for image filtering. Linear filtering techniques have been the methods of choice for many years for their mathematical simplicity and existence of unifying theory for their design and implementation. However, most of these techniques operate assuming a Gaussian model for the statistical characteristics of the underlying process, and thus they try to optimize the parameters of a system suitable for such a model. Classical image filtering techniques are generally based on averaging, transform domain filtering and contrast enhancement, with most of them being linear.

Filters having good edge and image detail preservation properties are highly suitable for image filtering and enhancement. New algorithms and techniques, which can take advantage of the increase in computing power and can handle more realistic assumptions, are needed. Thus, the development of nonlinear filtering techniques, which perform equally well under wide variety of applications, is of great importance.

In Noise adaptive switching median-based filter (NASMBF) method, which is quite similar to the previous methods, first of all a window of size say nxn is considered and all the pixels in this window are considered for local extreme (min or max) values. As we knowthat in a conventional sliding window system every pixel is a part of some window for Nnumber of times, where Nindicates the total number of pixels within the filtering window, therefore, a pixel inthis system, is considered noisy if it appears to be local extremum for Ntimes. For filtering, median ofnoise-free pixels is considered. This method is most suitablefor salt and pepper noise for highly corrupted images.

In Advanced Boundary Discriminative Noise Detection(ABDND)method, by using histogram of the image, the range of grayvalues of noise is estimated. Based on this noise range, a threshold is calculated, which is compared with the absolute difference of the current pixel with the brightest and darkest pixels in the working window, to determine whether the current pixel is corrupted bythe impulse noise. To avoid the false alarm generated in the first stage, the noise candidates are passed through a second stage using local statistics. For restoration of noisy pixel, noise adaptive switching median filter is used.

The techniques for noise filtering in color images can be divided into two classes :

In component wise methods, the three color channels R, G and B are treated independently for filtering of noiseand then they are combined togenerate the filtered color image. Under this category, all the methods discussed so far for the monochrome images can be used for noise removal in color images. The major problem with this approach is that component wise filtering can generate color artefacts.

In vector methods, every color pixel is considered as a vector and the noisy pixel is replaced by a noise-free vector within the filtering window. Because no new colors are introduced into the image, this approach does notgenerate color artefacts.

Impulse detector for color image is similar to that used in scheme with a difference that in case of color images, first of all R, G and B planes are separated and then they are considered as three gray images to detect the locations of noise impulses.

To overcome the above drawback, Spatial Median Filter (SMF) is proposed. In this, image is denoised by using a 3X3 window..

III. PROPOSEDSYSTEM

Our proposed Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) algorithm processes the corrupted images by first detecting the impulse noise and removes accurately withouting loosing valuable data in image. As shown in figure .3 flow diagram will gives overall operation of proposed scheme.,that works well for gray scale as well as video images.

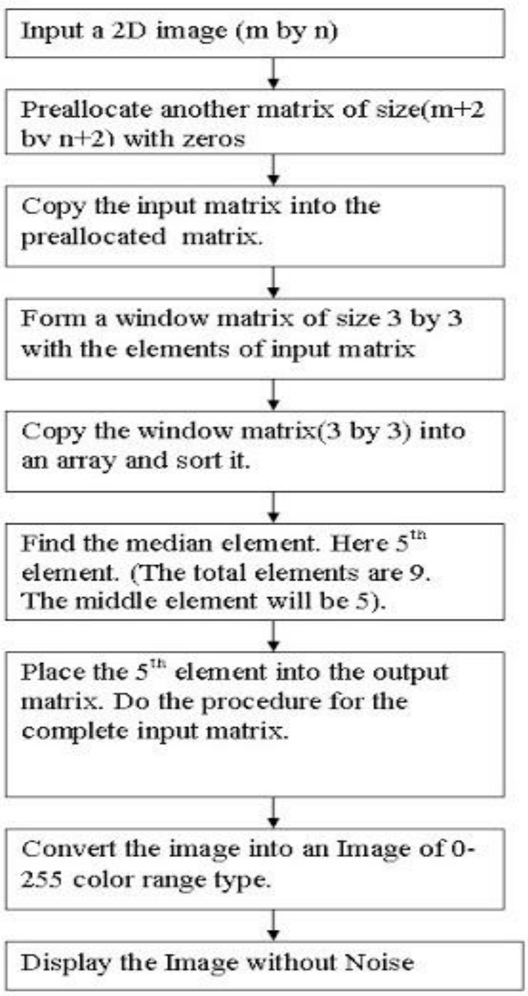

Figure .3 flow digram to remove niose in iimage

As we know that pixel to be processed is in betwwen minimum as well as maximum grey values then it will be treated as noiseless pixel that is not to be altered.Similarly pixel to be processed have maxima or minima grey values ,so to be treated as noisy pixel and to be processed by proposed MDBUTMF that takes following steps:

A. Proposed Algorithm:

Step 1: Intially consider 2D window having size of three by three matrix(3X3) and treated pixel to be processed is P_{ij}.

Step 2: If processed pixel lies between 0 and 255 as mentioned ($0 < \mathbf{P_{ij}} < 255$) then then it is indicated as noiseless pixel and there is no alteration inits value.

Step 3: If we got noisy pixel it takes two cases once again as described below in case i) and case ii)

Case i): We immediately replace pixel to be proceesed P_{ij} with that of calculated mean of element in the window when obtained window consists of all the elements that were present as 0's and 255's.

Case ii): In similar fashion eliminate 0's and 255's and determines the median value of remaining elements and replaces with that when obtained window doesn't consists of elements as 0's and 255's

Step 4: Eventually do ths process fro 1 to 3 so that all the pixels in the image or video frame tobe processed

B. Performance Measures

The following parameters are required to evaluate and also compare resultant images with the proposed algorithm as compared to other algorithms.

Among several error metrics to compare the various image/video filtering techniques like Peak signal to noise ratio (PSNR) Mean square error(MSE).So we shoe mathematical formulae of two are

$$MSE = \frac{1}{MN} \sum_{y=1}^{M} \sum_{x=1}^{N} [I(x,y) - I'(x,y)]^2$$

PSNR = 20 * log10 (255 / sqrt (MSE))

where I(x, y) is the original image, I'(x, y) is the approximated version (which is actually the decompressed image) and M, N are the dimensions of the images. A lesser value of MSE indicates lesser error and inverse to PSNR.Generally higher value of PSNR is the ratio of SNR is high

IV. SIMULATION RESULTS

The performance of the proposed algorithm is tested with different grayscale and color images. The noise density (intensity) is varied from 10% to 90%.

Figure. 4 Input image

As shown in figure 4 a gray scale image is given as input to algorithm .

Figure 5 Noise density

As shown in figure 5 a gray scale image is added with salt and pepper noise or impuse noise.

Figure 5Standard Median Filter (SMD)

Figure 6Traditional median

Figure 7 DBA

Figure 8 *Progressive Switched Median Filter* (PSMF)

Figure 9 MDBUTMF

V. CONCLUSION

In this proposed paper, a new algorithm (MDBUTMF) is proposed which gives better performance in comparison with MF, Mean and other existing noise removal algorithms in terms of PSNR. Also we observed the performance of the algorithm has been tested at low, medium and high noise densities on both gray-scale images and even applied to video and color images. So we observed for high noise density levels the MDBUTMF gives better results in comparison with other existing algorithms. Both visual and quantitative results are demonstrated. The proposed algorithm is effective for salt and pepper noise removal in images at high noise densities.

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