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Image De-Noising By Fuzzy, DBMF and Bilateral Filters

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ABSTRACT: Within the digital image processing, it is very difficult to determine which noise is present in an image as well as removal of noise. In this paper make use of various efficient filters as the proposed filters such as fuzzy-mean-median filter, alpha trimmed decision based median filter improves the quality of images. These proposed filters can easily remove Gaussian noise, salt and pepper noise and also mixed noise i.e. (Gaussian noise and salt and pepper). Various results of the proposed work are obtained by using parameters such as peak signal to noise ratio (PSNR), mean square error (MSE) and root mean square error (RMSE) which shows better performance.

KEYWORDS: Gaussian noise, impulse noise, Fuzzy-mean-median filter, Alpha trimmed decision based median filter, improved bilateral filter.

I. INTRODUCTION

The noise is the undesirable effects manufactured in the image. During image acquisition or transmission, several factors are responsible for introducing noise in the image. Depending on the sort of disturbance, the noise can affect the image in order to different extent. Generally our focus is usually to remove certain style of noise. So we identify certain style of noise and utilize different algorithms to clear out the noise. Image noise is usually classified as Behavioral instinct noise (Salt-and-pepper noise), Amplifier disturbance (Gaussian noise), Picture noise, Quantization disturbance (uniform noise), Picture grain, on-isotropic disturbance, Multiplicative noise (Speckle noise) and Periodic noise.

A. Impulse Noise (Salt and Pepper Noise)

The term impulse noise is also used for such a noise. Different terms are surge noise, random noise or independent noise. Black and white dots come in the image caused by this noise and as such salt and spice up noise. This noise arises within the image because of sharp and abrupt changes of graphic signal. Dust particles within the image acquisition source or higher heated faulty components can cause such a noise. Image is corrupted to a small extent because of noise. The impulse noise have two gray values: 0 represents white and 1 represents black for 8 bits gray image.

B. Gaussian Noise (Amplifier Noise)

The term normal noise model will be the synonym of Gaussian disturbance. This noise style is additive with nature along with follow Gaussian syndication. Meaning that each pixel within the noisy image is the sum of the true pixel value and also a random, Gaussian spread noise value. This noise is independent of intensity regarding pixel value in each point. The Gaussian noise can be quite common type regarding noise.

C. Poisson Noise (Photon Noise)

Poisson or perhaps shot photon noise will be the noise that could cause, when number associated with photons sensed because of the sensor is not sufficient to deliver detectable statistical info. This noise possesses root mean rectangular value proportional to help square root intensity of the image. Different pixels are generally suffered by self-

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sufficient noise values. At practical argument the photon noise along with other sensor based noise corrupt the indication at different proportions.

D. Speckle Noise

This noise deteriorates the caliber of active radar and also Synthetic aperture radar (SAR) pictures. This noise is originated due to coherent processing associated with back scattered alerts from multiple distributed points. In conventional radar system such a noise is noticed if the returned signal from the object having size lower than or equal to a single image control unit, shows immediate fluctuations. Mean filters are good for Gaussian noise and also uniform noise.

II. RELATED WORK

Ou, Zenggui. [1] made a discussion about how exactly to utilize the sequential characteristic in the span of Web data mining to hold out structural transfer of semi-structured data based promptly effect of data, that's the structuring of Web data, and solve the issues. Zhu, Xiaodong et al. [2] proposed a data mining metadata algorithm with automatic reasoning AR-DMM on the basis of the novel formal logic DLR_{DM} in the description logic family. A proper reasoning framework is developed to automatically check the consistency of AR-DMM. Famili, A. Fazel. [3] provided an summary of the above mentioned listed knowledge discovery applications. They provided examples where it's possible to demonstrate how small or huge amounts of data, when understood from the real-world data mining perspective and the required data is properly integrated, can lead to novel knowledge discovery case studies.Cao, Longbing et al. [4] summarized general frameworks, paradigms, and basic processes for multi-feature combined mining, multisource Bora, Shital P. [5] explore a few of the ad hoc methods generally used for Data Mining in the scientific community, including things like scientific visualization, and outline how a number of the recently developed products used in the industry. Madraky, Abbas et al. [6] proposed an intermediate data model that could represented ideal for Spatio-Temporal data and performing data mining task easily while facing problem in frequently changing the data. To be able to propose suitable data model, this research also investigate the analytical parameters, the structure. Farid, DewanMd, and Chowdhury Mofizur Rahman [7] proposed a fresh approach for detecting novel class in data stream mining using decision tree classifier. The experiments on real benchmark data evaluate the efficiency of the proposed approach in both detecting the novel class and classification accuracy with comparisons traditional data mining classifiers.

