# Implementation of High Density Noise Removal Using Modified Median Filter

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***Abstract-*** *Images are imitations of real world objects. Often an image is a two dimensional (2D) signal f(x,y) represent the amplitude or intensity of the image. In the Transmission of images, they are corrupted by salt and pepper noise, due to faulty communications. Salt and Pepper noise is also known as Impulse noise. The intention of filtering is to eradicate the impulses so that the noise less image is fully enhanced with slightest signal distortion. The best-known and most commonly used nonlinear digital filters, based on order statistics are median filters, also known as Simple Median Filter (SMF). Median filters are recognized for their capability to remove impulse noise without damaging the edges. The main aim of this work is to modify the existing median filters and implement the modified median filter for reduction of high density impulse noise (salt & pepper noise). Then evaluate the performance of the algorithm using MSE & PSNR parameters.*

***Keywords***- Image Processing, Image Filtering, Impulse Noise, Modified Median Filter.

## I. INTRODUCTION

Computers are faster and more accurate than human beings in processing numerical data. We encounter images everywhere in our daily lives. We see many visual information sources such as paintings and photographs in magazines, journals, image galleries, digital libraries, newspapers, advertisement boards, television, and the internet. Images are virtually everywhere! Many of us take digital snaps of important events in our lives and preserve them as digital albums. Then through the digital album we print digital pictures and/or mail them to our friends to share our feelings of happiness and sorrow. However, images are not used merely for entertainment purposes. Doctors use medical images to diagnose problems for providing treatments. With modern technologies, it is possible to image virtually all anatomical structures, which is of immense help to doctors, in providing better treatment. Forensic imaging applications process fingerprints recognition, hand recognition, faces recognition, and irises to identify criminals. Industrial applications use imaging technology to count and analyze industrial components. Remote sensing applications use images sent by satellites to locate the minerals present in the earth. Thus, images find major applications in our everyday life.

Images are imitations of real world objects. Often an image is a two dimensional (2D) signal *f(x,y)* represent the amplitude or intensity of the image. For processing using digital computers, this image has to be converted to the discrete form using the process of sampling and quantization, known collectively as digitization. In image processing, the term ‘image’ is used to denote the image data that is sampled, quantized and readily available in a form suitable for further processing by digital computers. There is no single accepted way of classifying images. They can be classified based on many criteria. Some ways in which images can be classified are shown in Figure 1.1

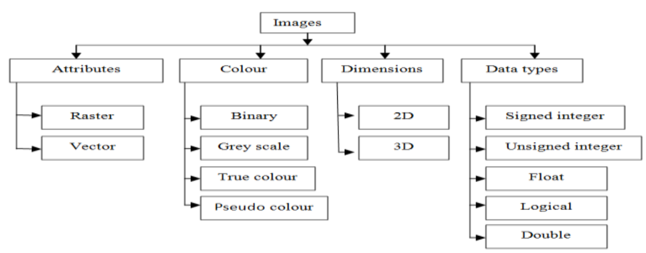



**Figure 1.1: Classification of Images**

## II. LITERATURE REVIEW

Priyanka Punhani et al. [1], Magnetic Resonance Imaging is most popularly used techniques in clinical diagnosis. During acquisition, image quality is degraded by certain noise and artifacts. Due to which, it is difficult to interpret important details of user. So it becomes necessary to denoise image. There are various denoising methods available now days.

Tian Bai et al. [2], Automatic Detection and Removal of High Density Impulse Noises, this study presents a novel method for automatic detection and removal of high density impulse noises. The method consists of two parts: the impulse detection part and impulse noise removal part. In impulse noise removal part, the newton Thiele filter (NTF) instead of median filter is applied to remove impulse image.

Arabinda Dash et al. [3], High Density Noise Removal by Using Cascading Algorithms**,** an advanced non-linear cascading filter algorithm for the removal of high density salt and pepper noise from the digital images is proposed. The proposed method consists of two stages. The first stage Decision base Median Filter (DMF) acts as the preliminary noise removal algorithm. The second stage is either Modified Decision Base Partial Trimmed Global Mean Filter (MDBPTGMF) or Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) which is utilized to evacuate the rest of the clamor and improve the picture quality.

Chauhan et al. [4], High Density Impulsive Noise Removal using Decision based Iterated Conditional Modes; in their paper propose that used to reduce impulse noise. LMM filter is a combination of Mean and Median filter. Where, linear value is taken from the linearity between mean and median value. Both mean and Median filter are only used for noise-free pixel on the 3x3 windows that has been sorted from the smallest to the largest value.

Noise is a disturbance which causes fluctuations in the pixel values. Hence the pixel values show random variation and this cannot be avoided. Suitable strategies should be designed to model and manage noise. Noise can be viewed in multiple ways some of the frequent noises that are encountered in image processing are categorized based on the criteria of distributions, correlation, nature, and source. On the basis of distribution, noise can be classified as:

1. Gaussian Noise
2. Salt & Pepper Noise
3. Poisson Noise
4. Exponential Noise
5. Gamma Noise

Spatial filters are useful for removing noise. Image restoration spatial filters are of two types- mean filter and order-statistic filter. The difference is that, mean filter is based on the concept of convolution, whereas order- statistics filter does not use convolution, but only orders the pixels of the neighborhood and selects a pixel value based on its order. he order statistics filters are further classified into:

1. Median Filter
2. Maximum Filter
3. Minimum Filter
4. Midpoint Filter
5. Alpha Trimmed Mean Filter

In this paper we are working on Modified Median filter to remove high density noise in biomedical images.

