International Conference on Advancements in Computing Technologies - ICACT 2018 ISSN: 2454-4248
Volume: 4 Issue: 2 20 – 24

Impulse Noise Removal Based on Artificial Neural Network Classification with Weighted Median Filter

Deepalakshmi R[1], Sindhuja A[2]

PG Scholar, *Department of Computer Science, Stella Maris College, Chennai, India*[1]

Assistant Professor, *Department of Computer Science, Stella Maris College, Chennai, India*[2]

Abstract: In the challenging area of Digital image processing, the image is degraded by noise, which is caused by sharp and sudden disturbances in the image signal. A large number of image de-noising techniques are proposed to remove noise from the images. The proposed work Artificial Neural Network based Weighted Median Filter (ANNWMF) extracts features from a sliding kernel of the corrupted image. ANNWMF classifies the features into noisy and non-noisy pixels, and adjusts the corrupted and non-corrupted pixels. ANNWMF which is a computational model based on the structure and functions of biological neural networks along with filtering techniques has been observed to lower Mean Square Error (MSE) that increases the peak-signal-to-noise ratio (PSNR) for high density of noise .

Keywords:*Impulse noise, Denoising, Feature Selection, ANN, WMF, ANNWMF.*

*****

I. INTRODUCTION

Removing or reducing impulse noise is a very active research area in image processing. Impulse noise is caused by errors in the data transmission generated in noisy sensors or communication channels, or by errors during the data capture from digital cameras. Noise is usually quantified by the percentage of pixels which are corrupted.To solve this problem many de-noising techniques have been introduced. The main aim of an image de-noising algorithm is to achieve both noisereduction and feature preservation. It is the most important pre-processing step for image analysis. The nature of noise removal depends on the type of noise. There are various types of noise that affects the original image. Salt-and pepper noise are caused by sudden disturbances in the image signal. It is in the form of white and black pixels. ANN is a computational model based on the structure and functions of biological neural networks can perform classification, regression clustering, dimensionality reduction, time-series forecasting, and dynamic system modeling and control. In this paper,extraction of feature is based on sliding kernel of the corrupted image with window size of 3X3.ANNWMF classifies the images in to noisy and non-noisy pixels.

II. LITERATURE SURVEY

A. NOISE ADAPTIVE FUZZY SWITCHING MEDIAN

In this paper, A two stage fuzzy based noise reduction-cum-edge detection filter INAFSM [1] (image & noise adaptive fuzzy switching median) filter for efficient removal of impulse noise from grayscale images. The main objective this paper is to get an actual image from the corrupted image. This also focus on the analysis of fuzzy switching median (FSM), non-adaptive fuzzy switching median filter (NAFSM) and the proposed filter INAFSM is able to suppress very low to very high density of noise from images .

B. MEDIAN FILTER

This paper focused on, Efficient Median Filter (EMF)[2] algorithm for removal or enhancement of gray scale images are highly corrupted impulse noise. Noise in image represent the pixel value 0’s and 255’s that are in black and white dot. EMF take an image and select 3x3 size window and target or center pixel value is 0’s or 255’s then image is corrupted otherwise noise free. Then the image replace pixel value with the median value and if neighboring pixel value is 0’s or 255’s then replace pixel value with the mean value or increased the window size and again repeat this process until image is de-noised. EMF shows better result when compare to other existing algorithms. The simulation result shows better and efficient performance of PSNR and MSE and computation time.

C. SWITCHED MEDIAN FILTER

In this paper, a new method of noise removal technique is applied on images corrupted by impulse noise[3]. This new Adaptive median filter (advantages of AMF) has a good trade-off between quantitative and qualitative properties of the recovered image and the computation time. With the help of AMF the corrupted pixels are replaced by using a median filter or, the values estimated by their neighbor values. AMF shows better results especially in very high density noisy images than Standard Median Filter (SMF), Adaptive Median Filter (AMF). The Experimental results show the superiority of the AMF algorithm in measures of PSNR and SSIM, specifically when the image is corrupted with more than 90% impulse noise.

D. FUZZY LOGIC

A novel method for image de-noising is proposed based on fuzzy logic[4]. Using fuzzy features an algorithm is primed which adaptively removes the impulse noise, this method consist of two parts first detection and removal of noise. Fuzzy reasoning is introduced to determine the type of intensity of noise. Second, noise removal using fuzzy filter the membership functions modeled in the previous part. The algorithm can remove both type of impulse noises such as fixed and random impulse noises. This method has been tested on several standard images and compared with existing-noising algorithms with the help of PSNR and quantitative analysis. This novel method demonstrates its robustness and accuracy under different noise scales.

