Impulse Noise Removal Using Soft-computing

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ABSTRACT

Image restoration has become a powerful domain now a days. In numerous real life applications Image restoration is important field because where image quality matters it existed like astronomical imaging, defense application, medical imaging and security systems. In real life applications normally image quality disturbed due to image acquisition problems like satellite system images cannot get statically as source and object both moving so noise occurring. Image restoration process involves to deal with that corrupted image. Degradation model used to trainfiltering techniques for both detection and removal of noise phase. This degeneration is usually the result of excess scar or noise. Standard impulse noise injection techniques are used for standard images. Early noise removal techniques perform better for simple kind of noise but have some deficiencies somewhere in sense of detection or removal process, so our focus is on soft computing techniques non classic algorithmic approach and using (ANN) artificial neural networks. These Fuzzy rules-based techniques performs better than traditional filtering techniques in sense of edge preservation.

KEYWORDS: Image fusion, Multi focus image fusion, Blurring, blurred images, spatial, Convolutional NeuralNetwork, Activity level measurements

1. INTRODUCTION

Image restoration advances the image quality it is a significant era of computer image and image processing that recovers the defective images. The quality of image improves, making it according to the machine learning as well as human perception. Image restoration is a procedure in which we obtain the original image by retrieving the degraded image, and to achieve this purpose our initial scenario approach is applied for enhanced evaluation of image restoration method applied on real-sounding images.

Image restoration is process of restoring a damaged image to its original state by reducing or eliminating its flaws. These flaws might appear during the image's creation, transfer, or interpretation. The out camera, or rotational movement between the subject and the camera, for example, distorts the captured picture; a camera sensor circuit or a communication medium might inject noisy data to the picture; and an artist's rendering can suffer from deformity caused by air disturbance. Many multidimensional real-world problems have been successfully solved using traditional techniques; however, ability to understand a mechanism is designed to solve problems using traditional methods.It is possible to restore images digitally in a broad variety of real-life situations. Most picture restoration techniques are created based on their intended use and the sort of deterioration they are intended to correct. Digital picture restoration is still used extensively in astronomy. Extraterrestrial studies of Earth and planets revealed motion blur produced by lower shutter speeds in relation to spacecraft velocity. Photon-counting statistics involving low-light sources are often cited as the causeof astronomical image degradation issues. Gaussian noise, in addition to the noises described above, is a major noise that is typically caused by electrical Imaging and broadcast systems components transmitting outcomes. Medical imaging has also benefited from image enhancement. In applications where input-output variables do not have precise mathematical relationships, such as hand - written graphics, image processing, learning through observation, autonomous car automatic pilot, machine learning, learning though the experience, and image restoration, their utility is limited by algorithmic constraints. As a result, a non-algorithmic method to dealing with such situations is necessary. Algorithmic programming has been replaced by soft computing/computational intelligence as a subject in engineering. In engineering literature, the words Computational intelligence and soft computing are often used correspondently. Before using any kind of picture restoration approach, it is necessary to model the deterioration, which is usually noise or blur. The majority of real-world scenarios, however, do not provide any information about the degrading system. As a result, with little knowledge about the imaging equipment, we must estimate both the degraded picture attributes and the real image. It is regarded a visual image restoration technique. As an engineering discipline, computational programming has been supplanted by soft computing/computational intelligence. Computing softness and evolutionary computation are mostly used identically in scientific publications.

First, it's important to simulate the degradation, which in most cases involves noise or blur. Most real- world scenarios, on the other hand, don't mention the deteriorating system at any point. So, given little information about the imaging equipment, we must estimate both the deteriorated image characteristics and the true image. In the field of visual picture restoration, it is recognized as amethod.

In addition, there are no precise mathematical connections between inputs variables, as well as uncertainty and imprecision in noise identification and removal. Therefore, soft computing is the ideal approach for Image Restoration by definition. Nearly all disciplines of engineering and computer science have benefited from the use of soft computing approaches. When restoring digital images, evolutionary computation methods are used to identify noisy pixels and to estimate the real value of each pixel based on its damaged form.

Real-life signal generation techniques will never provide perfect signals. There is always some degree of divergence between the produced signals and the original signals. As a result of the signal's variance, it is referred to as noise. A non-modeled event causes noise to appear during the generation and recording of the actual signal. Signals that are not perfect may develop owing to a variety of factors, such as variations in the environment or detector sensibility as well as propagation or quantization mistakes and the discrete character of radiation. etc. Noise caused by channel transmission problems or noisy sensors is called impulse noise. The approaches for image restoration seek to achieve two opposing goals: reducing noise and retaining edge features. For impulse noise reduction, non-linear approaches like the median filter (MF) have a tendency to to be more successful than linear filtering methods. However, it also blurs away fine details and edge information in the process of doing.

2. LITERATURE REVIEW

In this section we review different research article and on that bases we proposed our methodology.

