IJETST- Vol.||04||Issue||05||Pages 5176-5179||May||ISSN 2348-9480 2017

Open access Journal International Journal of Emerging Trends in Science and Technology
IC Value: 76.89 (Index Copernicus) Impact Factor: 4.219 **DOI:** https://dx.doi.org/10.18535/ijetst/v4i5.08

Removal of Impulse Noise in Image Using Reduced Simple Edge Preserving Denoising Technique

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Abstract
Images and videos are mostly depraved by salt and pepper noise during the process of signal accession and transmission. Removal of noise is one of the most important issue in image analysis and processing. Even though while removing the noise, we need to preserve the edges. Edge-preserving smoothing smooth away textures and retain the sharp edges. Our proposed work concentrates on an efficient Reduced Simple Edge Preserve De-noising Technique (RSEPD) implementation for removing impulse noise. The space needed for RSEPD is two line buffers rather than a full frame buffer. An efficient de-noising technique is one of the important method for image processing applications. Image de-noising methods have been proposed to carry out the impulse noise suppression. Some of them employ the standard wiener filter or its modifications to implement de-noising process. However these technique might mist the image because both noisy and noise free pixels are modified. Our extensive experimental results show that the proposed work preserves the edge features and obtains excellent performances.
Keywords—*Signal accession, Depraved, Denoising, Line buffer, RSEPD.*

I. Introduction

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an intensified image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Images are mostly corrupted by impulse noise due to the happenings of an error in the noisy sensor and communication channel. Hence, an efficient denoising technique is very important for the image processing applications. The main property of a good image denoising model is, it will remove noise while preserving edges. It is important to eliminate noise in the images before some subsequent processing, such as edge detection, image segmentation and object recognition. In this paper, we are going to analyses the impulse noise. In salt and pepper noise , pixels in the image are very different in color or intensity from their surrounding pixels. The defining characteristics are that the value of a noisy pixel bears no relation to the color of surrounding pixels. Generally this type of noise will only affect a small number of image pixels. When viewed, the image contains dark and white dots, hence the term salt and pepper noise.

II. Existing system

Based on less memory and few operation, a simple edge preserved denoising technique (SEPD) and its VLSI implementation for removing fixed-value impulse noise is proposed. The storage space needed for SEPD is two line buffers rather than a full frame buffer. Only simple arithmetic operations, such as addition and subtraction, are used in SEPD. In SEPD, Assume that the current pixel to be denoised is located at coordinate (i, j) and denoted as Pij, and its luminance values before and after the denoising process are represented as fij and fij ` respectively.

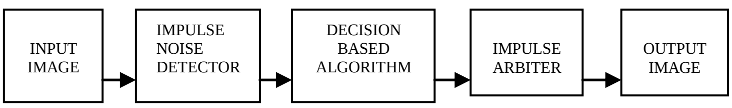

Figure 1. Block Diagram of existing system

A. Impulse Noise Detector

In an image contaminated by random-valued impulse noise, the detection of noisy pixel is more difficult in comparison with fixed valued impulse noise, as the gray value of noisy pixel may not be substantially larger or smaller than those of its neighbors. Due to this reason, the conventional median-based impulse detection methods do not perform well in case of random valued impulse noise. In order to overcome this problem, we use a nonlinear function to transform the pixel values within the filter window W(x) (i, j) in a progressive manner. This operation widens the gap between noisy pixel x (i, j) and the other pixels in the window W(x) (i, j). In the beginning of each iteration, the central pixel x (i, j) of each window is subtracted from all the pixels in the window and normalized absolute differences are obtained.

B. Decision Based Algorithm

In a decision-based algorithm (DBA) is used to remove the corrupted pixel by the median or by its neighboring pixel value according the proposed decisions. The picture quality is determined. The computational complexity is high.

C. Impulse Arbiter

A new impulse noise removal algorithm based on fuzzy impulse detection technique to restore digital images corrupted by impulse noise. The proposed algorithm performs significantly better than many existing algorithms. The low complexity makes it very suitable for hardware implementation.

