## ABSTRACT

Noise suppression in pictures is the most considered aspect in the processing of digitized pictures. There is probability of impulsive noise to be occurred in the process if acquisition of picture, storage or relay. The noise must be eliminated in a way so that the important data accumulated in the picture should be retained as such. There are various algorithms that can be implemented to eliminate salt & pepper noise from the pictures that are corrupted by noise. In this document, an algorithm is provided for restoring the gray scaled pictures that are corrupted by noise at a very high level. This algorithm has two phases. First phase has the responsibility to find out the processed corrupted pixels. In the second phase the pixels that are corrupted are regenerated by the means of suggested algorithm.

In this document, we tend to enhance the outcomes in form of MSE & PSNR. PSNR is termed as Peak Signal to Noise Ratio. The greater value of PSNR leads to better quality of picture. This means that we tend to enhance the value of PSNR from basic PSNR value. On the other outcomes, we need to present the values of MSE. MSE is termed as Mean Square Error. In the outcomes, we have to minimize the value of MSE. With a decrease in value of MSE, the outcomes of the suggested algorithm will be enhanced. In this we compare the outcomes of paper algorithm, median filter & this suggested algorithm. In the designing method, noise is added ranging from 1%-100%. From the outcomes, it is observed that the value of PSNR increase from base paper PSNT & MSE is decreased from base paper MSE.

A matrix of 5xx5 size is suggested where the impulse noise is located & eliminated. The outcomes of various grayscale images presents that suggested algorithm provides a better PPSNR & less amount of time for computation & works in a fine manner when density of noise is less, medium or high. These outcomes are evaluated for images of baboon, leena & tree. The outcomes for 10%, 30% & 50% noise are examined. We tend to improvise the value of PSNR & minimizing the MSE for the outcomes.

# CHAPTER 1
# INTRODUCTION

Image noise is referred as fluctuations in color or brightened detail in the images & is considered as part of electronic noise. It is generated by the circuitries or sensors of scanner or cameras. Image noise can incur as film grain & itches shot noise can't be avoided in a photon detector. Image noise is not needed while capturing a picture as it sums up extraneous & spurious data.

The actual meaning of noise is the 'not-required' signals, electrical variations in the signals that are being received by AM radios causing audible acoustic noise. By the definition, no-required electrical variations are termed to be as 'noise'Noise in image is inaudible.

The magnitude of an image noise can go from imperceptible specks on a digitized picture that is captured in fine light, to radio & optical astronomical pictures that contains most of the noise, by which very less amount of data is presented by processing in a sophisticated manner (the level of noise that cannot be accepted in a picture as it is not possible to actually identify the subject.

## 1.1 TYPES OF NOISE

### 1.1.1 Gaussian noise

The main source of Gaussian noise in digitized pictures is raised in the process of acquisition. As an illustration, sensor noise that is caused because of poor illumination or higher temperature or transmission e.g. electronic circuitry noise.

A basic model for noise in image is Gaussian, additive, independent over every pixel, & independent from intensity of signal, that is caused mainly by Johnson-Nyquist noise i.e. thermal noise incorporating that which is coming from reset noise of capacitors i.e. KTC noise. Amplifier is considered as a major portion of 'read noise' of an image sensor, that is having a stable level of noise in darker sections of a picture. In the colored cameras where more amount of amplification is required in the channel of blue color than red or green color, more noise is observed in the blue channel. On the greater level of exposures, shot noise dominates the image sensor, that is nor Gaussian & independent of intensity of signal.

### 1.1.2 Salt-and-pepper noise

Fat-tail distribution or impulsive noise at some level is termed as salt & pepper noise are spike noise. A picture that is consisting salt & pepper noise will be incorporating dark pixels in the brighter regions & bright pixels in darker portions. Such noise can be caused by analog to digital converter errors, bit errors in transmission etc. It can be eliminated by implementing dark frame subtraction, median filtering & interloping by the side of dark & bright pixels.

Figure 1.1 :- Image with salt and pepper noise

A dead pixel in an LCD monitor generates the same kind of non-randomized, display.

### 1.1.3 Shot noise

The dominant noise in the dark regions of a picture from image sensor is caused due to static quantum variations, which means fluctuations in the quantity of photons that are sensed at a provided level of exposure. This is also reefed as photon shot noise. Shot noise is having a RMS value that is proportionate to square root of intensity of a picture, & noises at distinctive pixels don't depend upon each other. Shot noise goes along the Poisson distribution that works at lower levels of intensity around the Gaussian distribution.

Adding up to the photon shot noise, there is a possibility of substitution shot noise in image sensor from dark leakage current. This noise is referred as 'dark shot noise' or 'dark current shot noise'. Dark current is at highest level in 'hot pixels' in the image sensors. The variable dark change in the normal & hot pixels is minus off, that eaves the shot noise behind or randomized constituents, of the leakage.. If the subtraction of dark-frame is not completed, or the timing of exposure is very large then charge of hot pixels gets raised by linear charge capacity, & the noise will be acting more than shot noise & these hot pixels seems to be as salt & pepper noise.

### 1.1.4 Quantization noise (uniform noise)

The noise incurred because of quantizing the pixels of sensed picture to several discrete steps is termed as quantization noise. It has almost uniformity in the distribution. Even thou it depends upon the signal, it will be independent from the signal is the sources of noise are large that will lead to dithering or if the dithering is implemented explicitly

### 1.1.5 Film grain

The noise in the grain of photographic film relies over the signal having same static distribution as per shot noise. If the distribution of film grains is uniform i.e. equal number over a region & every grain has the probability of equality & independency for formulating a dark silver grain after in-taking the photons, then quantity of these dark grains will be having a binomial random distribution. In those regions where this probability is less, distribution will be approximately nearby to classic Poison distribution of shot noise. A basic Gaussian distribution is implemented like a precise model. Film grain is also referred as isotropic source of noise. Its effect become worse when distribution of silver halide grains in file gets randomly distributed.

### 1.1.6 Anisotropic noise

Various sources of noise are presented by a determinant orientation in pictures. As an illustration, sensors in images are associated to column or row noise.

Picture on the left hand side is exposed as >10 seconds in less amount of light. Picture over right hand side possess sufficient lightening with exposure of 0.1 second. In the less amount of light, efficient exposure needs slow shuttering speed i.e. long time of exposure, more gain i.e. ISO sensitivity or both. In many of the cameras, the slower speed of shutter raise the salt & pepper noise because of photodiode leakage currents. Over the price of making the read noise variance double (41% hike in read noise standard deviation), the salt & pepper noise can be removed by dark frame subtraction. Banding noise which is just like the shadow noise can be implemented by increasing the brightness of shadows or by processing of color balance.

The associative impact of both of the read noise & shot noise hikes with the deduction in the exposure, linking to the raise sensitivity of ISO, as less amount of photons are counted (shot noise) & amplification of the signal is mandatory.

The size of image sensor or effective light collection area for each pixel sensor is highest determinant of signal levels that computes signal to noise proportion & so as per the noise levels it s presumed that area of aperture is proportionate to area of sensor, or else f-number or focal-plane luminance is kept consistent. It means, for a consistent f-number, sensitivity of an image scales generally with area of sensor. Hence, sensors with greater noise generate low amount of noise than the sensors of smaller size. In a scenario, the pictures have enough brightness to be incurred in the region of shot noise, as the picture is scaled down similar to the size of screen or either printed over the similar size, the count of pixels make very small difference to the levels of noise – this noise is dependent over area of sensor, but not on the area that is divided over pixels. The pictures having low level of signals (that are greater than ISO settings), in which read noise (noise floor) is significant; more number of pixels in a provided sensor are will invade more noise in the image if read noise for each pixel remains same.

The image sensor is comprised of distinctive photo sites for collection of light from a provided region. Not whole of the sensors are required for collecting the light because of other circuitries. A greater level of fill factor in a sensor leads to more collection of light, that allows the better performance of ISO on the basis of size of sensor.

The temperature also plays a significant role on the quantity of noise that is generated by image sensors because of leakage. By keeping this thing into consideration, it is also referred that DSLRs will be generating more amount of noise in summers than the winder season.

### 1.1.7 Impulse Noise

Corruption by Impulse noise  is highly observed in digitized pictures. This noise is independent & not related to pixels of a picture in any manner. This noise is distributed in random pattern in the picture. In the impulse noise, only some of the pixels are contaminated by the noise alike the Gaussian noise. There are several forms of impulse noise like salt & pepper noise & random valued noise.

## 1.2 IMAGE NOISE REDUCTION

Any photograph, picture or a form of 2-D presentation is termed as an image.  Many of the algorithms tend for transformation of image sensor data to an image, either in camera or computer, incorporate some type of deduction of noise. Various approaches are followed for this purpose, but all of them tend to find out if the differences in values of pixel invade any noise or actual detail about photograph & find average of the former & attempts to preserve the latter one. Though none of the algorithm makes perfect judgment, hence a tradeoff is made in the removal of noise & preserving the fine, low contrast detail may have the characteristics that are similar to the noise. Various cameras have the settings for regulation of the aggressiveness in-camera noise deduction .

A basic illustration for the impossibility for deduction in the noise that is unambiguous that is: a region with the uniformity in the red may be having a small black region in it. In this a single pixel, pixel, it is likely to be noise & spurious; if it takes over some of the pixels in a regularized shape, it may be counted as a flaw in the image taking sensor. If there is any irregularity in it is considered to be as an absolute attribute of the picture. Though a prices answer is not provided.