It is possible to remove impulsive noise in a variety of ways, mostly methods use medium filters and adjust the filter according to the scene. Noise detection is also an important step to good noise reduction. The characters are discussed described below papers. There are number of improved restoration approaches have been created in response to new features of picture restoration. They are designed to provide high performance by using dense networks of basic computational components, which are modelled after the biological brain network's synapses with neural network. Restoring high- quality pictures from a damaged recording is regarded an effective use of neural networks by several experts. It is possible to restore an image using neural networks by reducing the cost function. Using neural networks in this fashion, a collection of filters for an image may be implemented. Fuzzy Filter: Impulse noise eliminates by using the new fuzzy directional weight median filter[16]. This approach separates the continuous areas from the edges and applies the median edge axis to the edges in the direction of the minimum directional standard deviation and suffers from noise detection problems with the directional weighted median filter (Kiyani et al.
The latest introduced Adaptive fuzzy rule method for random impulse noise. That technique (Nadeem et al) includes cross windowing concept, using large window with sub-windows decomposing size - quadratic sets, that detect precisely low and highly corrupted images. Reorganization of noisy logic- based noise pixels with efficient search technology provides

improvement in terms of objective measures and visual inspection. For improvement in proposed technique, complexity can be reduced on the other side by emphasizing the RVIN blurred image. A new iterative proposed algorithm for the re-installation of gray-scale images corrupted with random value impulse noise[17]. RVIN has suggested lessons in various directions for detecting malicious pixels. The orientation of the text is determined by employing the minimum distance isometric grid. The most similar three-dimensional pixels get using Fuzzy rules to estimate magnitude of malicious pixels. The proposed algorithm (Marium et al) performance evaluate for low and high intensity of RVIN has been shown both quantitatively and visually in comparison with various sophisticated denoising methods. The drawback of proposed algorithm is highly computational cast because of multiple Iterations.

Isha et al describes the effective fuzzy filter (EFSIN) to suppress impulse noise in images in this paper. First, the impulse noise can be efficiently detected by the proposed algorithm with the use of two- phase fuzzy c -means (FCM). Valid pixels are restored after an unbiased distribution of noise pixels from the edge pixels. Miss detection and False alarm rate slightly increases with increasing noise. This technique does not apply to the restoration of color images [18].

Random value noise remover Adaptive Fuzzy Directional Mean filter (AFIDM) proposed by Habib et al. AFIDM filter builds simulation overcome system for each sliding window by monitoring neighboring directional data. The built-in fuzzy transmission system solves the problem of classification of soft and noise-free pixels over a wide range of areas. Depending on the exact classification of pixels, noise adaptive median based filtering techniques can be applied to degraded pixels, which effectively balance the noise sensitivity and edge protection [19].

Directional Weighted Median Filter based this paper proposes a Four Similar technique (MSN) described which takes first order absolute of the central pixel. In first detection phase, First Order Absolute is taken and sorted values in ascending order. This Paper work on up to 30% noise. Cluster shows that pixel values are same. The threshold parameters are set to compatible. Average fuzzy filter applied to corrupted pixels (Habib et al)[20].

Ayaz et al In this paper, he proposes (DROAD) scheme which partitioned Directional Neighbors into clusters. In this paper Thresholding also performed using Fuzzy logics DROD scheme. Adaptive filtering approach Fuzzy Membership used to restore malicious pixel values. Disrupted pixels are only restored. To avoid blurring effects, sound is restored in a simple area using a smooth center span. The sound is restored in the detail area using a fuzzy based filter. A noise adaptive filter is proposed this technique used homogenous images to check original image pixel values. Thresholding value used which is calculated by mean and median distance and due to adaptive nature window size can changed. To the first stage of detection as a corrupted pixel. On the basis of pixel values calculated by thresholding used to reconstruct the image (Isma et al)[21]. Dang et al In this article, a stage filter is used for S&P noise. The method consists two phases: I) Reduce high-density noise in the middle of the weaker original pixels in first phase, and the second) eliminates the low-density noise at the center of the maximum repetitive pixel value. Fixed value is good for excitation noise, random value is not for impulse noise[22] The drawback of proposed algorithm is highly computational cast because of multiple Iterations describes the effectiveness of non-fuzzy filter to suppress impulse noise in images in this paper. First, the impulse noise can be efficiently detected by the proposed algorithm with the use of two-phase means. Valid pixels are restored after an unbiased distribution of noise pixels from the edge pixels. Miss detection and False alarm rate slightly increases with increasing noise. This technique does not apply to the restoration ofcolor images.

Dante et al proposed a scheme based on nonlinear proposed letters; It has Modified neighbors and nearby neighbors. Redescending M-estimator introduced inside filter. A recursive M-estimator is used to analyze all the neighboring pixels, as well as to reduce the size of the current impulses; The nearest Neighbor get estimate the noiseless pixels. Sudden suppression applied to image use sliding window. The calculation of limit of estimated effect function, which is test in reading M-accelerator.

Singh et al This work proposed noise detect

Algorithm that satisfies detected pixels in images damaged by high-level noise from the images. Neighborhood decision based Impulse noise filter. This is efficiently detecting and removing noise. This is better than a medium filter. However, the raster scanning of the boundary rectangular windows of the algorithm results in a miss-classification of the boundary and the edge-free and non-corrupt pixels. Good for fixed noise not for random noise value.This method uses three steps robust constraints with extra state, which appropriately tells shortcomingsof actual methods, for noise disclosure in contrast less pixels. The noise signature calculate each pixel and the comparison of central pixel with second and third level Threshold, followed by first threshold for detecting noise. Quartile concept is used to understand Standard and Mean deviation. Once detected, a weight average used for damaged image restored[23].

Hassan et al proposed a repeat-based image blasphemy method used for (RVIN) removal from grayscale images. This method adopts switching based scheme that detects noise and restores in second stage by estimating their intensity values. Multitaxon-based noise detection using LS of text formed based on phase radial symmetry is proposed. During the noise recovery phase, very similar pixels can be obtained from four-connected neighboring pixels to compensate for the detected noise pixels. The edge pixels are restored by the slope given by their four interconnected neighboring pixels. That method preserves texture and edges of image in multiple curves of the sliding window due to the texture of the original. Additionally, the threshold selection criteria can be further enhanced so that the edge pixels are better detected to preserve the texture[24].