III. FILTERS

The majority of images are affected to some extent by noise, which is unexplained variation inside data: disturbances in image intensity that happen to be either not interpretable or not of interest. Image analysis is often simplified if this noise is usually filtered out. In an analogous way filtration are used in hormones to free beverages from suspended harmful particles by passing them via a layer of mud or charcoal. Engineers working in signal processing have extended this is of the term filter to add in operations which accentuate highlights of interest in files.
The various filters used to remove noises present in the images are as follows:

A. Mean Filter

Mean filtering is merely a simple, intuitive and always easy to implement method of smoothing images i.e.by eliminating the total of intensity alternative between one pixel plus the next. It's often accustomed to reduce noise within images. The notion associated with mean filtering is just to displace every pixel value in the image with the particular mean (`average') worth of its friends, including itself. They have affectation of removing pixel values that happen to be unrepresentative of the particular surroundings.

B. Median Filter

It has been desirable to have the ability to perform some type of noise reduction while on an image or signal. The median filter is simply a nonlinear digital filtering technique, often employed to remove noise. Such noise reduction is

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usually a typical pre-processing step to enhance the outcomes connected with later processing (for example, edge detection while on an image).

C. FMM Filter

With image processing, essentially the most frequent methods tend to be median filter as well as mean filter. With these, an approach to mix both mean separate out and median filter in addition to a modification parameter will be given. This adjustment parameter is merely corresponding to this fuzzy membership function. This novel separate out, fuzzy media-mean (FMM) separate out, is aimed to eliminate the mixed sound. The fuzzy media-mean filter operates using a filtering window.

D. Alpha trimmed decision based median filter

This filter is really a windowed filter about non-linear class. The basic thought behind filter is made for any element while using the signal (image) have a look at its neighborhood, discard by far the most atypical elements in addition to calculate mean value because of the rest of these.

E. Bilateral filter

That filters smooth pictures without effecting sides, by means of a non-linear combination involving nearby image beliefs. In this filtration replaces each pixel through weighted averages involving its neighbor's pixel. The weight issued to each neighbor pixel decreases with the distance in the image plane along with the distance on the intensity axis. This filter helps us to obtain result faster while compare to various other. While using bilateral filtration we use pre-processing and post processing steps for better results.

IV. PROPOSED ALGORITHM

The main motive of the proposed algorithm is to get smooth and clear images by using various filters such as fuzzy filter, bilateral filter, and alpha trimmed median filter. Several noises for example: Gaussian noise, impulse noise, speckle noise as well as Poisson noise can be removed after applying these filters. The fuzzy rules are used to identify which noise is present in an image. This proposed algorithm shows the promising results as compare to existing results.This technique continue to be proposed so far to get rid of the noise through digital images within more optimistic way.

