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# Reduction of Noise in Restoration of Images Using Mean and Median Filtering Techniques

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***Abstract:*** ***The purpose of this paper is to present a study of digital technology approaches to image restoration. This process of image restoration is crucial in many areas such as satellite imaging, astronomical image & medical imaging where degraded images need to be repaired Personal images captured by various digital cameras can easily be manipulated by a variety of dedicated image processing algorithms [2]. Image restoration can be described as an important part of image processing technique. Image restoration has proved to be an active field of research in the present days. The basic objective is to enhance the quality of an image by removing defects and make it look pleasing [2]. In this paper, an image restoration algorithm based on the mean and median calculation of a pixel has been implemented. We focused on a certain iterative process to carry out restoration. The algorithm has been tested on different images with different percentage of salt and pepper noise. The improved PSNR and MSE values has been obtained.***

***Keywords: De-Noising, Image Filtering, Mean Filter & Median Filter, Salt and Pepper Noise, Denoising Techniques, Image Restoration.***

## I. INTRODUCTION

Digital images play an important role both in daily life applications such as satellite television, magnetic resonance imaging, computer tomography as well as in areas of research and technology such as geographical information systems and astronomy. Here, Noise can be introduced by transmission errors and compression. It is necessary to apply an efficient denoising technique to compensate for such data corruption. Image denoising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. Different algorithms are used depending on the noise model. One such method use in this paper is mean and median filtering technique.

## II. IMAGE CLASSIFICATION

Images [1] can be either digital or analog. Pixel's value in digital images must be discrete whereas pixel value should be continuous in Analog images. One more difference between digital and analog images is storage of pixels. It is possible to store all pixels of digital image whereas not possible for analog images. In digital image processing, quality of an image is crucial to obtain high accuracy on features extraction, classification, identifying diseases etc. Noise occurs during image acquisition and transmission processes. During Transmission, images may be corrupted due to obstruction in transmission channels. Images can be classified into:

*A.* Binary Image
*B.* Gray Scale Image
*C.* Colour Image

Binary images [1] can be represented with only two values 0 (Black) & 1 (White). Binary image can also be classed as 1-bit image as it need only one byte for representing each pixel. These are repeatedly used where information is required only in the form of shape or general line.

Mainly there are 5 formats for storing images [2].

1) *TIFF (Tagged Image File Format):* Creates very large files and mostly used in Photoshop, Quark etc.
2) *JPEG (Join Photographic Experts Group):* Generally used for photographs on the web. These are the images that have been compressed to store large amount of data.
3) *GIF (Graphic Interchange Format):* Compressed but lossless.
4) *PNG (Portable Network Graphics):* Extensively used for web images.

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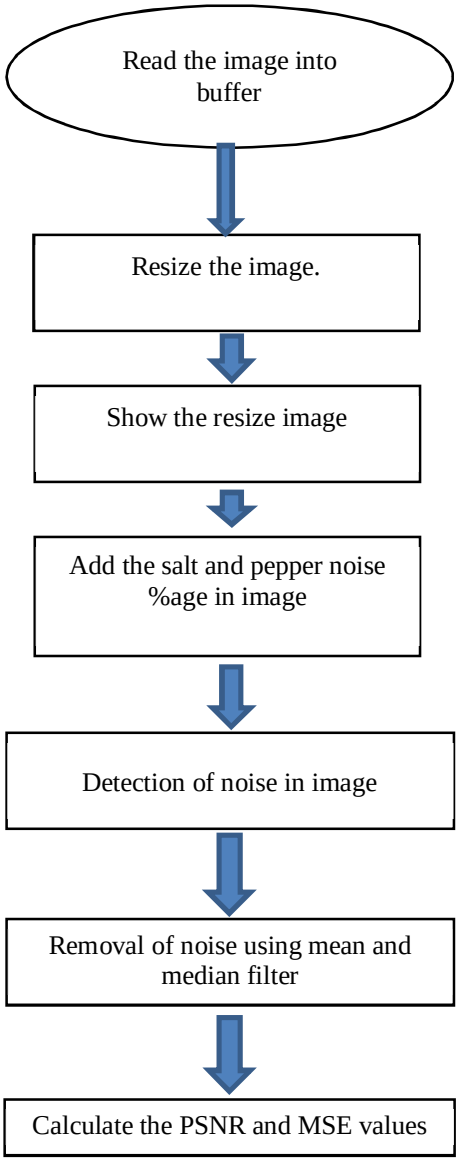
5) *RAW image File:* contains data from a digital camera and also contains a huge amount of data that is uncompressed. Today's increasingly digital world, digital images play an important role in the day today life as well as in areas of research and technology such as in Magnetic Resonance, satellite TV including geographic information System etc. Noise is unwanted signal that interferes with the original image and degrades the visual quality of original image. The main sources of noise in digital images are imperfect instruments, problems with the data acquisition process, natural phenomena interference, transmission and compression [2]. Image noise removal is a phenomenon for removal of noise from digital image which gets affected during the acquisition or while maintaining visual quality. Thus, it is necessary to design some effective techniques for denoising of digital images. Reduce image noise is a fundamental problem in the field of image processing. This document provides several techniques for eliminating noise and also gives us knowledge about which method will provide reliable and rough estimate of the original image, given its degraded version [3].