E. DECISION BASED UNSYMMETRICAL TRIMMED MODIFIED WEIGHTED MEDIAN FILTER

This paper focused on, a Novel Decision based Unsymmetrical Trimmed modified winsorized mean algorithm uses modified winsorized mean [5] rather than conventional median for the restoration of gray scale and color images that are heavily corrupted by salt and pepper noise. The processed pixel is checked for 0 or 255, if examined pixel is equal to 0 or 255, then it is considered as noisy pixel else non-noisy. The noisy pixel is replaced by modified winsorized mean of the unsymmetrical trimmed array. The non-noisy pixel is left unaltered. The DBUTWMF algorithm eliminates the salt and pepper noise by preserving fine details of an image even at high noise densities and also shows excellent results quantitatively and qualitatively when compared to existing and recently filters. DBUTMWM algorithm is tested against different images of varying details, which gives PSNR, Image Enhancement Factor (IEF), Structural Similarity Index Metric (SSIM) and low Mean square error(MSE). The information preserving capability is evaluated using Pratt's FOM, which yielded very good result even at high noise densities.

F. ANN CLASSIFICATIONBASED ON FIZZY FILTER

This paper deals with artificial neural network (ANN)based fuzzy filter for removal of impulse noise from gray images. ANN is used for classification of noisy and non-noisy pixels from the image corrupted by impulse noise[6]. Based on the classification, fuzzy filtering is done to adjust the corrupted and non-corrupted pixels. In this method, feature set comprises of predicted error, absolute difference between the median and processing kernel, pixel under operation and median value within the kernel. It has been observed that this method increases peak-signal-to-noise ratio (PSNR) not only for low density of noise but also for high density of noise. This method maintains structural similarity of the original image from that corrupted one to a great extent. It reduces computation time of the removal process while removing noise from the corrupted image.

III. PROPOSED METHODOLOGY

In this paper ANNWMF is used for classification of noisy and non-noisy pixel form the corrupted image based on this classification weighted median filter is applied by adjusting the pixel (ANNWMF). Selection of feature is most important in machine learning algorithm. It plays the major role in classification and pattern recognition. The feature is selected with sliding kernel values.

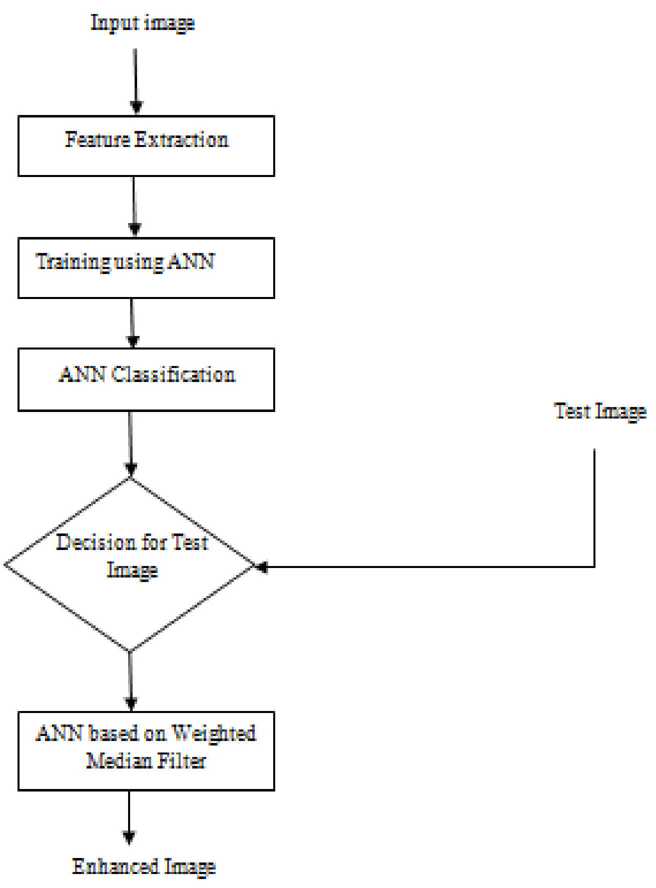

Fig.1.work flow of ANNWMF

International Conference on Advancements in Computing Technologies - ICACT 2018
Volume: 4 Issue: 2
ISSN: 2454-4248
20 – 24

A. Feature Extraction

Feature extraction is based on the sliding kernel value, the sum of the 3X3 is calculated and the difference between the sum and the kernel values aretaken as feature in Table .1,$X_{m,n}$is the center- pixel of (3X3) kernel. Now the value is calculated for each channel individually and value are considered as selected set of feature [6].