Ashock et al [25] In this paper, the rank-ordering moderately precise difference and the adaptive window Median filter and Threshold were eliminated to eliminate impulse noise of random values. The algorithm used 3x3 small window. Improved performance of detector for miss rate and inaccuracies using real images. Algorithm performs better in terms of noise removal with better qualititative performance.

Chen et al proposed a positive probability filter that using minimum and maximum intensity values for Salt-papper noise detection. This method check noise intensity probability after certain interval use neighborhood technique and use median filter for low intensity and for high intensity high repetition frequency used. It performs better at high noise density but does not perform well at low noise levels.

Ercan et al gives a new method to overcome the noise using base pixel density filter (BPDF). In first level pixel detected if noisy then determine the optimal window size for which the pixel is centrally accepted. The pixel value that does not have the most repetitive noise in window is set as the new pixel value.

Kumar et al This paper proposed a solution for S&P noise implementing Neighborhood decision based Impulse noise filter. This is efficiently detecting and removing noise. This is better than a medium filter. It has Modified neighbors and nearby neighbors. Redescending estimator introduced inside filter. A recursive estimator is used to analyze all the neighboring pixels, as well as to reduce the size of the current impulses; The nearest Neighbor get estimate the noiseless pixels. Sudden suppression applied to image use sliding window. Sudden suppression applied to image use sliding window. The calculation of limit of estimated effect function, which is test in reading accelerator [26].

Noise detect algorithm that satisfies detected pixels in images damaged by high-level noise from the images. Neighborhood decision based Impulse noise filter. This is efficiently detecting and removing noise. This is better than a medium filter. However, the raster scanning of the boundary rectangular windows of the algorithm results in a miss-classification of the boundary and the edge-free and non- corrupt pixels. Good for fixed noise not for random noise value. This method uses three steps robust constraints with extra state, which appropriately tells shortcomings of actual methods, for noise disclosure in contrast less pixels. The noise signature calculate each pixel and the comparison of central pixel with second and third level Threshold, followed by first threshold for detecting noise. The calculation of limit of estimated effect function, which is test in reading accelerator.

Singh et al This work proposed noise detect Algorithm that satisfies detected pixels in images damaged by high-level noise from the images. However, the raster scanning of the boundary rectangular windows of the algorithm results in a miss-classification of the boundary and the edge-free and non- corrupt pixels. Good for fixed noise not for random noise value.Zhang et al proposed pre-detection, the adaptive average design letter is generated, which determines the estimated window noise and the window size of the letters .

corresponding to the level of local corruption. BBA generation method used to handle uncertainty and noise detection performs betters.

Research Paper	Image Type	PSNR	SSIM
"Salt and Pepper noise remove using Extended Median Filter"	Peppers Boats Mandrill House	31 26.85 26.78 28.05	N/A
"Pixon-based Segmentation and Adaptive Median Filter for Salt and Pepper noise"	Lena Bridge	28.64 26.23	0.85 0.94
"Using Adaptive Median Filter and Local Pixel Distribution for Salt and Pepper Noise"	Lena	29.02	
"A Fuzzy Directional Median Filter for Fixed-value Impulse Noise Removal"	At 5% noise Lena Peppers Cameraman		
"Adaptive Edge Preserving Weighted Mean Filter for Removing Random-Valued Impulse Noise"	Lena Peppers Bridge Boat	28.03 26.62 21.75 24.87	
"Quantized Adaptive Switching Median Filter for Impulse Noise Reduction"	Aerial Sail boat on lake Male		0.845 0.843 0.8399
"Adaptive Sequentially Weighted Median Filter for Image Highly Corrupted by Impulse Noise"	Lena Mandrill Man	32.3 28.7 30.5	0.974 0.9545 0.7
"Edge Preserving Fuzzy Filter for Suppression of Impulse Noise in Images"	Lena Mandrill Cameraman	36.66 35.18 37.81	0.8991 0.8910 0.8981
"A Two Stage Filter for removing Salt and Pepper Noise"	Lena Boat Zelda	32.13 28.99 36.28	0.95 0.97 0.9858
"Adaptive Right Median Filter for Salt-and-Pepper Noise Removal"	Lena Cameraman Baboon	30.62 29.55 26.17	0.8991 0.9345 0.8315
"Triple Threshold Statistical Detection filter for removing RVI"	Lena Boat Cameraman	33.18 33.02 33.23	0.65 0.658 0.63
"A new Adaptive Switching Median Filter for Impulse Noise"	Lena Baboon Cameraman	34.1 24.99 23.5	0.754 0.786 0.58
"Neighborhood Decision based Impulse Noise Filter"	Lena Baboon Flower Fish	52.4 35.7 45.96 49.22	

TABLE I. COMPARISON OF Related work TECHNIQUE

3. PROPOSED METHODOLOGY

We analyzed many kinds of filters at different Noise scale performs well in specific scenarios but overall, somewhere deficient. So, we will using evolutionary algorithm and artificial neural networks to noise detection phase and adaptive filtering technique for noise redemption.

Our proposed technique consisting average filter and median filter to remove salt and pepper noise. First we take a 8-bits grey scale image then add 40% impulse noise on this image randomly.

Noise caused by channel transmission problems or noisy detectors is called impulse noise. In order to remove noise and preserve edge features, picture restoration methods must achieve two opposing goals simultaneously. For impulse noise reduction, non-linear approaches like the median filter tend to shows better than conventional filtering methods. However, it also blurs away essential features and information about edges in the process of doing so.