## III. PROBLEM IDENTIFICATION & ALGORITHM

To improve the interpretability or perception of information in images for human viewers, or to provide better input for other automated image processing techniques is the mail focus of image enhancement. It refers to accentuation, or sharpening, of image options like boundaries, or contrast to create a graphic show a lot of helpful for show & amp; analysis. It includes grey level & amplitude; distinction manipulation, noise reduction, edge adjusting and sharpening, filtering, interpolation and magnification, pseudo coloring, and so on. Image enhancement can be sub divided in two categories:

1. Spatial domain methods, which operate directly on pixels.
2. Frequency domain methods, which operate on the Fourier transform of an image.

By this algorithm we are trying to identifying the noise in the image and then denoising it using double threshold median filter as well as preserving edges of image.

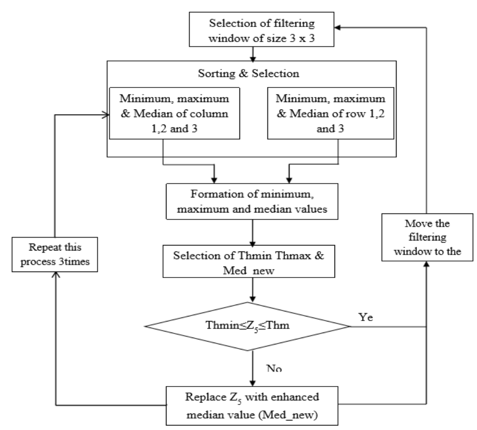



**Figure: 1.2: Flow chart of proposed method for filtering window size 3x3**

The simple algorithm is developed in which we perform the noise detection & noise removal process simultaneously. The smallest window size is used which preserves the fine details of image. The window of size 3x3 chooses for noise detection and noise removal. The window contains total 9 elements which are as follows: Z1, Z2, Z3, Z4, Z5, Z6, Z7, Z8, Z9. First step selects the maximum, minimum and median values of columns and rows. Second step stores these values and selects minimum threshold, maximum threshold and final median value. Third step use threshold values for noise detection and final median value for noise removal.

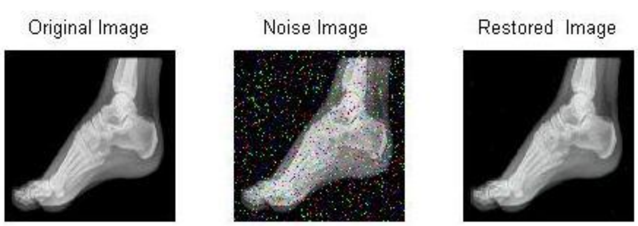
## IV. SIMULATION RESULTS

In this section we are showing the results of simulation which is done by MATLAB. Biomedical images like Brain image and Foot image is used at different noise densities.


(a) 0.01 Salt & Pepper noise and restored/filtered image


(b) 0.03 Salt & Pepper noise and restored/filtered image


(c) 0.05 Salt & Pepper noise and restored/filtered image




(d) 0.07 Salt & Pepper noise and restored/filtered image

**Figure 1.3: Experimental Results of Proposed Method for Foot Image**

The results in the Table 1.1 clearly show that the PSNR of different method is much better at high density of salt and pepper noise. As the density of noise increasing, the response of proposed filter is becomes better in comparison of other filters.

**Table: 1.1: Comparison of PSNR for two images at same noise density**

| Density | Ankle X- | Brain |
|---|---|---|
| 1 % | 50.09 | 47.77 |
| 2 % | 46.90 | 45.14 |
| 3 % | 45.42 | 43.55 |
| 4 % | 43.97 | 42.08 |
| 5 % | 42.73 | 41.14 |
| 6 % | 42.13 | 39.98 |
| 7 % | 42.08 | 39.60 |
| 8 % | 41.32 | 38.96 |
| 9 % | 40.38 | 38.62 |
| 10 % | 40.74 | 37.37 |

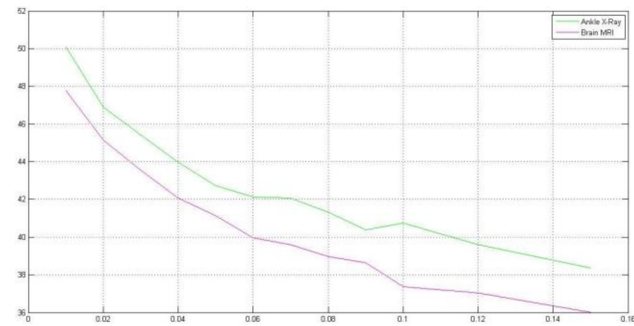



**Figure 1.4: Graph for PSNR value of the different image at same density**

Figure 1.4 shows the graphical illustration of the performance of proposed method discussed in this research work in term of peak signal to noise ratio (PSNR). From the above graphical representation it can be inferred that the proposed architecture gives the best performance for foot image.

## V. CONCLUSION

The proposed filter has described that it is exceptionally productive for irregular esteemed motivation commotion in light of the fact that for all intents and purposes clamor is not uniform over the channel. The idea of most extreme and least limit is utilized here to distinguish both positive and negative commotion. It delivers great PSNR (Peak Signal to Noise Ratio) and little MSE (Mean Square Error) for profoundly debased pictures as per the reference papers. Due to its less unpredictability of count, this channel will have incredible application in the field of picture handling. The proposed method improved the quality of de-noised image especially for random valued impulse noise. PSNR & MSE has been calculated for the performance analysis and result shows excellent variations in the result.

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