This idea is supported by getting information about attributes of source picture & of need of person. Many of the algorithms implemented for deduction in noise has more aggressive chromo noise minimization as there is less important details about fine chromo that is not worth of loosing. Also many of the people see the luminance noise not fit for the eyes as its textured style copies the presentation of film grain.

The higher sensitivity in the quality of an image from a provided camera (or RAW development workflow) maybe depending upon the algorithm quality that is implemented for deduction of noise. As the levels of noise raise the sensitivity of ISO, many of the manufacturers of cameras raise the aggressiveness at the higher level of sensitivity. These results in breaking down of picture quality over high sensitivities in two forms: level of noise increases & fine details are smoothened by aggressive deduction in noise.

In a scenario where noise is very high, like astronomical images of objects located at a distance, it Is not the matte or deduction of noise as small amount of noise is incorporated in the hefty amount of noise, methodologies are versatile that tends to attain some regularities is high randomized information.

### 1.2.1 Filter Types

This document explains various filtration methods of Gaussian noise. This noise is invaded as the GPP is incorporated with the processor based over FPGA. This was implemented for the purpose of enhancement in the quality of image being processed. This experiment achieved success to a level as explained before but it produce small quantity of Gaussian noise. Therefore several filters are implemented & their codes are devised for removing the ubiquitous noise of Gaussian image. A basic algorithm implemented for purpose of coding is described in the given chapter. The Appendix C is comprised of codes for every filter that are implemented in this research. The outcomes from simulations are also linked in the subsequent chapters.

Some of the filters that are implemented for removal of Gaussian image noise in the document are explained as below:

- Adaptive Window Filter
- Adaptive Median Filter
- Relaxed Median Filter
- Median filter

#### 1.2.1.1 Adaptive Window Filter

As actual image signals & noise has a cardinal role in the de-noising a picture. The window filters that are fixed require prior details about the noise & actual image signal. In that case only they can be implemented efficiently in removal of noise. On the counterpart, filters of adaptive window don’t need any detail. They got inbuilt capability for making adjustments about impulse responses that eliminates the correlated signal in an input. They need very less or no information regarding signal or noise. No such previous details are required in-spite of that if the signal is broadband or narrowband. Even the adverse conditions can be handled by adjusting the size of window by a sliding method. The signal may get hampered if the pervious information is not present in the process of removal of noise. Thus, adaptive filter face the condition by adjustment of response of impulse in order to minimize the error signal while taking the outcome of filter into consideration. Responses of impulse & filter weights are managed by various adaptive algorithms. So, adaptive filters are able to lessen the noise by making minimal distortion to signal. All in one adaptive filtration methods lessen the levels of noise to a high level in contrast to direction filtration methodologies.

The value of mean square error relies over the provided application. Two necessary states that are required for this are least mean square error & lessening of temporal average of least square error & further. The applicable algorithms for such filters are – LMS(least mean square) algorithm & RLS (recursive least square algorithm. MSE state tends to explain the MSE criteria. This thesis is comprised of adaptive window filter of the two different sizes i.e. 3x3 & 5x5. Codes are implemented for both of the sizes of windows for pictures of female called Lena & tree. Appendix C is comprised of codes where further chapter comprises the outcomes of simulation.

#### 1.2.1.2 Adaptive Median Filter

Median filter is implemented in cases of colored pictures. it supports the treatment of distortion of color & loss of attributes for preservation of edge. It attains this state by considering all of the three constituents of colors over the same instance. Various different forms of median filter are described as below:

#### 1.2.1.3 Scalar Median Filter

This filter is developed by Valavanis et al. They made some transformations in the filter taking their color as a base & termed it as scalar median filter. This filter has to follow some rules for restriction on the basis of color. Initially it makes the hue transformations minimal. Further changes occurring in the saturation are observed very strictly. It is believed that improvisation in the saturation is far better than the associative decrement. Lastly, contrast in luminance is assigned its largest value.

#### 1.2.1.4 Vector Median Filter

The scalar median filter has some drawbacks as it doesn’t formulate the values for pixels that are not present in the actual picture. To cope up with this drawback vector median filter is not implemented. In the vector median filter whole of the computations rely upon the weights of filter. So these weightings may produce an error if it is not computed in a smart manner. This may conceive loss in the preservation of attributes of an edge. Though it is assured by this method that filtration is free from the substantial ambiguous color vectors unlike the scalar median filter.

#### 1.2.1.5 Reduced Vector Median Filter

The vector filter is more popular that scalar median filters as it possess more advantages. Though, the computation by this filter is time taking & hefty task. Hence, Teschioni & Regazzoni provided n approximated method of this & referred it as reduced median filter. It was mainly implemented in space filling curves & scanners. Their function is to transform the 3-D color vector to a 1-D space vectors in the scanner. So, median is approximated by a traditional methodology. Also, in reduced median filter the proportion of signal to noise is found to be worse than their counterpart.

#### 1.2.1.6 Median Filter Applied To Chromaticity In The HSI Space

This is referred as highly distinctive methodology that emerged to eliminate the confusion in order of rank color vectors in the median filter methodology. As per a scientist called Frey, ordering is reliable when it is performed taking chromaticity & hue as the base. Before that mean value of color vectors was presumed for the task of ordering. In this methodology, the color vectors were presumed in the HSI space. This model resembles to the median filter. In this mean value is identified in the chromaticity plane & it is sure that value remains unchanged in the outcome image. So this technique works as per chromaticity.

#### 1.2.1.7 Median Filter Based On Conditional Ordering In The HSV Space

In this conditional ordering is given more weight age. Initially, vectors are considered as by the value of first constituent & the succeeding component follows the order. Vardavoulia suggested this method of ordering. Initially sorting of vectors is done on the basis of HSV color space that depends from minimal to highest value. Further, vale of saturation is organized in the descending form from higher to smaller. In next step matching of values of v & s is done. At last, these values are organized in the ascending form for sorting of pixels.

#### 1.2.1.8 Vector Directional Filters

These are termed as multivariate filters that rely upon the angle in the color image vectors for the purpose of ordering. They have to follow the principles of ordering constituted over coordinates of polarity. So the vector directional filters work in the same fashion as they have to scout the component of chromaticity of color. They act like in various directions of picture & eliminate all the vectors that follow a particular defined direction. They are implemented for only defined work where the estimation of a definite direction is highly required

#### 1.2.1.9 Relaxed Median Filter

When the turn comes over relaxed median filter, it is presumed to be of upgraded version of early explained median filter. These attributes seems to be similar but their implementation is quite easy. The working of relaxed median filter goes with the principle of upper & lower bounds. Such bounds present a window that is comprised of gray levels. These gray levels are also not considered into process of filtration. In such a case as input reacts to sub-list, it remains as such. If the input lies out of the scope of sub-list, standard value of relax median filter is extracted out as final outcome. Hence, relaxed median filter functions fast than a basic median filter. Even though it is considered as sub class of median filter, ranking order also goes along the same principle as like median filter. The provided figure presents the real picture. Here after noise is invaded into the picture & the filtered picture is presented that is attained by the support of relaxed median filter.

Figure 1.2:- Original Image of Lena

Figure 1.3:- Image Corrupted By Gaussian Noise

Figure 1.4:- Image Filtered By Standard Median Filter

Figure 1.5:- Image Filtered By Relaxed Median Filter

The given picture of Lena is required in the purpose of coding, the given four images presents an evolutionary study bout the ability of filtration by the standards & also relaxed median filter. This gives a very the capability to every median filter to have clarity in functioning. By this chapter explains all of the image noises while focusing more on Gaussian noise. Further it gives a theoretical explanation of the methods for filtration of noise that are implemented in this research to remove Gaussian noise from the actual image.

# CHAPTER 2
# LITERATURE REVIEW

Noise is considered as un-necessary information that puts some corruption or flaws into a picture. There are several noises seen in the digitized pictures. Various noise modules that debase the picture are Impulse, Gaussian, Rayleigh or Erlang & speckle. The picture can be debased by either Impulse noise type as the cameras having some faults error occur in the acquisition systems & transmission by the noisy channel. In the Impulse noise, the intensity of pixels will be much higher or minimal . Two forms of Impulse noise are basically found i.e. random valued and salt & pepper noise. Considering salt & pepper noise, for some of the pixels, grey level will be 255 that is maximum value or 0 that is minimal value. The noise appears like black & white dots. This is why it is termed as salt & pepper noise. The data incorporated in the picture may be debased by invasion of this noise. Si there is a cardinal need for elimination of this noise from the picture so that actual information can be extracted from the picture . Various types of filters are suggested here in order to restore the corrupted pictures due to salt & pepper noise. In these, the standard median filter is the best approachable method by not affecting the details about edge. But in the approach, if the level of noise goes beyond 50%, there is no way to preserve the actual picture as it is effective over less density of noise . In WM (weighed median) filter & CWM (center weighed median filter are allocated to the chosen pixels in filtering window for controlling the functioning of filtration. Such filters don’t tends towards processing & find the corrupted pixels but rather process whole of the elements of pixels. Hence, when the density of noise is high, such filers are not much effective in generating actual image along with the details of edges. So, ACWM i.e. adaptive centre weighted median is implemented to eliminate the disadvantages of CWM filter.