In this chapter, a new approach for minimizing noisy pixels based on the fuzzy logic and ordered statistic is presented. Fuzzy membership functions with trapezoidal shapes are formed using the median in the following manner. These functions play an important role in noise reduction and detail retention. When the given window contains over than 50 percent corrupted data (a robust estimator), since may estimate distribution variance with high accuracy. To make the fuzzified normal distribution more resistant against noise, we can use this to identify homogeneous pixels in the examined window. This will help us estimate the number of damaged pixels in a more accurate manner.

The technique's major contributions include the following:

We can properly estimate the distributed variance using robust accuracy of data, even if the imageis contaminated with over than 50% noise.

To make the fuzzy sets function homogeneous more resistant against noise, the covariance estimate is then applied to it.

Well-known approaches for removing impulsive noise are outperformed by fuzzy sets createdusing statistics estimation technique.

We already discussed above there are two types of Impulse noise i.e.

Salt & peppers impulse noise (S & P)

Random-value impulse noise (RVIN)

Randomly chosen pixels in the salt and peppers noise model are assigned a minimum or maximum pixel values. This is the most widely used model of noise removal, while being quite basic. Random- valued impulse noise models on the other side, allow pixels to experience any value within the permissible frequent range. In comparison to random-valued impulse noise salt and pepper noise iseasy to identify and eliminate. 8-bit grayscale pictures are subjected to random-valued and mixed impulse noise (salt & pepper and random-valued impulse noise). For the original and noisy images, let the pixels at positions (a, b) be Y(i,j) and x(a, b) correspondingly.

Where η (a,b) shows noisy pixel at point (a,b) . The values of noisy pixel may be lie between 0 and

255. The proposed technique removes mixed impulse noise more effectively.

It is proposed to use noise detection and fuzzy homogeneity-based noise reduction techniques for impulse noise filtering. It consists of two subunits that define corrupted impulse noise pixels. To determine whether a pixel may be called impulse noise, the first component analyses its immediate surroundings. To assess the degree to which a pixel may be classified as impulse noise, the secondsubunit employs fuzzy gradation values.

Consider Y(i, j) as observed pixel at point (a,b) to check that pixel is noisy or not we take the 3x3 , 5x5 and 7x7 window size centered around position (a,b) and then calculate the mean differences between neighborhood pixels selected on the basis of window size and centered point. Corrupted pixels show large difference between centered pixel and neighborhood pixels but it may be an edge pixel to ensure that this pixel is corrupted pixel not edge pixel we apply Fuzzy rules based scheme. At this stage that pixels show large differences may be noisy or edge pixels are considered as centered pixel and calculate the difference between neighborhood pixels selected on the basis of window size and new centered point if the neighborhood pixels are similar to the new centered point then it is considered as edge pixel otherwise it is considered noise.

Here Y (i,j) is selected center pixel, where k and l represents the size of window which is adaptively selected 3x3 , 5x5 and 7x7. Z (i,j) represents the

$$A(i,j) = Median\ (Y(i+k, j+l))$$

weights assigned to neighborhood pixels of center observed pixel. Those pixels which are homogeneous means similar to the center pixel are assigned more weights based on the Fuzzy rules and the others neighborhood pixels are non-homogeneous mean not similar with center pixel given less weights based on Fuzzy rules. In this

$$A(i,j) = Median$$

Fuzzy membership function edge pixels are also assigned higher weights because the are homogeneous to their neighborhood pixels. Hence this technique performs better than median filtering techniques because it is not only well performed in condition of similar neighborhood pixels but also in situation where non-homogeneous pixels are available. This technique also preserved edges and not smooth regions during perform filtering)
Four parameters are used to calculate Fuzzy membership function values. Pixels having value between membership function are assigned value 1 and pixels are dissimilar means non-homogeneous are assigned value 0 mean no weights, therefore in our technique noisy pixels never contribute in filtering method. For defining parameters:
In first step calculate the median of selected window.
In second step find the difference between this median value and neighborhood values in that selected window In third step find the average of these pixel values gained after second step

The following equations shows the final resultant parameters.

$$X(i,j) = (1 - Z(i,j)) \frac{\sum_{k=-3}^{3} \sum_{l=-3}^{3} Y(i+k, j+l) Z(i+k, j+l)}{\sum_{k=-3}^{3} \sum_{l=-3}^{3} Z(i+l, j+k)} + Z(i,j) Y(i,j).$$

$$m = A(i,j) + MAD\ \{Y(i,j)\}$$
$$n = A(i,j) + 1.1MAD\ \{Y(i,j)\}$$
$$o = A(i,j) + MAD\ \{Y(i,j)\}$$
$$p = A(i,j) + 1.1MAD\ \{Y(i,j)\}$$

3.1 Pseudo Algorithm

Step 1: Select a degraded image.

Step2: Take adaptive size window.

Step3: Construct Fuzzy rules.

Step4: Compute absolute median deviation.

Step5: Classify pixels as noisy and non-noisy.

Step6: Weighted pixels on the basis of noisy and non-noisy.
Step7: Restore Image

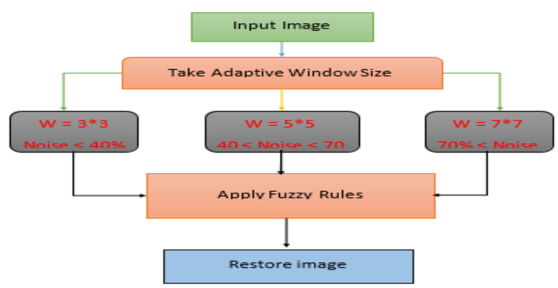


Fig. 1. Graphical Representation of Proposed System

3.2 Fuzzy rules

▶ Rule for Non-noisy pixel

▶ If (ΔX (i.j) is large) AND (Δ'X (i,j) is large) and (Δ''X (i,j) is large) OR
(ΔX (i.j) is not large) AND (Δ'X (i,j) is not large) and (Δ''X (i,j) is not large)