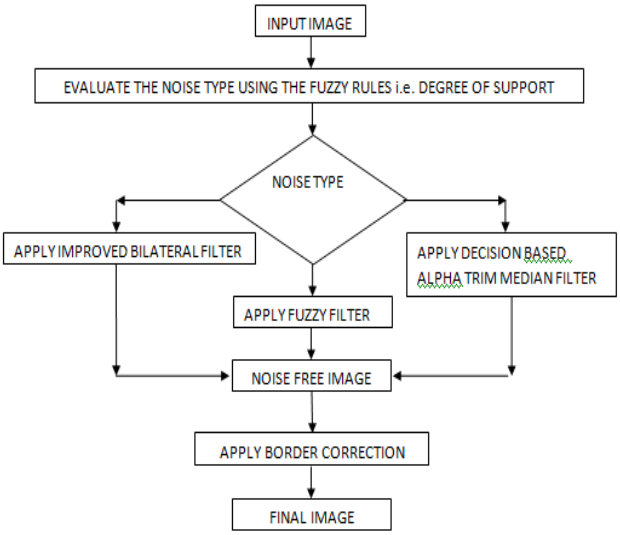

Fig 1: Flow chart of proposed work

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Step 1: Firstly take any input image for example: any medical images.
Step 2: Then apply fuzzy logic to find out which type of noise is present in an image (i.e. Gaussian noise, Impulsive noise, or both, Speckle noise, Poisson noise etc).
Step 3: When noises are identified then various filters are used to remove them. Filters such as fuzzy-mean-median filter are used to remove mix noise (i.e. Gaussian noise and impulsive noise) present in an image, improved bilateral filter and alpha trimmed median filter.
Step 4: After applying filters, noise free image is formed which is same as the original input image.
Step 5: In order to check whether the image formed from filtering technique is exactly equal to the original image, various parameters are used. In border correction, edge preservations can be done.
Step 6: At the end, noise free image is formed as an final image

V. SIMULATION RESULTS

Eliminating the noise coming from digital images is among the most major issue within the digital image processing. The experimental results are shown by using filters such as fuzzy-mean-median filter, bilateral filter and alpha trimmed median filter. Figure 2 (a) shows the input image taken from any camera or any printing devices. Figure 2 (b) is the noisy image in which various noises are present. Many noises such as Gaussian noise, salt and pepper noise, speckle noise, Poisson noise are added in an image.

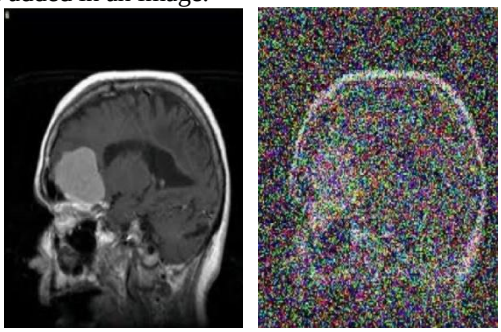

Fig 2: (a) Input image (b) Noisy image

The figure 3 (a) shows the output of the median filter. This median filter is used to remove noises from an image as well as enhance the quality of the noisy image which is further interrupted by various noises. The figure 3 (b) shows the output of the mean filter. This is also used to improve the quality of an image as well as for noise reduction.

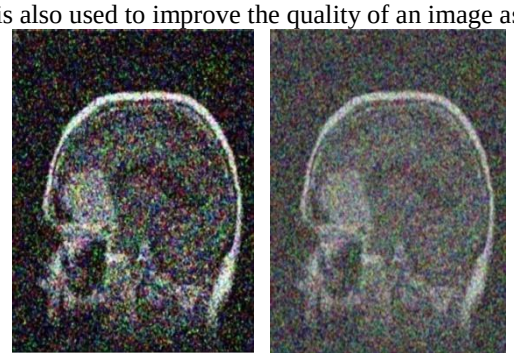

Fig 3: (c) Median filter (d) Mean filter

The figure 4 (a) shows the output the existing works, which uses Fuzzy-Mean-Median filter (i.e. FMM filter). But the quality of the image is not improved by using FMM filter. The figure 4 (b) shows the output of the proposed work which removed noises as well as enhance the quality of an image by using filters such as FMM filter, bilateral filter and alpha trimmed median filter.

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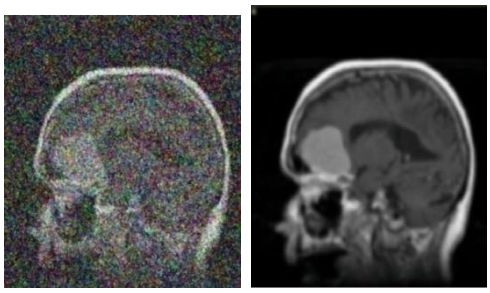