III. Proposed System

In SEPD, we consider 12 directional dissimilarity to decide the proper edge. When more edges are considered, more difficult computations are required. To further reduce the cost of implementation, we modify SEPD and propose another design, named as reduced SEPD (RSEPD). Only three directional differences are considered in RSEPD. A RSEPD offers slightly lack in image quality but requires much lower cost than SEPD.

A. Sobel Edge Detector

Sobel edge detector performs 2-D spatial gradient measurement on an image. It is used to find the absolute gradient magnitude at each point in an input gray scale image. It consist of a pair of 3x3 convolution covariance mask. Each kernel is rotated by 90 degree. It is similar to Roberts Cross Operator. One mask is estimating in x direction and other in y direction. The main idea is to bring out the horizontal and vertical edges individually and combine them together for the resulting edge detection. The Sobel–Feldman operator is based on convolving the image with a small, separable, and integer-valued filter in the horizontal and vertical directions and is therefore relatively inexpensive in terms of computations. On the other hand, the gradient approximation that it produces is relatively crude, in particular for high-frequency variations in the image.The 2 filters highlights areas of high spatial frequency which defines edges in an image. It is used to bring out the diagonal edges within the image. It smooth the input image to a greater extent. It is less sensitive to noise.

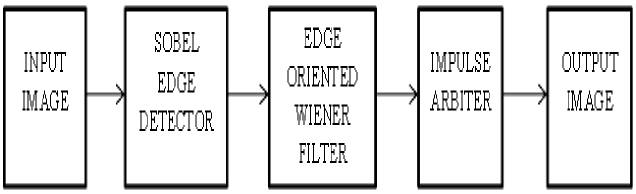

Figure 2. Block Diagram of proposed system

B. Edge Oriented Wiener Filter

To locate the edge existed in the current W, a simple edge catching technique which can be realized easily with VLSI circuit is adopted. To decide the edge, we consider 12

Sectional differences, from D1 to D12. Only those are composed of noise-free pixels are taken into account to avoid possible misdetection. If a bit in B is equal to 1, it means that the pixel related to the binary flag is suspected to be a noisy pixel. Directions passing through the suspected pixels are discarded to reduce misdetection. In each condition, at most four directions are chosen for low-cost hardware implementation. If there appear over four directions, only four of them are chose according to the variation in angle. The mapping table between B and the chosen directions adopted in the design. If pi,j-1 ,pi,j+1, pi+1,j-1,pi+1,jand pi+1,j+1 are all suspected to be noisy pixels (B="11111"), no edge can be processed, so f̂i, j (the estimated value of pi, j)is equal to the weighted average of luminance values of three previously denoised pixels and calculated.