▶ Rule for Noisy pixel

▶ If (ΔX (i.j) is large) AND (Δ'X (i,j) is not large) and (Δ''X (i,j) is not large) OR

▶ If (ΔX (i.j) is large) AND (Δ'X (i,j) is large) and (Δ''X (i,j) is not large) OR

▶ If (ΔX (i.j) is large) AND (Δ'X (i,j) is not large) and (Δ''X (i,j) is large) OR

▶ If (ΔX (i.j) is not large) AND (Δ'X (i,j) is large)

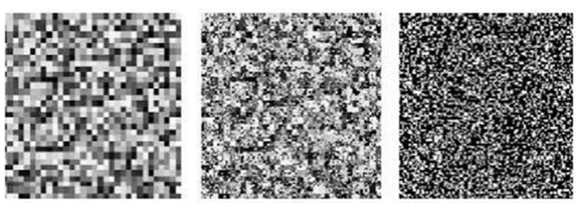
and (Δ’’X (i,j) is large)
Here ΔX (i.j) is target pixel while Δ’X (i,j) and Δ’’X(i,j) are right angle neighborhood pixels

3.3 Implementation of proposed fuzzy homogeneity-based noise reduction technique (FHNR)

This proposed solution is implemented on MATLAB. For implementation first we create dataset then load and apply verification method to detect noisy and non-noisy. To perform we do some steps

3.4 Dataset Preparation

Figure 3.5 (a) A 320x320 pixels image is selected as for reference training image. This image consists of square boxes and bright, very bright, dark, very dark and gray values present in every square box. These pixel values chosen randomly lies between [0,255].
50% Salt and pepper impulse noise added on training image and resultant image shown in Figure 3.5 (b). This noise added uniformly through all square boxes.



(a) (b) (c)

Figure3.4 (a) is reference training image. (b) is noisy image. (c) is resultant image

Figure 3.4 (c) is our resultant image for testing our framework. We chose random salt and pepper noise values that performs batter and accurate results in context of training classifier. These random values help in train classifier more than fixed value impulse noise to deal with noise detection. Take adaptive size NxN window 3x3, 5x5, 7x7 and 9x9, then add variable noise ratio from 10% to 90% salt and pepper noise to trained image. In all above 3 cases feature are extracted and combined to train classifier for each window size. Machine Learning methods are then trained using the feature vector and class of the full training image with salt & pepper noise.

3.5 Training Classifiers

Every NxN window's feature extraction, as mentioned in the preceding noise detector, is computed, and is labelled 0 as non-noisy and 1as noisy. Trained data is calculated using feature vectors of the entire trained image, which are labelled.
Decision Tree based classifier 4.5,Naive Bayes and Neural Networks are the machine learning approach used for detection of noise. These classifiers perform better according to scenario. In our scenario decision tree C4.5 performs better give low miss and false detection rate as compared to other classifiers which are trained and saved as model to test the data. After testing the classifier selected asnoise detector make set of rules use for this model. After setting the rules which are simple if-then- else rules, which are easy to use and simple to apply, then this classifier applies on testing image. These images are shown below.

In Figure 3.5 (a)(b)(c)(d)(e) all are testing images

These standard images are used as test images figure 4.3 (a) cameraman (b) house (c) lena 256x256 (d) lena 512x512 (e) lake take as test images we applied 40% to 50% noise and then applied trained classifier to detect noise.

3.6 Read Dataset

We'll use 'imread function' to read all of the concatenated pictures and then load them. After that, we use the'reshape function' to transform the pictures into a single column matrix, and then we use the'size function' to determine the size of the images' rows and columns. We use the 'uint8' function to convert pictures into 8bit unsigned integers to save memory. The final step is to set the loaded variable to 1 since we don't want any more datasets to load and we don't want the function to load dataset, so we set loaded=1. The graphical representation of the system's operation is shown below.