In this paper, author have carried regarding the noise suppression in pictures is the most considered aspect in the processing of digitized pictures. There is probability of impulsive noise to be occurred in the process if acquisition of picture, storage or relay. The noise must be eliminated in a way the important data incorporated in the picture should be retained as such. There are various algorithms that can be implemented to eliminate salt & pepper noise from the pictures that are corrupted by noise. In this document, an algorithm is provided for restoring the gray scaled pictures that are corrupted by noise at a very high level. This algorithm has two phases. First phase has the responsibility to find out the processed corrupted pixels. In the second phase the pixels that are corrupted are regenerated by the means of suggested algorithm. This algorithm has better outcome than SMF, CWM, DBA, ACWM & MDBUTMF algorithms. From the outcomes of various grayscale pictures, it is observed that high PSNR & low time of computation is there in process of elimination of salt & pepper noise over low to high densities.

the Another algorithm which is suggested here for restoring the gray scale & color pictures that are contaminated by salt & pepper noise. This suggested algorithms gives out better outcomes than SMF, DBMF,MDBMF, PSMF & BDBUTMF. This algorithm makes the replacement of pixels containing noise with the trimmed median value when the values of other pixels are 0’s & 255’s.The the replacement of noisy pixels is done by raising the size of window & obtaining trimmed mean based over algorithm. Various colored & gray scale images are evaluated by this algorithm & it is observed that they produce fine PSNR & IEF.

Pictures are contaminated by several noises in the process of production & transmission. Mainly, the pictures are contaminated by impulse noise. The impulse noise is counter in two forms as salt & pepper noise & random valued noise. The salt & pepper noise contaminated pixels of a picture either consider maximum or minimal pixel value. In this document, we cope up with the salt & pepper noise from contaminated images. Elimination of salt & pepper noise is performed in two levels: identification of pixels containing noise & replacing that pixel. Various filters are suggested for recovery of pictures that are been corrupted by impulse noise. Out of these SMF is considered to be most efficient. Though, the disadvantage of MF is that it is able to work fine when the density of noise is less . To deal with this disadvantage, DBUTMF is suggested . If all the components are 0’s & 255’s it is not possible to attain trimmed median. SO, MDBUTMF algorithm is applied . The suggested algorithm gives better outcomes at 80%-90% of noise levels & gives a better IEF & PSNR value.
the phase of transmission of the pictures over channels, images get contaminated by salt & pepper noise because of faulty communications. Salt & Pepper noise can also be inferred as Impulse noise. The main idea behind implementation of filtration is to eliminate the impulses so that pictures can be reproduced with minimal distortion in the signal. The best & highly implemented non-linear digitized filters constituted over order stats are median filters. Median filters are sounded because of their capability in removal of impulse noise by not affecting the edges & preserving them. The efficient elimination of the impulse may incur distortion & blur in the picture. Over high density of noise, they performance is not much effective. A latest algorithm is suggested to eliminate the salt & pepper noise over high densities by implementing DBUTM algorithm.

The motive behind filtration is to eliminate the impulse so that a picture with no noise is attained with minimal distortion in the signal. The known & implemented non-linear digitized filters are termed as median filters. Median filter possess the capability for eliminating impulse noise & also preserving the edges. The elimination of impulse leads to blurring & distortion of pictures. on ideal basis, filtration must be implemented to the contaminated pixels where un-corrupted pixels are left as such. While implementing the median filter without any restrictions over whole picture will alter the intensities & also destroy details of image of the non-corrupted pixels. So the implementation of a process for identification of noise is implemented to differentiate the corrupted & non-corrupted pixels. Adaptive filter is considered as decision based or switching filter that initially tends to recognize the pixels containing noise & replacing the corrupted pixels with median filter or its sub-types where the non-corrupted pixels are not affected by any means. This adaptive design of mentioned filer makes sure that almost all of the impulse noises re identified even when the density is high & size of window is large. The present non-linear filters are SMF, AMF, DBA & REA that gives fine outcomes over less & intermediate level of noise. Over high densities of noise, they fail to work efficiently. A latest algorithm is suggested for eliminating salt & pepper noise by implementing shear sorting technique & DBUTM is also suggested.

a picture presenting a filter for noise of pepper & noise is suggested. We reveal the ROAD for evaluation of pixels of noise where the image is contaminated by noise. The statics of ROAD evaluate the value of pixels from its associates. As the noise is evaluated, a filter is implemented for its elimination. In order to assess the efficacy of filter, the methodologies on quality & quantity are implied & a contrast is invaded for the suggested filter, it is seen that the filters as suggested can remove the noise in a better way than other filters. Here we suggest a transformed filter at median to eliminate noise. Also the statics of ROAD are invaded to associated pixels. On the other part, the statics of ROAD may identify presence of nose as it goes for each intensity & geometric domain. Lastly to evaluate the performance, several tests are conducted by taking the pictures which are corrupted on scale of gray. It is also seen that the suggested filter is better on base of IEF & MAE.

The six algorithms for filtration are suggested on the basis of their capability to reformulation of pictures contaminated by noise. This algorithm is deployed to eliminate noise that is incurred while data is relayed. The algorithm of spatial filter of median is defined in present picture with smoothening methodologies. There are several terminologies are explained for removal of noise. The outcomes reveal that efficacy of MDUBUTM is much better than AMF, MF & DBA even in terms of PSNR & IEF. Also another algorithm on the base of MDBUTMF is suggested on the same basis. Its efficacy is tested at all levels of densities even at scale of gray & colored pictures. Much enhanced contrasts are provided at the other algorithms. The outcomes are revealed in terms of quality & quantity. It has a main effect on elimination of noise even at greater density.

An algorithm of SUMF is suggested for elimination of noise from pictures. There are 2 levels in algorithm: in the 1st level, the picture contaminated by noise is processed through a median filter which is modified. The pixels with noise are contrasted with the associated pixels. If it is found different from others, then it is taken as noisy. These pixels are then replaced with median figures of other associated pixels. There are 2 parts of 2nd level: in phase 1, the pixels which have noise are identified & next they are replaced by not noisy pixels in a matrix of 2*2. The outcomes reveal that filter works absolutely fine for compression of noise. There are multiple simulations with several parameters to make contrasts, make use of similar techniques of filtration like DBA, ENLAFT, AMF, EDBAMF, SMF etc. This filter possesses much enhanced efficacy than other ones on scale of gray. It is ployed for noises with greater densities. It is also evaluated on the various levels on real pictures. Its performance is assessed on basis of MSE & PSNR. It is also put in contrast to various other algorithms & filters like SMF, CWMF, DBA, MDUBUTMF. This filter gives much better performance over other demanding filters even when noise is 95% on terms of quantity & visuals. It puts a great impact on elimination of noise.

A new methodology for restoration of pixels is suggested in this document which is contaminated with a large amount of noise. This method retains the pixels that have value of 255 or 0 & then imitates the process to associates neighbors. And the pixel so formulated is put in place of that one that has noise. When all pixels are of these values, it signifies that mean values is there on each pixel. The algorithm as suggested gives is efficient outcomes than the other ones like DBA, MDBUTMS, MF etc. This algorithm is evaluated against various levels of gray & frames of video & furnishes some better IEF & PSNR. Here an algorithm of ADBUTMF is suggested which furnish better contrast in performance on DBA, MF, MDBUTMF & several others. The efficacy is evaluated on basis of level of gray with noises of high density. This algorithm is a fine approach for noise of pepper & salt where noise is in between 80-90%.

Compression of pictures is one of the major aspects in the processing of images of digital format. These noises may incur while invasion of pictures, storage & capacity & noise must be eliminated in a way that the edges of picture should be retained. There are much algorithms that can be deployed to attain the real picture & for elimination of pepper & salt noise. The noise of pepper & salt can corrupt picture where pixels which are corrupted can attain extreme level of gray. There are 2 levels of suggested algorithms. There are 2 levels in detection of noise of impulse. In $1^{st}$ step, a median filter which is adaptive is ployed to identify the contaminated pixels. At next level, an algorithm of non local means is ployed top attaining enhanced quality from its reformulation. The algorithm works absolutely fine during the elimination of noise of pepper & salt where the details & edges are retained when the noise is even high. The outcomes as received present the execution of the proposal which gives a provision of compression of noise at greater density. Here an algorithm for elimination of noise & retention of images of digital format is suggested. The suggested methodologies reveal that it retains the actual picture in much better way than RAMF & other algorithms. Around 95% of the picture can be restores but it will take some more time in computation in contrast to others. But this time can be improvised in an approach.

An algorithm is suggested for elimination of noise from pictures. At next level, an algorithm of non local means is played top attaining enhanced quality from its reformulation. The algorithm works absolutely fine during the elimination of noise of pepper & salt where the details & edges are retained when the noise is even high. The outcomes as received present the execution of the proposal which gives a provision of compression of noise at greater density. The suggested methodologies reveal that it retains the actual picture in much better way than RAMF & other algorithms. Around 95% of the picture can be restores but it will take some more time in computation in contrast to others. But this time can be improvised in an approach. Here another algorithm PA is explained which gives finer outcomes than that of others as it makes use of a small & faster window of size of 3*3. Also it produces a finite transaction of the values of pixels my making use of inter relations of the pixels to its associates & retaining the details of the edges to a better level.