## III.FLOW CHART




This is diagram of flow chart of proposed work. In this flow chart firstly, we read the image into buffer. After that we compress the image, then we add salt and pepper noise into the images. Then we find the noise in images, after that we remove the noise using mean and median filter techniques. At the end we calculate the values of PSNR and MSE values.

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## IV. VARIOUS NOISE MODELS

Noise present in the image, either additive or multiplicative form [5].

1) *Additive Noise Model* Signal is additive in nature to the original signal is added to produce a noisy signal corrupted and follows the following pattern noise:
   $l(u, v)$=A(u,v)+B,(u,v).
   Where,
   A (u, is the actual image and B (u is the noise.
2) *Multiplicative Noise* Model In this model, the noise signal is multiplied to the original signal. The multiplicative noise model follows the rule:
   $l(u, v) = A(u, v) * B(u, v)$
   Where,
   The noise B (u, is multiplied with original image **l (u,** and produces corrupted image **l (u**, at **(u,** pixel location

## V. TYPES OF NOISES

Image noise is the random variation of brightness or colour information in images produced by the sensor and circuitry of a scanner or digital camera. Image noise is considered as an undesirable by product of image capture. The types of noises are as follows: -

### *A. Gaussian Noise (Amplifier Noise)*

The standard model of gaussian noise is accessory. Gaussian noise is independent at each pixel and independent of the signal intensity.

### *B. Salt and Pepper Noise*

An image with salt-and-pepper noise contains dark pixels at bright regions and bright pixels at dark regions [5].

### *C. Speckle Noise*

Speckle noise is a grainy noise that intrinsic in nature. Speckle noise is a significant disturbing factor for SAR image processing. SAR is caused by unified processing of disperses signals from multiple distributed targets [1].

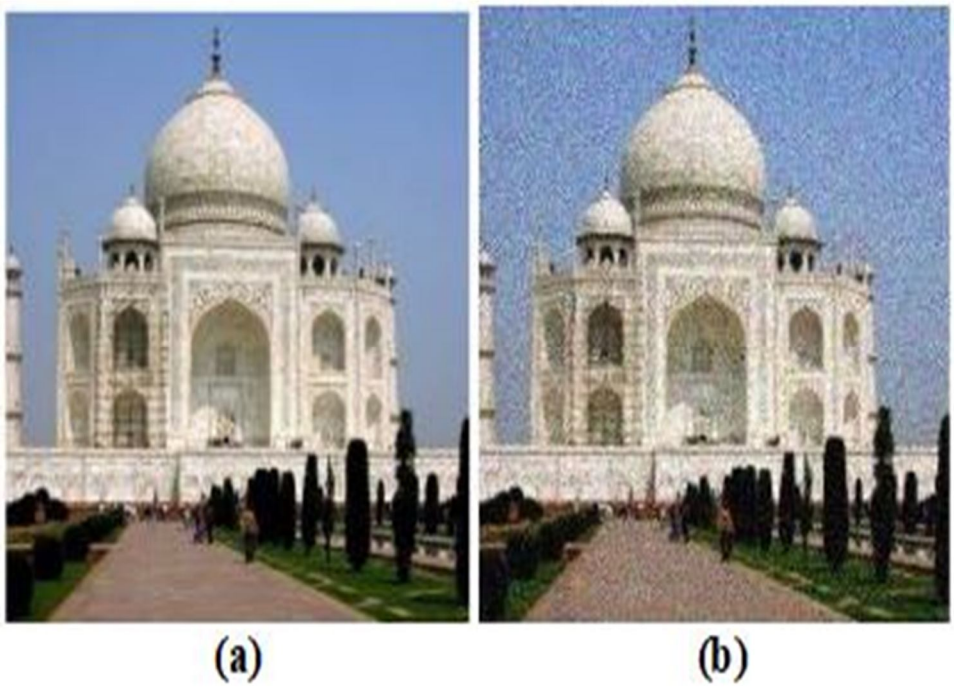


Figure. 1 (a) Image without noise [5] (b) Image with noise [5].