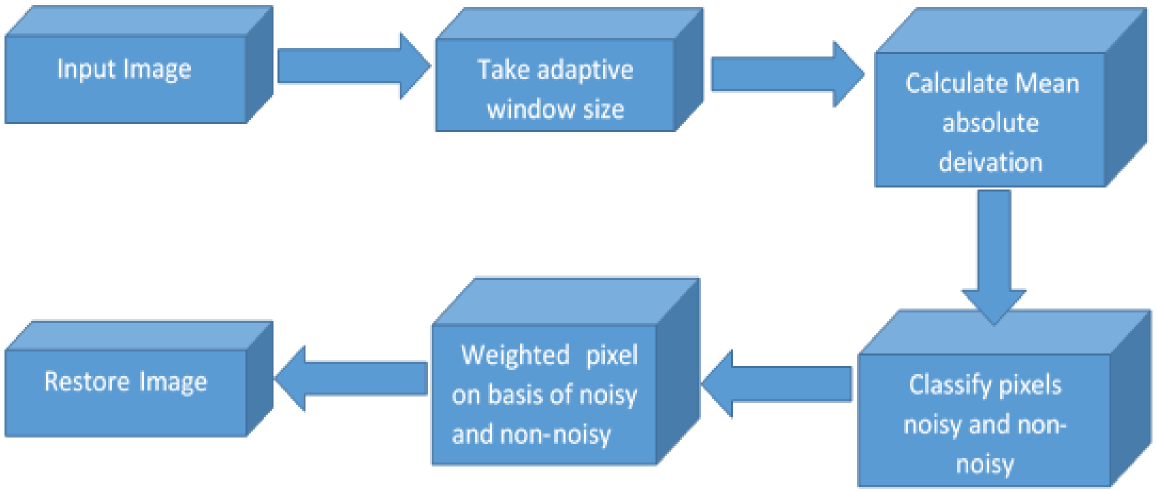


Fig 3.6 is flow diagram of proposed system

4. EVALUATE THE RESULTS

The multiple outputs of the proposed Multi focus image fusion methodology are discussed in this section. We assess the suggested system's results based on the implementation. In four phases, the proposed system is implemented and validated. To begin we use a data set produced from the ImageNet data set to train the CNN. The second step is to divide the source pictures into patches. Each pair of source image patches is merged and sent to the expert CNN to obtain the clarity score which is used to assess patch clarity. Finally based on the clarity scores of each patch, an initial clarity map is created. Finally the clarity map is treated by using a small region approach and morphological opening operation to rectify certain incorrectly categorized pixels. The final clarity map is used to rebuild the fusion image.

4.1 Result and Discussions

Propose filtering method based on homogeneous and non-homogeneous develop on the basis of fuzzy member-ship function. Median absolute deviation is used to calculate the parameters. Those pixels which are homogeneous means similar to the center pixel are assigned more weights based on the Fuzzy rules and the others neighborhood pixels are non-homogeneous mean not similar with center pixel given less weights based on Fuzzy rules. In this Fuzzy membership function edge pixels are also assigned higher weights because there are homogeneous to their neighborhood pixels. Hence this technique performs better than median filtering techniques because it is not only well performed in condition of similar neighborhood pixels but also in situation where non-homogeneous pixels are available. This technique also preserved edges and not smooth regions during perform filtering.

Four parameters are used to calculate Fuzzy membership function values. Pixels having value between membership function are assigned value 1 and pixels are dissimilar means non-homogeneous are assigned value 0 mean no weights, therefore in our technique noisy pixels never contribute in filtering method. Corrupted pixels show large difference between centered pixel and neighborhood pixels but it may be an edge pixel to ensure that this pixel is corrupted pixel not edge pixel we apply Fuzzy rules-based scheme.

At this stage that pixels show large differences may be noisy or edge pixels are considered as centered pixel and calculate the difference between neighborhood pixels selected on the basis of window size and new centered point if the neighborhood pixels are similar to the new centered point then it is considered as edge pixel otherwise it is considered noise.

Fig 4.1 (a) original image (b) noisy image (c) DWM filter result (d) FRINRM technique result (e) HFF resultant image (f) NFF resultant image (g) Nemanja's technique result (h) Median filter3x3 result (i) Proposed technique resultant image

In above figure 512x512 Lena image is degraded with 50% impulse noise and apply noise removal technique discussed in above section hence results shows that this technique performs better. At below section table shows that based on PSNR.

Image	**Techniques**	**Noise Density**				
		0.50	**0.55**	**0.60**	**0.65**	**0.70**
Lena	**DWM**	28.98	27.80	26.41	24.49	**22.60**
	FRINRM	27.99	26.49	24.51	22.47	19.61
	FIDRM	21.91	19.90	18.01	16.49	14.97
	Nemanja's tech.	26.29	24.79	23.40	21.88	19.88
	HFF	19.49	18.70	18.01	17.20	16.49
	NFF	16.80	16.11	15.48	14.88	14.47
	Ch 3	29.00	27.81	26.41	24.50	22.60
	MED3x3	21.61	20.09	18.99	17.79	16.69
	Proposed tech.	**29.08**	**27.86**	**26.42**	**24.89**	22.46
Peppers	**DWM**	28.87	27.29	25.60	23.61	21.29
	FRINRM	27.98	26.31	23.49	21.31	18.39
	FIDRM	20.99	18.88	17.29	15.69	14.51
	Nemanja's tech.	25.50	24.09	22.39	20.38	19.01
	HFF	18.70	17.90	16.99	16.29	15.71
	NFF	15.79	15.19	14.79	14.31	13.88
	Ch 3	28.90	27.81	25.71	23.70	22.60
	MED3x3	20.79	19.40	17.99	17.01	15.87
	Proposed tech.	**28.97**	**28.26**	**26.46**	**24.68**	**21.76**

Table 4.1: Noise filtering results of different techniques based on PSNR for random valuedimpulse noise

As a result, detail integrity and noise reduction are viewed as competing goals. Noise reduction in grayscale pictures can smoother the image, while increasing detail information might add noise. As a result, most noise reduction filters do not maintain image information like texture features and fine lines.

We have thus additionally tested the filter's efficiency using SSIM, a local statistical metric. Our technique's ability to preserve information on different test pictures based on SSIM. We find that our methodology preserves more information than well-known noise reduction methods, especially when noise rate is too high. The suggested approach, on the other hand, performs just as well at low noise levels as the other strategies.