The elimination of noise of impulse throws a major challenge in the area of processing of images of digital format. With furtherance, the enhancement has gain a raise for improvisation of images. This document gives an idea about manipulated decisions constituted over an algorithm of trimmed median for retention on scale of gray & images of colored format which are contaminated by noise of pepper & salt. The suggested filter replaces the value of median when the constituents with value of 0’s & 255’s are located in the window. When all pixels are of these values, it signifies that mean values is there on each pixel. Its quality for deduction of noise in a static basis is calculated as RMSE & PSNR. The algorithm as suggested out produce a basic MF, MDBA, DBA. Also another methodology of hybrid nature is explained in this document. The algorithm of MDBUTHMF produce much better efficacy in contrast to other algorithms. Their efficacy is evaluated on basis of level of gray with noises of high density. This algorithm is a fine approach for noise of pepper & salt.

A Improved non-linear filtering methodology is presented by this paper which is furnished for removing high density noise of pepper & salt from digital images. This methodology is used to integrate analysis of local features with statistics of local features. The suggested methodology incorporates the static assessments of the local characteristics along an adaptive filter of noise that segregates the contaminated & non contaminated filters & takes the pixels that possesses noise as inputs. The attitude of adaptability of the filter triggers it to adjust the window constituted on the noise & the approximation of values free of median noise. Since many of the filters transform the pixel with an average median or the pixel that has been just processed to attain the maximum size the suggested methodology gives more static outcomes to attain the actual terms.

The outcomes of experiments reveal that the methodology as suggested works out at a better pace than the filters which are not linear compressing the noise to upto 95% while retaining the quality of visuals. Here another algorithm suggests that the enhanced efficacy is out in contrast to other algorithms for elimination of noise. The efficacy of the suggested methodology is tested on a set of basic pictures which are disposed by the noise with greater density. The greatness in the suggested methodology is because of invasion on a basis of local statics on the median method of filtration that supports the estimated correction. This images which are retained furnish superior quantity & quality services.

The hunt for an algorithm for elimination of noise is a great aspect of challenge for researchers. The elimination of noise to a clear end is the main concern before the image is processed & algorithms are implemented over it. A set of approximations are put over it while each of them possess some approximations, advantages, theories & demerits. These present a great performance when the model of image fail & formulate the artifacts & eliminate the fine architecture. The document focuses on the views & comparison assessments on some cardinal noises elimination methodologies for deduction of noise in the domain of time. The document puts concern on the static filter which is not linear in order. The adaptive filter deal with the purpose of noise of impulse from deducing 7 distorting the noise. The filter can attain the operation of the image which is contaminated with noise to a level of

In this paper, author have carried regarding These days the information in the form of visual is more relayed as a mode of communication, but instead the picture as relayed gets contaminated by the noise. Some main information is covered by this noise. Thus to cover up this issue &

enhance the quality any sort of noise that is observed should be eliminated. The demonizing of picture is a great methodology for elimination of noise that is employed for elimination of noise by transforming the data to yield images of high quality. Several noises an contaminate the images which comes over in various forms like during invasion of sensors, faulty media of storage, camera etc. There are basically 2 forms of noses which are random valued & pepper & salt noise where the level of noise is contaminated to either minimal or maximum. Several non-linear filters have been established as reliable method to remove the salt and pepper noise without damaging the edge details, each having their own merits and demerits.

A standard filter which is not linear which is MF & several variants like AMF & DBMF are also explained. There are several terminologies are explained for removal of noise. The outcomes reveal that efficacy of MDUBUTM is much better than AMF, MF & DBA even in terms of PSNR. In a nut shell, it is seen that efficacy of manipulated filter of median which is non symmetrical & trimmed is greater than the filters that have more density in noise. The outcomes of the algorithm contrast to the other present algorithms 7 this methodology gives out better visuals & measures in terms of quantity & quality at noise even at densities of 90%.

# CHAPTER 3

# PROBLEM STATEMENT AND PROPOSED METHODOLOGY

Noise is considered as un-necessary information that puts some corruption or flaws into a picture. There are several noises seen in the digitized pictures. Various noise models that debase the picture are Impulse, Gaussian, Rayleigh or Erlang & speckle. The picture can be debased by either Impulse noise type occurs in as the cameras having some faults error occur in the acquisition systems & transmission by the noisy channel. In the Impulse noise, the intensity of pixels will be much higher or minimal . Two forms of Impulse noise are basically found i.e. random valued and salt & pepper noise. Considering salt & pepper noise, for some of the pixels, grey level will be 255 that is maximum value or 0 that is minimal value. The noise appears like black & white dots. This is why it is termed as salt & pepper noise. The data incorporated in the picture may be debased by invasion of this noise. So there is a cardinal need for elimination of this noise from the picture so that actual information can be extracted from the picture .

Various types of filters are suggested here in order to restore the corrupted pictures due to salt & pepper noise. In these, the standard median filter is the best approachable method by not affecting the details about edge. But in the approach, if the level of noise goes beyond 50%, there is no way to preserve the actual picture as it is effective over less density of noise . In WM (weighed median) filter & CWM (center weighed median filter are allocated to the chosen pixels in filtering window for controlling the functioning of filtration. Such filters don’t tends towards processing & find the corrupted pixels but rather process whole of the elements of pixels. Hence, when the density of noise is high, such filers are not much effective in generating actual image along with the details of edges. So, ACWM i.e. adaptive centre weighted median is implemented to eliminate the disadvantages of CWM filter. But some values about threshold are needed in this filter . In AMF, the size of window is increased & it works fine when density of noise is less . Filters like decision based finds out noise by processing every pixel. If the value of pixel being processed is either 255 or 0, it is classified as noise & if processed further. When the density of noise if high, filters such as DB tend to replace the pixels containing noise by the adjoining filters.

When the density of noise is more, streaks are generated in picture produced as output by DBA filter as replacement is done over continuous basis & improvised DBA filter is implemented to eliminate this disadvantage. In DBUTMF, trimmed median value that is unsymmetrical is implemented rather doing replacements by adjoining pixels. Though, at higher density of noise, in the chosen window, all of the pixels should be either 0 or 255 or both. In this scenario, the trimmed median value will be taken as either 0 or 2555 that is also counted as noise. In order to get rid of this disadvantage, we opt for MDBUTMF i.e. Modified decision based un-symmetric median filter. In this thing as the described situation comes, mean of the values so selected is computed & replaced . All of the mentioned algorithms are not highly effective when density of noise is high. The suggested research is an initiative towards improvisation in the methods implemented to eliminate salt & pepper noise over more densities [10] from digitized pictures.

### 3.2 PROBLEM STATEMENT

In the type of trimmed filter, a window of 3x3 size is chosen & the pixels having some corruption are eliminated. ATMF (Alpha Trimmed Mean Filter) is similar kind of filter in which trimming is performed similarly over both of the sides. In this methodology, sometimes pixels that are not corrupted may also get trimmed. So, loss of details of picture & blurring may take place. To remove this disadvantage, UTMF i.e. Unsymmetrical Trimmed Median Filter is implemented. In the UTMF, window of 3x3 size is chosen & constituent are organized in descending or ascending order. By this, pixels containing noise that are 0s or 255s are removed, that are the cause of occurrence of salt & pepper noise & median value of other leftover pixels are considered. The pixels having corruption are replaced by the computed median value. As the pixels that are either 0s or 255s are removed from the window it is termed as trimmed median filter. This technique is an advanced version of ATMF as it is able to detect the noise & eliminates it [9]. The suggested algorithm does the processing of pictures containing noise by initially identifying the impulse noise. Processing of value of pixels is done to find out the possible incorporated corruption. If the level of gray is in between 0 & 255, it is not considered to be having any corruption & is left as such. Or else it will be corrupted & is processed by the help of suggested filter. The algorithm is described below:

### 3.3 ALGORITHM

Step 1: A 2-D window of size 5*5 is chosen. Let P (i, j) be the pixel to be processed.

Step 2: It is evaluated that if pixel P (i, j) that is being processed is corrupted or not.

Step 3: If P (i, j) is the pixel that is not contaminated than it is left as it is. It is presented in Case iii) of Section IV.

Step 4: If P (i,j) is a pixel that is corrupted, then there are two possible cases. In case i): if the chosen window is comprised of all the elements as 0’s & 255’s. Then these are replaced by the method of midpoint filter. Case ii): If the chosen window has few components as 0’s & 255’s. Then the O’s & 255’s are replaced by median value from the leftover components.