Fig 4: (e) FMM filter (f) Proposed technique

PERFORMNACE EVLAUTAION

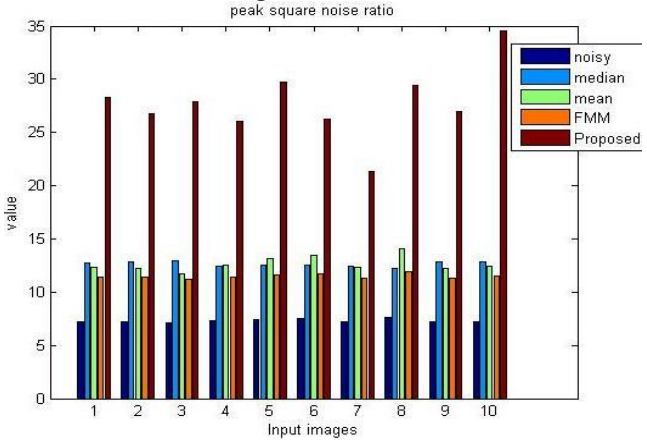
1. PSNR (peak signal to noise ratio) - Peak square noise ratio is the ratio of peak signal to noise. It is measured in decibels (db)[8]. It can be expressed as: $\text{PSNR} = 10.\log_{10}\left(\frac{MAX_I^2}{MSE}\right)$

Table 1: This table indicates the values of the parameter PSNR, which is high from existing work. This comparison table shows that the values of the noisy image and various filters such as median filter, mean filter, FMM (fuzzy-mean-median filter) filter and finally proposed filters (i.e. bilateral filter, DBMF and FMM filter) with noise intensity (a) Gaussian noise 0.2 (b) Impulsive noise 0.3

Images	Noisy	Median	Mean	FMM	Proposed
1.	7.2169	12.7001	12.2864	11.4021	28.2953
2.	7.1997	12.7956	12.2559	11.3726	26.7190
3.	7.0675	12.9827	11.7579	11.2089	27.8368
4.	7.2772	12.4056	12.5533	11.4290	26.0630
5.	7.4006	12.5162	13.1574	11.6620	29.7625
6.	7.4948	12.5031	13.4666	11.7349	26.2990
7.	7.2385	12.4044	12.3181	11.2645	21.3556
8.	7.6173	12.2380	14.0996	11.9365	29.3942
9.	7.2001	12.8791	12.2503	11.3372	26.9664
10.	7.2512	12.8314	12.4841	11.5271	34.5872

Table 1: PSNR values of existing filters and proposed filters

Graph 1: This graph shows that the values of PSNR of proposed work as well as existing work. The values of PSNR of the proposed work show better results than the existing work because the value of PSNR is as high as possible.



Graph 1: PSNR graph show results of existing filters and proposed filters

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2. MSE (mean square error) - Mean square error is to compute an error signal by subtracting the test signal from the reference, and then computing the average energy of the error signal. It can be expressed as:

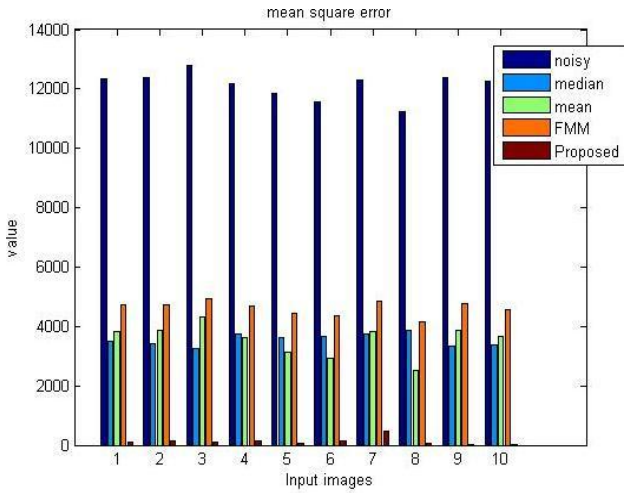
$$\mathrm{MSE} = \frac{1}{\mathrm{MN}} \sum_{i=1}^{M} \sum_{j=1}^{N} (f(i,j) - f'(i,j))^2$$

Table 2: This table indicates the values of the parameter MSE, which is low from existing work. This comparison table shows that the values of the noisy image and various filters such as median filter, mean filter, FMM (fuzzy-mean-median filter) filter and finally proposed filters (i.e. bilateral filter, DBMF and FMM filter) with noise intensity (a) Gaussian noise 0.2 (b) Impulsive noise 0.3