Image	Noise density									
	Techniques		10%	20%	30%	40%	50%	60%	70%	80%
Lena 512x512	DWM	SSIM	0.476	0.481	0.384	0.542	0.570	0.775	0.446	0.394
		PSNR	24.51	24.27	25.14	27.75	28.33	25.77	24.07	23.96
	FRIDM	SSIM	0.482	0.485	0.387	0.551	0.596	0.783	0.463	0.396
		PSNR	24.52	24.27	25.15	27.76	28.33	25.78	24.08	23.97
	Proposed	SSIM	0.501	0.492	0.388	0.558	0.598	0.942	0.468	0.412
		PSNR	24.61	24.38	25.17	27.79	28.45	25.94	24.24	24.43
Lena 256x256	DWM	SSIM	0.353	0.3481	0.4384	0.542	0.5170	0.3975	0.3046	0.323
		PSNR	23.51	24.61	25.2814	27.75	25.02	24.59	23.1307	22.44
	FRIDM	SSIM	0.355	0.3485	0.4387	0.551	0.5196	0.3983	0.3063	0.325
		PSNR	23.52	24.62	25.315	27.76	25.96	24.60	23.1508	22.45
	Proposed	SSIM	0.3552	0.3492	0.4388	0.558	0.5298	0.402	0.3168	0.356
		PSNR	23.53	24.63	25.317	27.79	26.97	24.71	23.3724	22.80

Table 4.2 is results of proposed technique comparison with two different techniques on the basis of PSNR and SSIM at different noise levels using Lena images

Above resultant table shows our proposed Fuzzy based Homogeneous Neighborhood noise reduction technique compare with two different techniques Directional Weighted Median filter and Fuzzy Random Impulse Noise Directional Median filter using 256x256 and 512x512 Lena images.

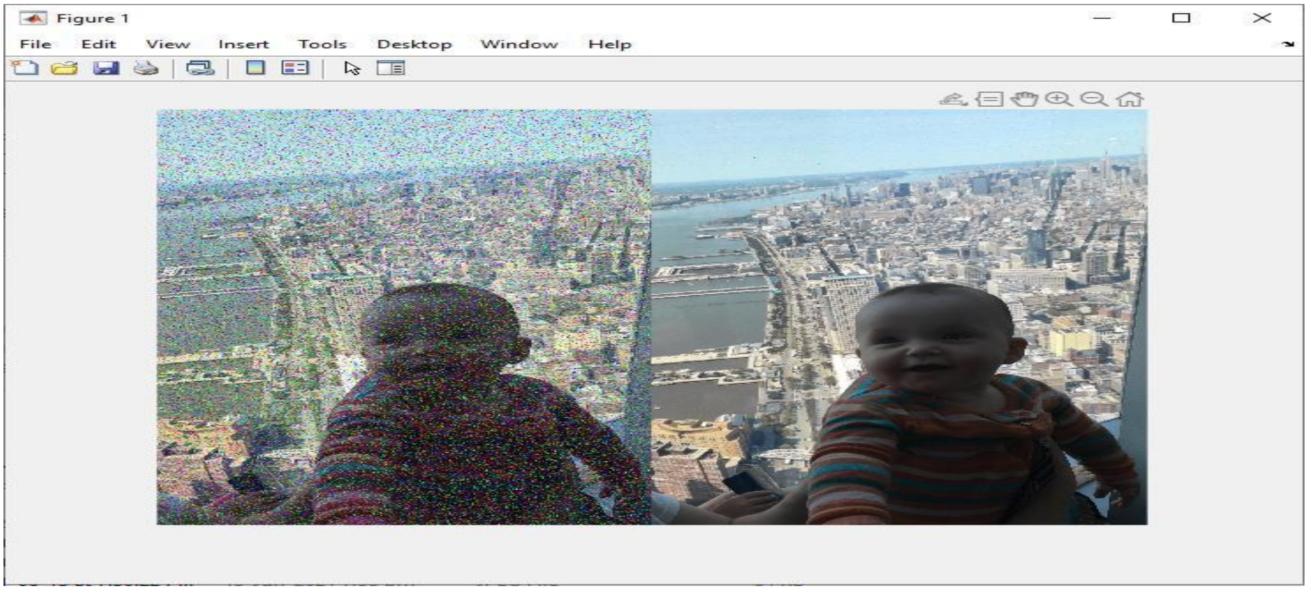


Figure 4.2 with 40% Noise and resultant image

Above figure 4.2 shows that 40% random value impulse noise is added on this image and then applying Fuzzy filter using fuzzy rules Mean absolute deviation.