$X_{m-1,n-1}$	$X_{m,n-1}$	$X_{m-1,n-1}$
$X_{m-1,n}$	$X_{m,n}$	$X_{m+1,n}$
$X_{m-1,n+1}$	$X_{m-1,n+1}$	$X_{m-1,n+1}$

Table.1.Kernel

a. Feature prediction steps

For vector multiplication row and column must be vector. In addition, the vectors must contain the same number of elements, unless one is a scalar. If row vector,

$$X = [X_1 \quad X_2 \quad \dots \quad X_n],$$

and column vector,

$$X = \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_3 \end{bmatrix}$$

1. Sum is calculated for $X_{m,n}$ by using 3×3 dimension to predict $(P_{m,n})$ the center pixel value for each channel.
2. The sum value is divided by $m \times n$
3. Finding the absolute difference between the median value and the processing pixel . The predicted error is given by

$$e_{m,n} = abs(X_{m,n} - P_{m,n})$$

The predicted error holds important information in case of impulse noise. So, the error will be more, the chanced of computing an image by impulse noise is increased. The next section is followed by ANN Classification

B. Artificial Neural Network Classification

The selected feature of the image is trained with ANN for classification. The ANN[7][8] with hidden layers can model the non-liner behavior present in the pattern. It is motivated by biological nervous system and composed of large number of highly interconnected processing elements called neurons. It takes the inputs and calculate the summation of inputs and compare with the threshold being set during the learning phase.

In Fig.2. a set of input values (x) and associated weights (w) a function (g) that sums the weights and maps the results to an output (y) Neurons are organized into layers input, hidden and output.
The input layer is composed not of full neurons, but rather consists simply of the records values that are inputs to the next layer of neurons. The next layer is the hidden layer. Several hidden layers can exist in one neural network. The final layer is the output layer, where there is one node for each class. During this phase all the pixel are assigned to 0 and 1. For adjusting the weight of the network training is done by back-propagation algorithm it has been seen that 100 epoch are enough for system as Mean Square Error (MSE) between the predicted and the desired output.

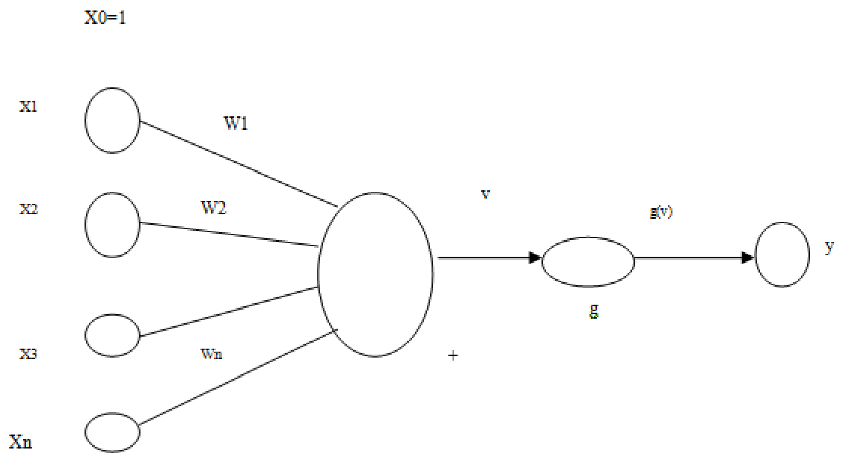

Fig.2. Ann classification

C. Weighted Median Filter

Weighted Median filters are threshold functions allows the use of neural network training methods to obtain adaptive WM filters.A 3X3 weighted mask is taken and placed left corner. After multiplication the pixels are arranged in ascending order then the median is taken among the 9 values. Median is replaced with center. Then the mask is moved throughout the image.

IV. EXPERIMENTAL RESULT

This proposed method has been tested on lena, cameraman, peppers, gold hillhere, the system is trained with different density of noise.The experiment have done when system with trained image corrupted with impulse noise.