Step 5: Steps 1-4 are repeated till all of the pixels in the picture gets processed. The suggested algorithm has two phases. First phase tends to identify that if the pixel being processed is corrupted. In the next phase, corrupted pixels are regenerated by implementing the suggested algorithm. There is a need to check every picture for the occurrence of salt` & pepper noise. Various cases are presented in this section. If the pixel being processed contains noise & other pixels are O's or 255's is presented in Case i). If the pixel being processed contains noise which means it is 0 or 255 is presented in Case ii). If the pixel is being processed don't contains noise & its values lies in between 0 & 255, it is presented under Case iii). Case i): If the chosen window is comprised of salt & pepper noise as processing pixel (i.e. 255/0 pixel value) & associating pixel values is comprising of all the pixels that invades salt pepper noise to a picture. The illustration is given below.

| | | |
|---|---|---|
| 0 | 255 | 0 |
| 0 | 255 | 255 |
| 255 | 0 | 255 |

Table 5.1:- 3x3 widow m the process matrix

Here "255" is pixel that is being processed, i.e., P (i,j). As all the surrounded components are O's & 255's. If median value is to be considered, it will be 0 or 255 that is also counted as noisy. to deal with this issue, mean of pixels that were processed earlier from a chosen widow is taken & the elements are replaced by that value. A midpoint filter is implemented to search for that mean value. P is the considered as matrix being processed & P' is matrix that is already processed. A window of 3x3 size is chosen as the processing matrix as given below.

| | | |
|---|---|---|
| P(i-1, j-1) | P(i-1,j) | P(i-1, j-1) |
| P(i,j-1) | <P(i,j)> | P(i,j+1) |
| P(i+1, j-1) | P(i+1,j) | P(i+1,j+1) |

Table 3.2:- 3x3 widow m the process matrix

In a case where the pixel under processing is contaminated & also the associated pixels contain noise, those pixels are replaced by mean value of pixels that are processed already. In this we search the mean of [ P' ( i-l,j-l ) , P' ( i-l,j ), P '( i-l,j+l ), P' ( i,j-l ) ], previously processed associated constituents, with the support of midpoint filter &processing pixels are replaced by this value. ####}}}}


Fig 3.1 :- Original image

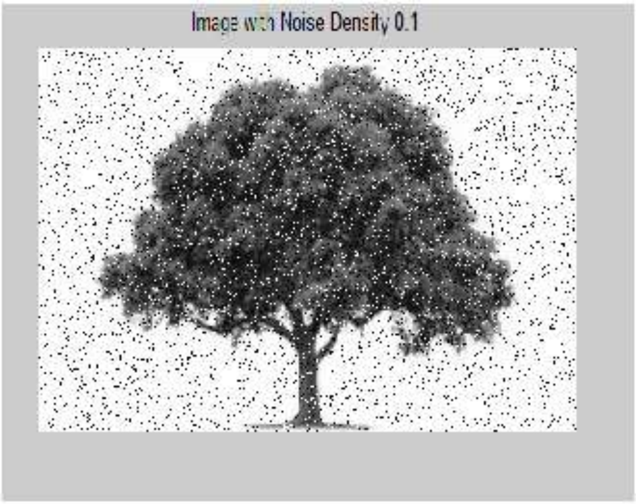


Fig 3.2 :- Noisy Image

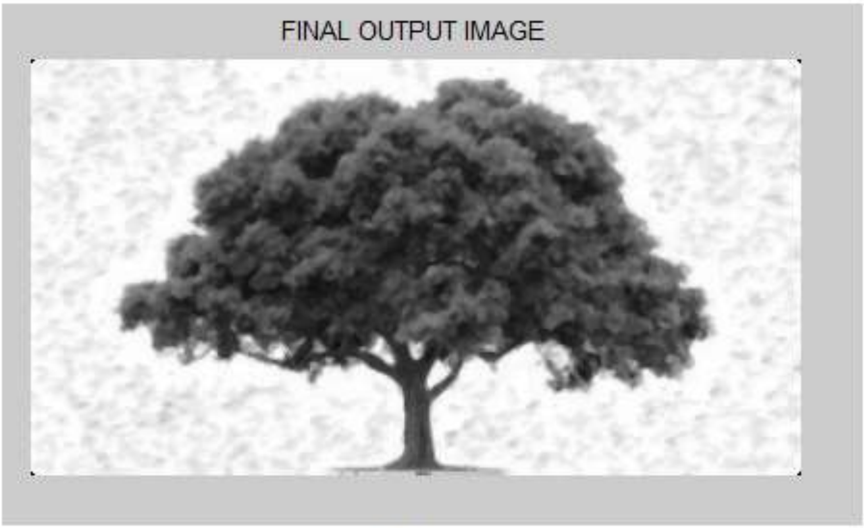


Fig 3.3 :- Final Output Image

**3.4 MEDIAN FILTER**

Neighborhood averaging can suppress isolated out-of-range noise, but the side effect is that it also blurs sudden changes such as line features, sharp edges, and other image details all corresponding to high spatial frequencies.

The median filter is considered as an effective technique that can distinguish by going out of range & isolate the noise from legitimate picture tributes like lines & edges. Particularly, the median filter replaces the pixel by median, rather than the average of all the pixels in neighborhood.

$$y[m,n] = \text{median } \{x[i,j],(i,j) \in \psi \}$$

Here $w$ presents a neighborhood that is defined by the user, concentrated around the center [m,n] in the picture.

### 3.4.1 1D median filter

A window of 1x5 size slides over 1-D array either in horizontal or vertical direction of the pixels. It is presumed that five of the pixels contained inside the windows are:

| | | | | |
|---|---|---|---|---|
| 80 | 90 | 200 | 110 | 120 |

Here the intermediate pixel having value of 200 is isolated out of bound & so is seen as noisy. Median of five of the values is computed by sorting the values. The median calculated is 110, which is the middle value.

| | | | | |
|---|---|---|---|---|
| 80 | 90 | 110 | 120 | 200 |

The actual value of pixel is 200 that is replaced by median value i.e. 110.

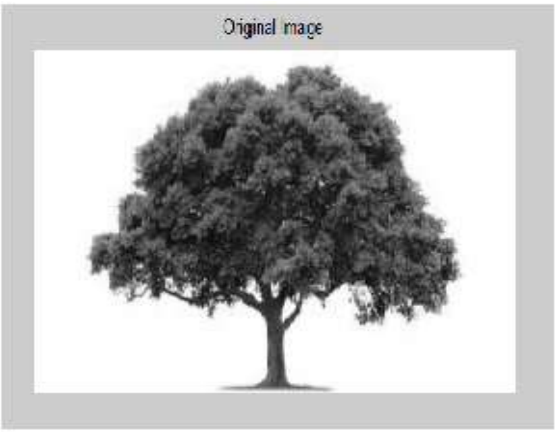


Fig 3.4 :- Original image

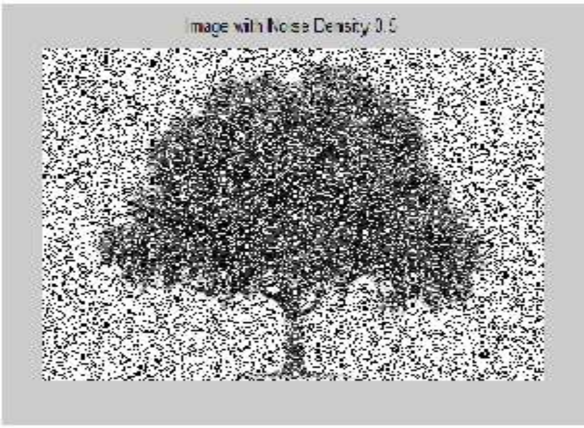

Fig 3.5 :- Noisy Image

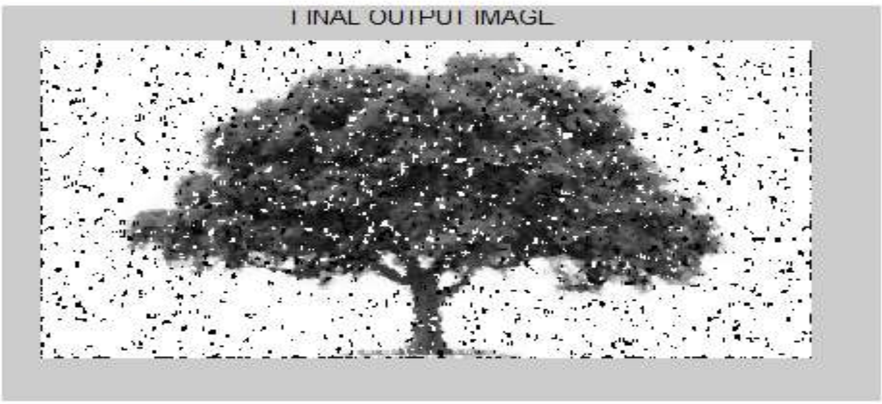

Fig 3.6 :- Final Output

### 3.5 ADAPTIVE MEDIAN FILTER

Adaptive median filter is implemented to enhance the flexibility in a filter so that it is able to modify its size as per the approximated density of local noise. This adaptive median filter is constituted over trans-conductance comparator. In this there is a provision to transform the saturated current so it is able to work like local weight operator.