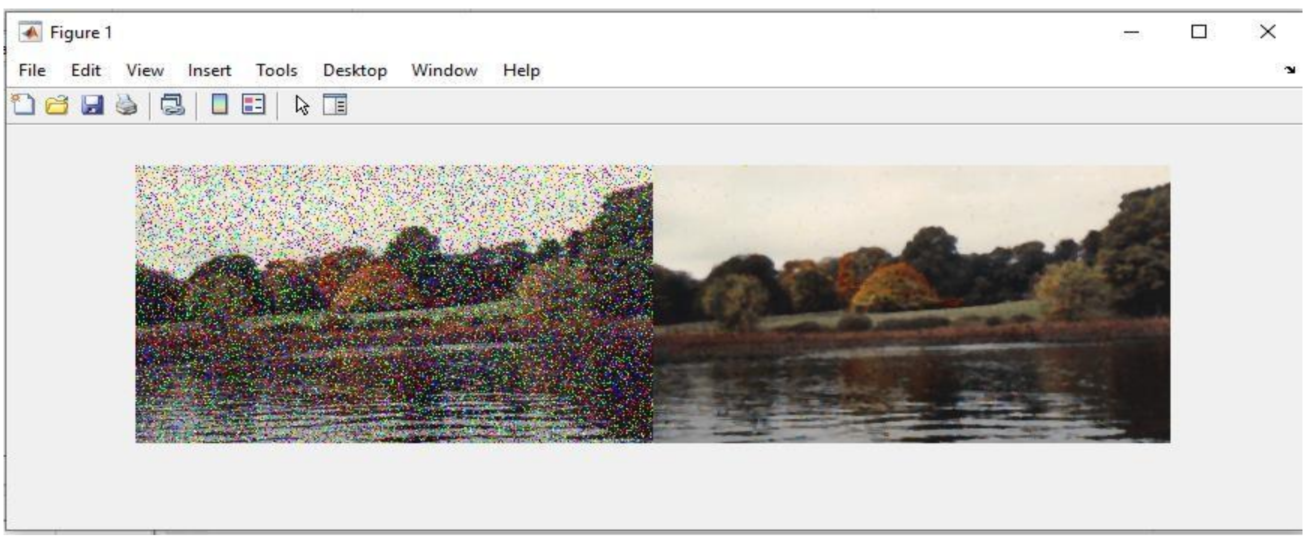


Figure 4.3 with 40% Noise and resultant image

Above figure 4.3 shows that 40% random value impulse noise is added on this image and then applying Fuzzy filter using fuzzy rules Mean absolute deviation. An adaptive window size Medianfilter is used Window size (3x3) for less than 50% noise and window size (5x5) for less than 70% and above 50% noise and window size (7x7) for more than 70% noise and results shows that noiseremoved successfully.

Figure 4.4 with 40% Noise and resultant image

Above figure shows that 40% random value impulse noise is added on this image and then applying Fuzzy filter using fuzzy rules Mean absolute deviation. An adaptive window size Median filter is used Window size (3x3) for less than 50% noise and window size (5x5) for less than 70% and above

50% noise and window size (7x7) for more than 70% noise and results shows that noise removedsuccessfully.

Figure 4.5 with 50% Noise and resultant image

Above figure shows that 50% random value impulse noise is added on this image and then applying Fuzzy filter using fuzzy rules Mean absolute deviation. An adaptive window size Median filter is used Window size (3x3) for less than 50% noise and window size (5x5) for less than 70% and above50% noise and window size (7x7) for more than 70% noise and results shows that noise removed successfully.

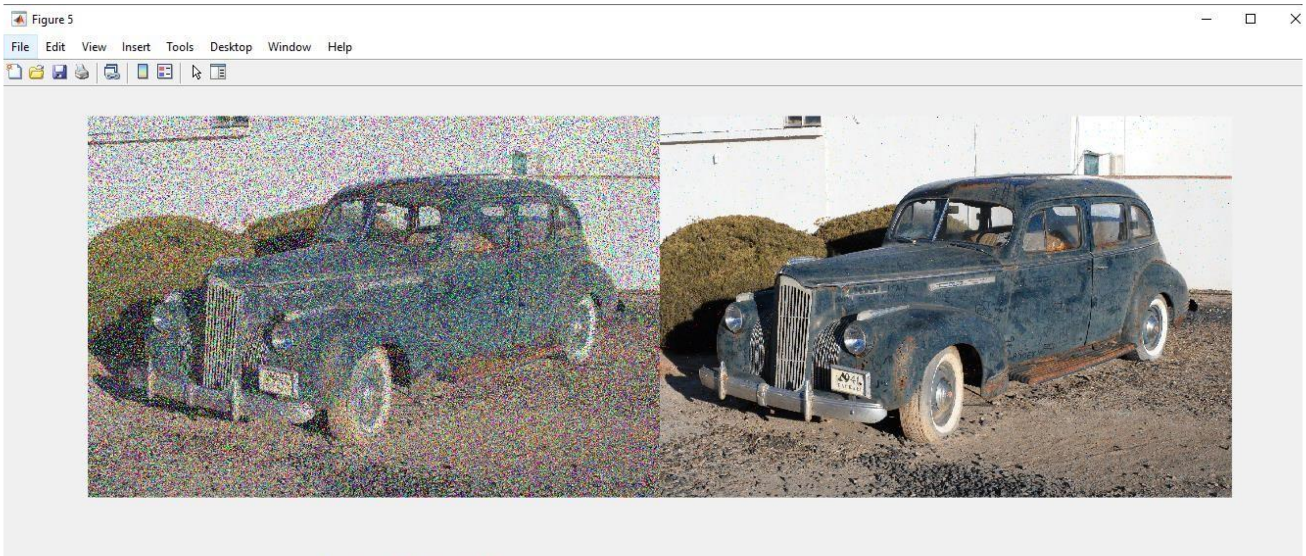


Figure 4.6 with 60% Noise and resultant image

Above figure 4.6 shows that 60% random value impulse noise is added on this image and then applying Fuzzy filter using fuzzy rules Mean absolute deviation.

An adaptive window size Median filter is used Window size (3x3) for less than 50% noise and window size (5x5) for less than 70% and above 50% noise and window size (7x7) for more than 70% noise and results shows that noise removed successfully.

5. CONCLUSION AND FUTURE WORK

The proposed technique based on fuzzy rules performs better in both fixed value impulse noise and Random value impulse noise also although it is difficult to detect and reduce RVIN as compared to fixed salt and pepper noise. Our proposed method consist on Fuzzy rules based technique. The filtering method based on homogeneous and non-homogeneous develop on the basis of fuzzy member-ship function. Median absolute deviation is used to calculate the parameters. Those pixels which are homogeneous means similar to the center pixel are assigned more weights based on the Fuzzy rules and the others neighborhood pixels are non-homogeneous mean not similar with center pixel given less weights based on Fuzzy rules. In this Fuzzy membership function edge pixels are also assigned higher weights because these are homogeneous to their neighborhood pixels. Hence this technique performs better than median filtering techniques because it is not only well performed in condition ofsimilar neighborhood pixels but also in situation where non-homogeneous pixels are available. Fuzzy membership functions with trapezoidal shapes are formed using the median in the following manner. These functions play an important role in noise reduction and detail retention. When the givenwindow contains over than 50 percent corrupted data (a robust estimator), Since may estimate distribution variance with high accuracy. For environment images, this method works well, but its effectiveness suffers in medical images.

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