Images	Noisy	Median	Mean	FMM	Proposed
1.	12342	3492	3841	4708	96.2826
2.	12391	3416	3868	4740	138.4133
3.	12774	3272	4338	4922	107.0047
4.	12172	3737	3612	4679	160.9839
5.	11831	3643	3143	4434	68.6792
6.	11577	3654	2927	4361	152.4683
7.	12281	3738	3813	4859	475.9099
8.	11255	3884	2530	4163	74.7582
9.	12390	3351	3873	4779	13.7505
10.	12245	3388	3670	4574	22.6133

Table 2: MSE values of existing filters and proposed filters

Graph 2: This graph shows that the values of MSE of proposed work as well as existing work. The values of MSE of the proposed work show better results than the existing work because the value of MSE is as low as possible



Graph 2: MSE graph show results of existing filters and proposed filters

3. RMSE (Root Mean Square Error) - Root-mean-square error is a measure of the differences between values predicted by a model or an estimator and the values actually observed. It can be expressed as: $\mathrm{RMSE} = \sqrt{\mathrm{MSE}}$

Table 3: This table indicates the values of the parameter RMSE, which is low from existing work. This comparison table shows that the values of the noisy image and various filters such as median filter, mean filter, FMM (fuzzy-mean-

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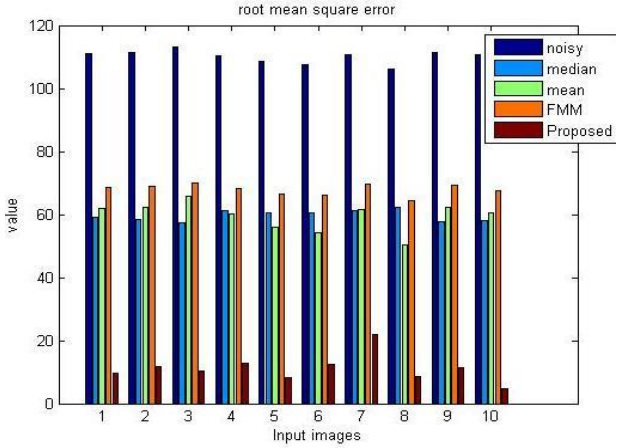
median filter) filter and finally proposed filters (i.e. bilateral filter, DBMF and FMM filter) with noise intensity (a) Gaussian noise 0.2 (b) Impulsive noise 0.3

Images	Noisy	Median	Mean	FMM	Proposed
1.	111.0946	59.0931	61.9758	68.6174	9.8124
2.	111.3149	58.4466	62.1932	68.8513	11.7649
3.	113.0221	57.2014	65.8635	70.1612	10.3443
4.	110.3268	61.1310	60.0999	68.4054	12.6879
5.	108.7704	60.3573	56.0625	66.5946	8.2873
6.	107.5965	60.4483	54.1018	66.0382	12.3478
7.	110.8197	61.1392	61.7495	69.7133	21.8154
8.	106.0896	62.3217	50.2991	64.5233	8.6463
9.	111.3104	57.8878	62.2334	69.1326	11.4346
10.	110.6571	58.2065	60.5805	67.6375	4.7553

Table 3: RMSE values of existing filters and proposed filters

Graph 3: This graph shows that the values of RMSE of proposed work as well as existing work. The values of RMSE of the proposed work show better results than the existing work because the value of RMSE is as low as possible.



Graph 3: RMSE graph show results of existing filters and proposed filters

VI. CONCLUSION

Noise is often a random variation associated with image Intensity in addition to visible as grains from the image. It may produce before capturing or impression transmission. Many noises such as Gaussian noise, salt and pepper noise, speckle noise as well as Poisson noise can make image not easily visible so fuzzy filters, improved bilateral filter and alpha trimmed decision based median filter are used to eliminate these disturbances. The comparison results of proposed work is far better because the values of parameters such as PSNR shows value as high as possible and also MSE and RMSE is as low as possible.

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BIOGRAPHY

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