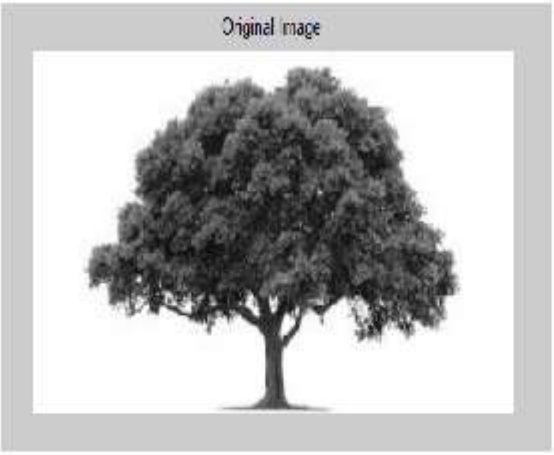


Fig 3.7 :- Original image

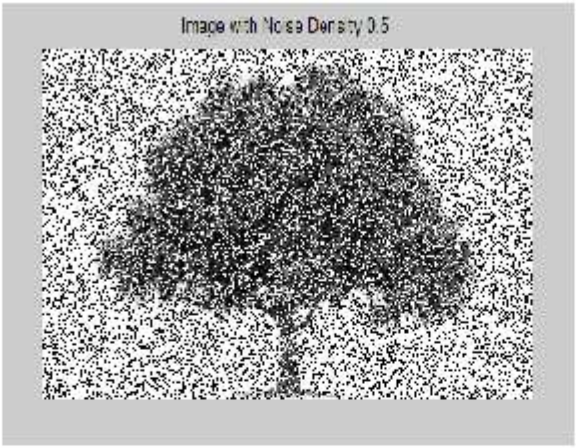


Fig 3.8 :- Noisy Image

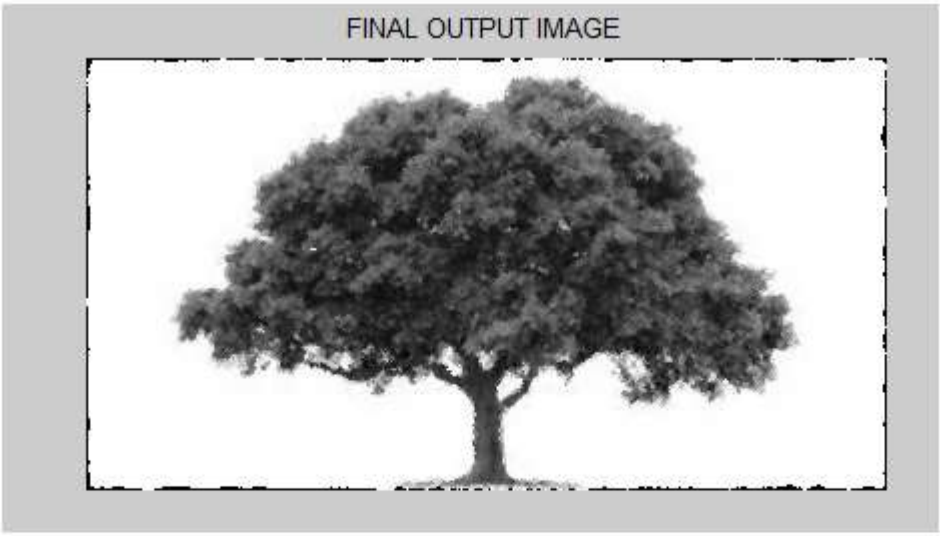


Fig 3.9 :- Final Output Image

### 33.6 PROPOSED METHODOLOGY

#### 3.6.1 Peak Signal to Noise Ratio

PSNR is the abbreviating of Peak signal to noise ratio. T is the ration in the maximum amount of power of signal & power of contaminating noise that puts an adverse impact over fidelity of the presentation. As several signals possess a wider dynamic range, PSNR is classified as logarithmic decibel scale. PSNR is generally implemented for computing the quality of reconstruction of loosy compression codec's. The signal in the scenario is observed as actual information & noise is the flaw invaded by the process of compression. In contrast to compression codec's, PSNR is seen as an estimate to quality of reproduction. Though high value of PSNR signifies that reproduction needs to be of high quality, in some of the scenarios it may not be like as per required. One needs to put complete focus with range of validation of the metric; it is valid when it contrasts the outcome for the same codec or its type & similar content.

$$\text{PSNR in dB} = 10 \log_{10} 255^2 / \text{MSE} \quad \ldots\ldots. (1)$$

$$\text{MSE} = \frac{\sum_i \sum_j (Y(i,j) - Y^{(i,j)^2}}{M*N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2)$$

A matrix of 5x5 size is suggested & is replaced by 3x3. The replacement of matrix furnishes a higher amount of pixels to salt & pepper noise. We focus on enhancing the methodologies for eliminating the noise. As the writer is working over window of 3x3, it signifies that 9 pixels re processed an instance. So, it takes more time to process the pixels. The size of matrix is raised to 5x5 & so 25 pixels are processed at one time. We tend to improvise the MSE & PNR values as more amounts of pixels are evaluated in less amount of time.

**Step 1 :-** In this paper & salt noise is invaded in the for 10 % , 20 % ,30% ,40%, 50% ,60%,70%,80%,90%,100%.

**Step 2:-** Now another algorithm is formulated for elimination of paper & salt noise. In the base paper, salt & pepper noise is eliminated by a 3*3 matrixes. But we tend to formulate it for 5*5 matrixes. By this we are able to eliminate salt & pepper noise by present algorithm & it provides high level of performance for values of MSE & PSNR.

**Step 3:-** Now in the code, actual images are presented.

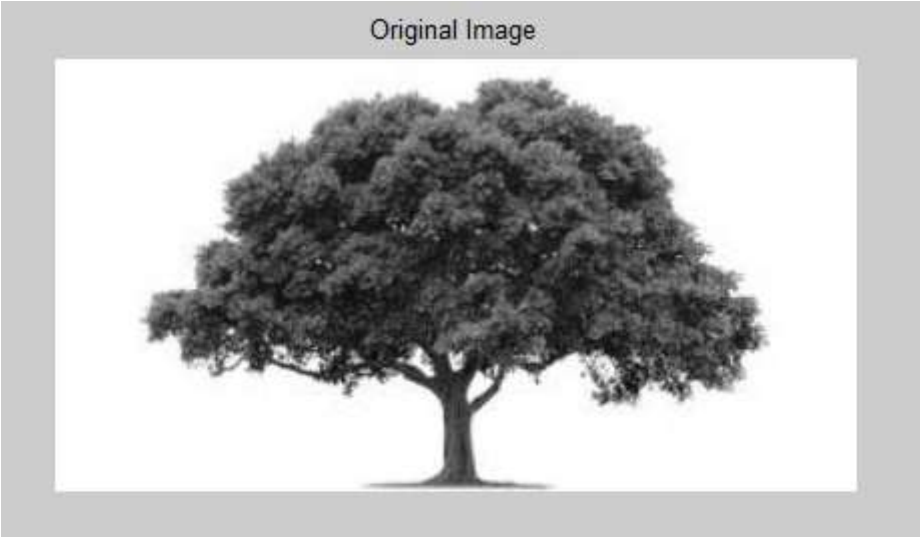


Figure 3.10: - Original image

**Step 4:-** Then noisy pictures are presented.

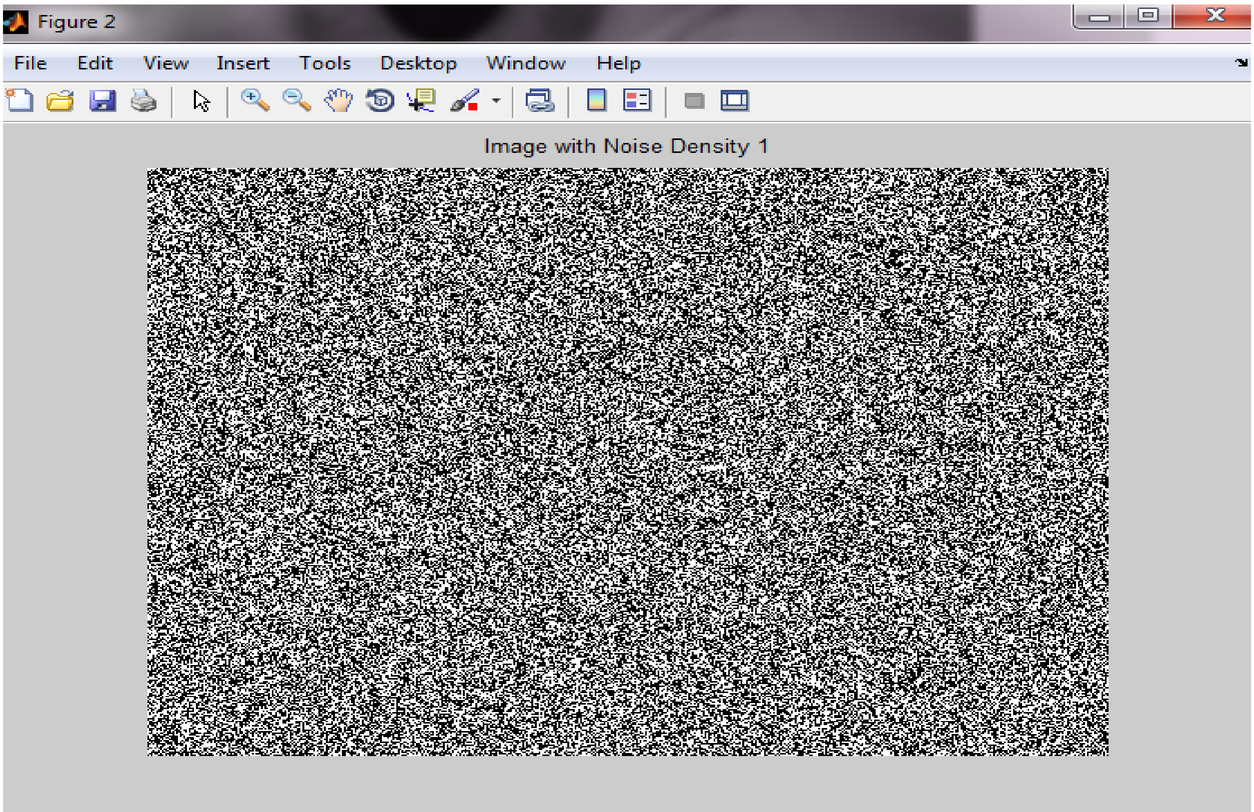


Figure 3.11:- Noisy Image

Step 5:- The suggested algorithm is implemented as given below:

### 3.6.2 Algorithm

Step 1: A 2-D window of size 5*5 is chosen. Let B (i, j) be the pixel to be processed.

Step 2: It is evaluated that if pixel B (i, j) that is being processed is corrupted or not.