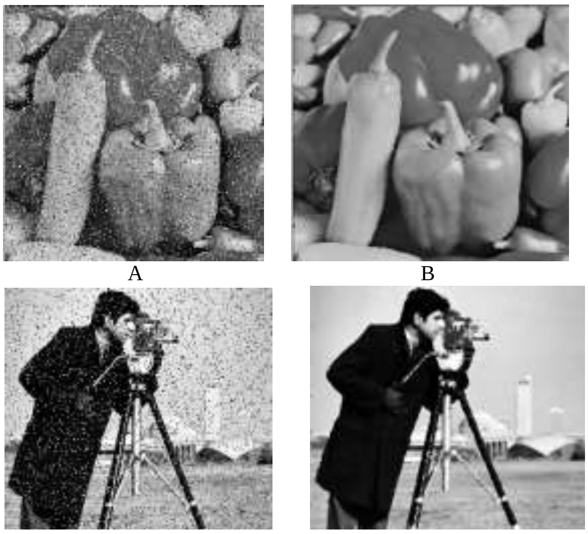

Fig. 3 peppers, cameraman image with 20% of noise density.(A, B, C, D) ANNWMF is applied on peppers, cameraman image with noise density of 20%.Here the results are compared with PSNR and MSE.

A. PSNR and MSE

Peak Signal Noise to Ratio is defined by the power ration between a signal and the background noise. Where p is the average power, both noise and power must be measured at the same point in a system with same bandwidth.
The PSNR is defined as:

$$PSNR = 10log_{10}^{(I^2_{MAX}/_{MSE})}$$

Eqn. (2)

wherel_{max} gives the maximum intensity in the image which is 255 in all cases [6].Where mean square (MSE) is given in Eqn. (3)

$$MSE = \frac{1}{MN}\sum_{p=1}^{M}\sum_{q=1}^{N}(Y_{p,q} - Y_{p,q})^2$$

Eqn. (3)

The original and the noise free images are given by respectively $O_{p,\,r,t}$ and $O^{l}_{p,r,\,t}$ and if the M, N, S give the size of the image i.e. length, width and channels of image.

Images	ANNFF	ANNWMF
Pepper	25.32	28.12
cameraman	21.06	23.30

Table.2.PSNR values for two different images.

Images	ANNFF	ANNWMF
Pepper	8.85	7.01
cameraman	14.93	12.33

Table.3.MSE values for two different images.

V. CONCLUSION

In this work, ANNWMF classifies the image in to noisy and non-noisy pixel which is corrupted by impulse noise. It has been proved that this proposed filter works better for the different set of images corrupted with impulse noise. The comparative analysis shows that the proposed ANNWMF works better than the ANNFF. The exsisting ANNWMF can be further enhanced for better image de-noising. Also, many filter techniques can be introduced to improve the quality of image.

REFERENCES

[1] Ishta, Anuj Goel and Richa Gupta, "Fuzzy Based New Algorithm for Noise Removal and Edge Detection,"International Journal of Advanced Research in Computer Science & Technology, Vol. 2, Issue 2, April - June 2014.

[2] Trapti Soni and Narendra Rathor, "Removal of High Density Impulse Noise using Efficient Median Filter for Digital Image, "InternationalJournalofComputerApplications, Volume 115 – No. 5, April 2015.

[3] A. Jourabloo, A.H. Feghahati and M. Jamzad, "New Algorithms for Recovering Highly Corrupted Images with Impulse Noise,"Computer Science & Engineering and Electrical Engineering, Scientia 19 (6), 1738–1745, July 2012.

[4] H. M. Rehan Afzal, Jun Yu and Yu Kang, "Impulse Noise Removal using Fuzzy Logics,"IEEE, "University of Science and Technology of China"978-1-5386-2901-7/17/, 2017**.**

[5] K. Vasanth, T. G. Manjunathand S. Nirmal Raj, "A Decision based Unsymmetrical Trimmed Modified WinsorizedMean Filter for the Removal of High Density Salt and Pepper Noise in Images and Videos,"ELSEVIER http://creativecommons.org/licenses/by-nc nd/4.0/, 2015.

[6] Amarjit Roy, Salam Shuleenda Devi and R H Laskar, "Impulse Noise Removal from Grayscale Images Based on ANN Classification Based Fuzzy Filter,"IEEE, 2016.

[7] S. Haykin, "Neural Networks: A comprehensive foundation, Prentice-Hall Inc., NJ, 1999.

[8] M. Hagan, M. Beale and H. Demuth, "Neural Network Design," PWS Publishing Company, Boston, MA, 1996.