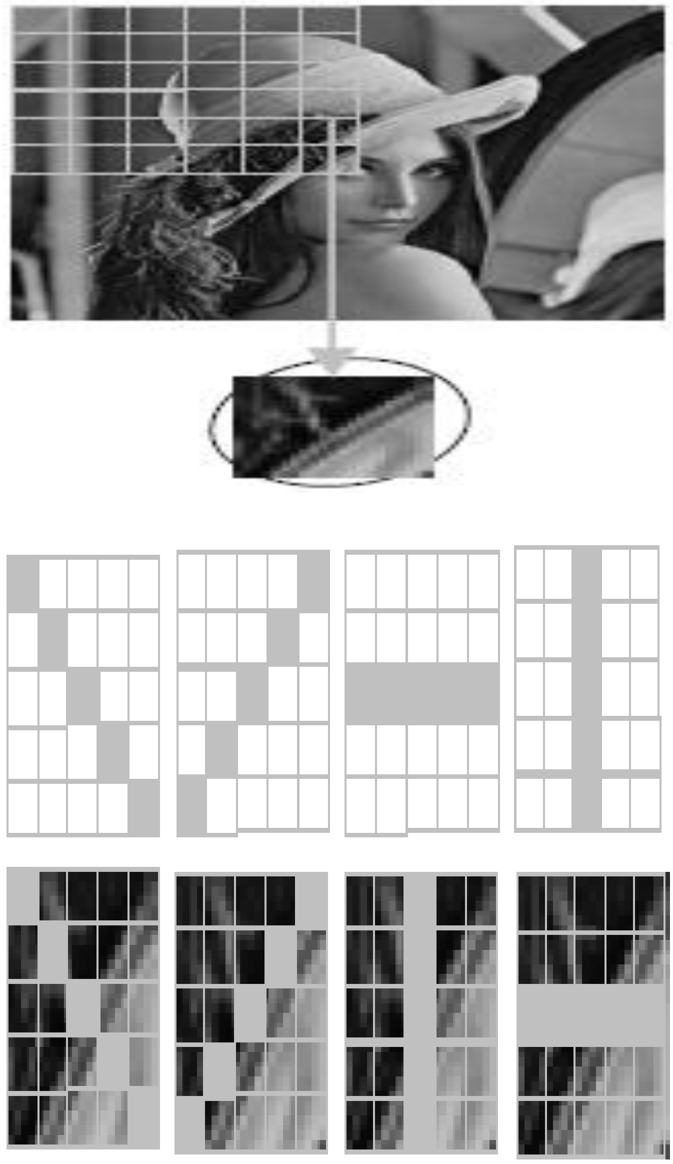

Figure 3. Example for Edge Oriented Wiener Filter

C. Impulse Arbiter

Since the value of a pixel corrupted by the fixed-value impulse noise will jump to be the minimum/maximum value in gray scale, we can conclude that if pi,j is corrupted, f i, j is equal to MIN in W or MAX in W . However, the converse is not true. If fi, j is equal to MIN in W or MAX in W, pi, j, may be corrupted or just in the region with the highest or lowest luminance.

IV. Result Analysis and Comparison

To verify the characteristics and performances of various denoising algorithms, a variety of simulations are carried out on the well-known 256 x 256 8-bit gray-scale Pout image. In the simulations, image is corrupted by impulse noise (salt-and-pepper noise), where "salt" and "pepper" noise are with equal probability. The peak signal to noise ratio (PSNR) is calculated to illustrate the quantitative quality of the reconstructed image. Table I shows PSNR value with impulse noise at various noise densities from 10% to 90% for the reference images. It can be observed from the results that the performances of the images processed by the proposed algorithm are always better.

Table I Comparisons of PSNR of image "Pout"

NOISE DENSITY	DBA	RSEPD
10%	37.1908	46.6015
30%	24.3597	41.0145
50%	15.7468	35.7045
70%	10.4530	30.684

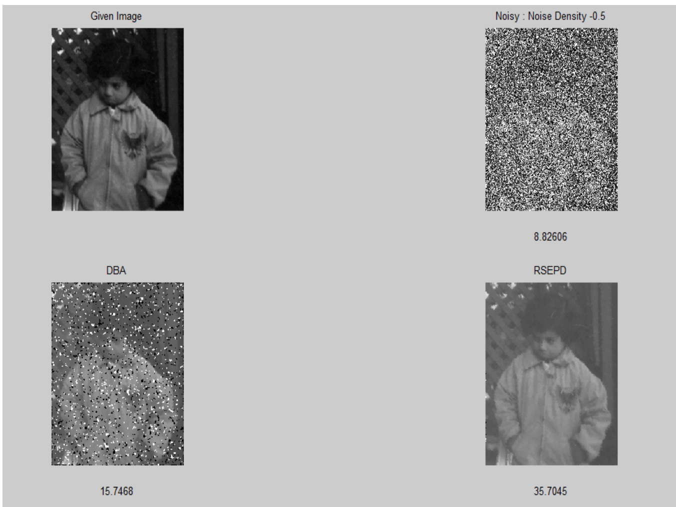

Figure 4. Results of SEPD in MATLAB, (a) Noise-free image; (b)Noisy image; (c) DBA; (d) Edge Preserved output

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