Step 3: If B (i, j) is the pixel that is not contaminated than it is left as it is.

Step 4: If the chosen window is comprised of few components as O's & 255's. Then 255's & O's are eliminated & median value is computed for rest of the components. The pixels having noise are replaced by this median value.

Step 5: Steps from 1 to 4 are repeated till all the pixels in the whole of the image gets processed.

```
for i=3:a-2
        for j=3:b-2
            If B (i,j)==255 || B(i,j)==0
                X = [B(i-2,j-2),B(i-2,j-1),B(i-2,j),B(i-2,j+1),B(i-2,j+2),...
                    B(i-1,j-2),B(i-1,j-1),B(i-1,j),B(i-1,j+1),B(i-1,j+2),...
                    B(i,j-2),B(i,j-1),B(i,j+1),B(i,j+2),...
                    B(i+1,j-2),B(i+1,j-1),B(i+1,j),B(i+1,j+1),B(i+1,j+2)...
                    B(i+2,j-2),B(i+2,j-1),B(i+2,j),B(i+2,j+1),B(i+2,j+2)];
                B (i, j) = mean(X);
```

As per the above given code is explained, if B (i,j) = 255 or 0 then all the associated pixels are accumulated in X. Then mean of stored vales of pixels is computed that is accumulates B (i, j).

MSE22 (k) = sum (sum (MSE2))/ (a*b);

PSNR22 (k) = 10*log10 (double (max (max (B)) ^2/MSE22 (k)));

# CHAPTER 4

# RESULTS

## 4.1 TREE IMAGE OUTPUTS

### 4.1.1 Median Filter

#### 4.1.1.1 10% Noise

Here, picture of baboon is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 14.36 & PSNR is 12.55.


Fig 4.1 :- Output image (10% noise )


Fig 4.2 :- Output image (30% noise )

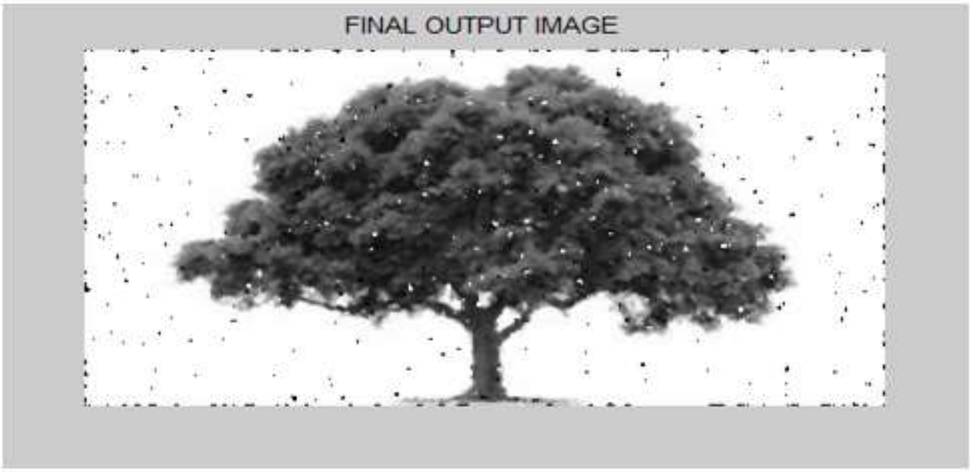


Fig 4.3 :- Output image (50% noise )

**4.1.1.2 30% Noise**

Here, picture of tree is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 18.35 & PSNR is 11.46.

**4.1.1.3 50% Noise**

Here, picture of tree is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 25.88 & PSNR is 10.00.

**4.1.2 Adaptive Median Filter**

**4.1.2.1 10% Noise**

Here, picture of tree is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 4.50 & PSNR is 17.56.


Fig 4.4 :- Output image (10% noise )

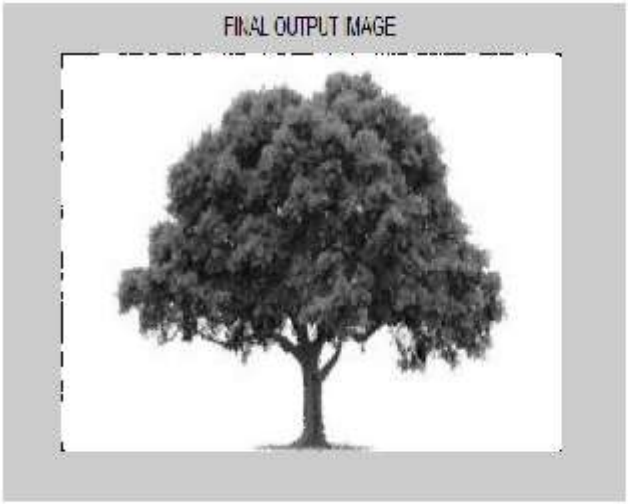


Fig 4.5 :- Output image (30% noise )

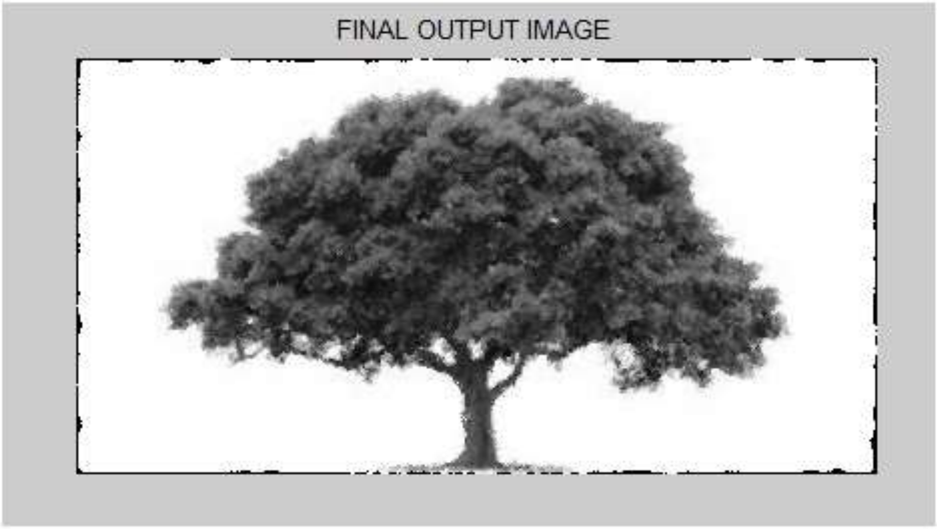


Fig 4.6 :- Output image (50% noise )

**4.1.2.2 30% Noise**

Here, picture of tree is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 8.64 & PSNR is 14.77.

**4.1.2.3 50% Noise**

Here, picture of tree is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 14.45 & PSNR is 12.55.

**4.1.3 Proposed Methodology**

**4.1.3.1 10% Noise**

Here, picture of tree is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.


Fig 4.7 :- Output image (10% noise )

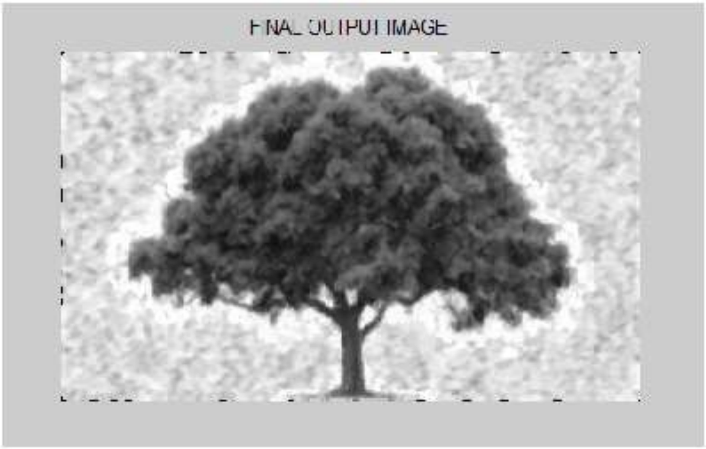


Fig 4.8 :- Output image (30% noise )

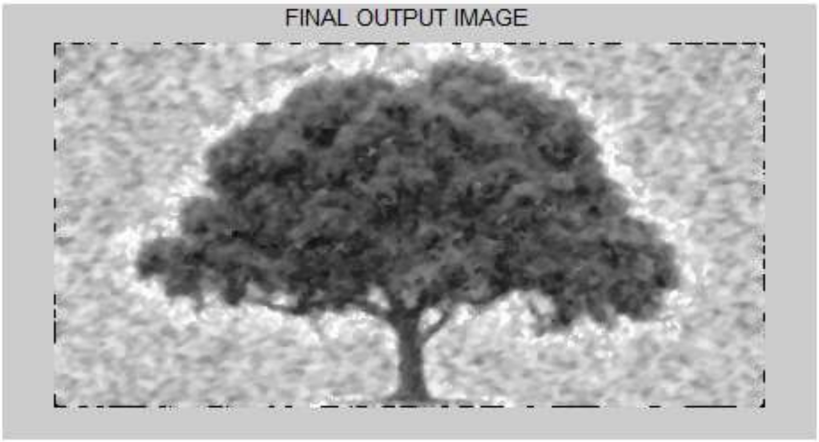


Fig 4.9 :- Output image (50% noise )

**4.1.3.2 30% Noise**

Here, picture of baboon is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

**4.1.3.3 50% Noise**

Here, picture of tree is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

**4.2 LENNA IMAGE**

**4.2.1 Median Filter**

**4.2.1.1 10% Noise**

Here, picture of leena is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 14.31 & PSNR is 9.57.


Fig 4.10 :- Output image (10% noise )


Fig 4.11:- Output image (30% noise )


Fig 4.12 :- Output image (50% noise )

#### 4.2.1.2 30% Noise

Here, picture of leena is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 15.76 & PSNR is 12.04.

#### 4.2.1.3 50% Noise

Here, picture of tree is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 30.10 & PSNR is 9.03.

### 4.1.2 Adaptive Median Filter

#### 4.1.2.1 10% Noise

Here, picture of leena is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 3.52 & PSNR is 18.57.


Fig 4.13 :- Output image (10% noise )


Fig 4.14 :- Output image (30% noise)


Fig 4.15 :- Output image (50% noise )

**4.1.2.2 30% Noise**

Here, picture of tree is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 7.05 & PSNR is 15.56.

**4.1.2.3 50% Noise**

Here, picture of leena is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 12.53 & PSNR is 13.01.

**4.1.3 Proposed Methodology**

**4.1.3.1 10% Noise**

Here, picture of leena is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.


Fig 4.16 :- Output image (10% noise )


Fig 4.17 :- Output image (30% noise )


Fig 4.18 :- Output image (50% noise )

**4.1.3.2 30% Noise**

Here, picture of leena is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

**4.1.3.3 50% Noise**

Here, picture of tree is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

## 4.3 BABOON IMAGE

### 4.3.1 Median Filter

#### 4.3.1.1 10% Noise

Here, picture of baboon is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 15.68 & PSNR is 12.04.

Fig 4.19 :- Output image (10% noise )

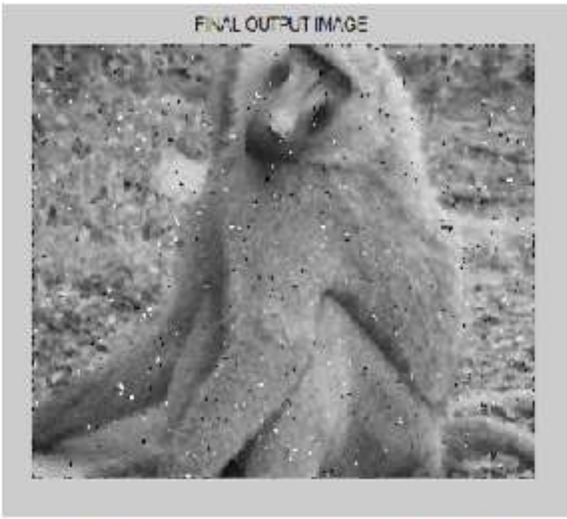


Fig 4.20 :- Output image (30% noise )

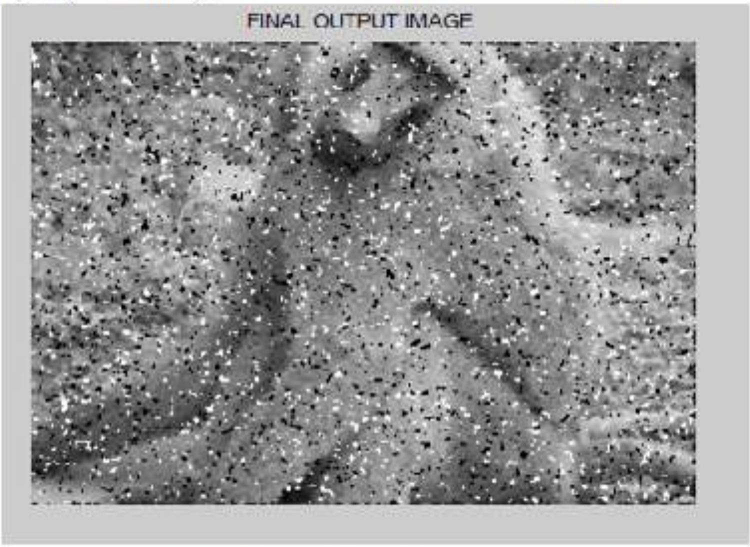


Fig 4.21 :- Output image (50% noise )

#### 4.3.1.2 30% Noise

Here, picture of baboon is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 23.84 & PSNR is 10.41.

#### 4.3.1.3 50% Noise

Here, picture of baboon is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 38.76 & PSNR is 8.45.

### 4.3.2 Adaptive Median Filter

#### 4.3.2.1 10% Noise

Here, picture of baboon is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 5.16 & PSNR is 16.90.


Fig 4.22 :- Output image (10% noise )


Fig 4.23 :- Output image (30% noise )

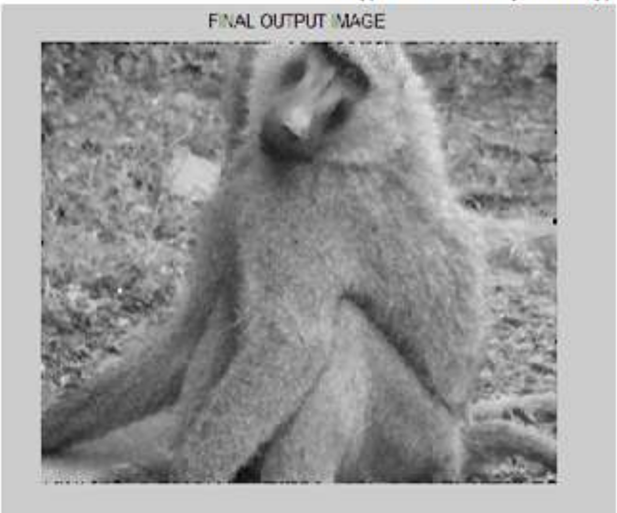


Fig 4.24 :- Output image (50% noise )

#### 4.3.2.2 30% Noise

Here, picture of baboon is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 10.70 & PSNR is 13.80.

#### 4.3.2.3 50% Noise

Here, picture of baboon is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 20.20 & PSNR is 11.14.

### 4.3.3 Proposed Methodology

#### 4.3.3.1 10% Noise

Here, picture of baboon is taken into consideration & noise of 0.1 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.


Fig 4.25 :- Output image (10% noise )


Fig 4.26 :- Output image (30% noise )


Fig 4.27 :- Output image (50% noise )

#### 4.3.3.2 30% Noise

Here, picture of baboon is taken into consideration & noise of 0.3 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

#### 4.3.3.3 50% Noise

Here, picture of baboon is taken into consideration & noise of 0.5 is invaded into it. Picture obtained as outcome is presented by MSE & PSNR values. MSE is 0.00 & PSNR is 24.07.

## 4.4 COMPARISON TABLE

### 4.4.1 For Lenna Image

| Noise Level | Median Filter | | Adaptive median Filter | | Proposed Methodology | |
|---|---|---|---|---|---|---|
| | PSNR | MSE | PSNR | MSE | PSNR | MSE |
| **10%** | 14.31 | 9.57 | 18.57 | 3.52 | 18.57 | 3.55 |
| **30%** | 12.01 | 15.76 | 15.56 | 7.05 | 15.44 | 7.20 |
| **50%** | 9.03 | 30.10 | 13.01 | 12.53 | 13.01 | 13.02 |

### 4.4.2For Baboon Image

| Noise Level | Median Filter | | Adaptive median Filter | | Proposed Methodology | |
|---|---|---|---|---|---|---|
| | PSNR | MSE | PSNR | MSE | PSNR | MSE |
| **10%** | 12.04 | 15.68 | 16.90 | 5.16 | 24.07 | 0.00 |
| **30%** | 10.41 | 23.84 | 13.80 | 10.70 | 24.07 | 0.00 |
| **50%** | 8.45 | 38.76 | 11.14 | 20.20 | 24.07 | 0.00 |

### 4.4.3 For Tree Image

| Noise Level | Median Filter | | Adaptive median Filter | | Proposed Methodology | |
|---|---|---|---|---|---|---|
| | PSNR | MSE | PSNR | MSE | PSNR | MSE |
| **10%** | 12.55 | 14.36 | 17.56 | 4.50 | 24.07 | 0.00 |
| **30%** | 11.46 | 18.35 | 14.77 | 8.64 | 24.07 | 0.00 |
| **50%** | 10.00 | 25.88 | 12.55 | 14.45 | 24.07 | 0.00 |

# CHAPTER 5

# CONCLUSION AND FUTURE SCOPE

In this thesis the suggested algorithm gives a new way to enhance the PSNR in high corrupted pictures. This technique provides a significant reproduction of pictures even when the density of noise is 90%. Apart from other filtration methodologies that need iteration for their function & require more processing time, the suggested filter needed to be implemented for one time only & works efficiently with the time of computation.

As per the outcomes from experiments, the suggested method works superior to the traditional techniques in perceptual quality of picture. Also it is able to give stability is performance over different images over different densities of noise. One advantage of this methodology is that it doesn’t require any parameter for threshold. Outcomes of simulation reveal that this technique gives a fine outcome when experimented over high densities of noise. Hence the suggested filter has the ability for suppressing salt & pepper noise from lower to higher densities. At the same instance it helps is preserving of details about picture, textures & edge also.

In the field of criminology probability of occurrence of salt & pepper noise is very high in the digitized images. Though the pictures captured in the CCTV cameras get blur. In these scenarios, the suggested methodologies are implemented in preprocessing state of the confined picture. After the preprocessing, the blur is eliminated & so the perceptional quality of picture is enhanced.