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## VI.RESTORATION METHOD

Advanced pictures are undermined by different sorts of commotion during the cycle of securing as well as transmission. The discovery and evacuation of this commotion assumes a vital part in reclamation. Assessing the commotion level from a solitary picture appears to be an inconceivable undertaking, and because of this we need to perceive whether neighbourhood picture varieties are man to shading, surface, or lighting varieties from the actual picture or because of the clamour. It may appear to be that precise assessment of the commotion level would require an extremely refined earlier model for pictures. In any case, in this piece of work, we utilize the mean channel to process the mean of the multitude of neighbours and further supplant the middle pixel by the mean worth. This guarantees reclamation of an uproarious picture to a generally excellent degree. Picture reclamation is generally the initial step of the entire picture preparing measure. It builds the nature of the picture by disposing of uproarious pixels. The reclamation of a really debased picture should be possible by composing calculations, which continue for distinguishing a boisterous pixel in the whole picture. The picture rebuilding strategy shows up in numerous fields. These incorporate stargazing, military, medications to give some examples. Photograph handling labs may likewise discover reclamation methods an important apparatus in finishing up extraordinary photos. These fields have different focuses on picture reclamation, yet certain essentials are regular to all picture rebuilding issues. The corruptions may have numerous causes, however the two kinds of debasements that are frequently predominant are clamour and obscuring, every one of which presents impossible to miss issues in picture rebuilding. In the calculation referenced, the debasement acquainted due with obscuring is invalidated [2]. This obscuring can be caused because of relative movement between the camera and the first scene, or by an optical framework that produces out of centre pictures. At the point when ethereal photos are created for distant detecting purposes, obscures are acquainted in the pictures due with barometrical turbulences, abnormalities in the optical frameworks and relative movement between the camera and the ground. Henceforth, with every one of these prospects, we need to do rebuilding of pictures created by the gadgets. Additionally, when this occurs, some measure of data contained in the first scene is lost or covered up due to obscuring of picture. Picture preparing strategy should manage the essential reality that data has been lost or clouded. The fundamental impediment in rebuilding procedure could be the absence of information about debasements. In a large portion of the cases, the corruption really annihilates the data in a picture, and the information on debasement can be inadequate to check the debasement. Then again, most rebuilding calculations require some measure of earlier data to get a re-established picture. This data can be given from various perspectives. The best wellspring of data can be acquired by making a suspicion that the first scene is smooth for example there is a level of relationship be tween's the different adjoining focuses in a picture or state, all the pixels in a picture are by one way or another identified with one another. Consequently, we register the mean an incentive in a sifting window and supplant the defiled pixel by mean of its neighbours. This remains constant for each genuine picture; however, the degree and the kind of relationship may change altogether from one picture to other.

### *A. Restoration Technique using Neighbour Method*

As the name says, to do rebuilding, we consider the closest neighbours of a pixel. In this paper, we consider for N=1, for example an aggregate of eight neighbours of every pixel is considered in a separating window of 3x3.The size of the window can be more than 3x3 as well. In the 2D network of picture components, every component has a specific relationship with its closest components. With the guide of this property, we can compose calculations to supplant an uproarious pixel by a worth which turns out to be the mean of all the closest neighbours. This guarantees a decent degree of reclamation as demonstrated in the outcomes. The calculation proposed does an iterative cycle wherein the mean force is found and further substitution of uproarious pixel is finished. Consider an information picture. Allow us to characterize a pixel at a position (i,j) in the information picture. Right off the bat, the likelihood of event of each neighbour of Im(i,j) is determined. For an aggregate of eight neighbours in that window, the mean worth is acquired by utilizing the accompanying articulation

$$M = \sum_{I=1}^{N} XiP(Xi)$$

The worth got in the above case gives the mean of all adjoining purposes of a specific pixel. This gives a worth what we call as a "great pixel esteem". Hence, we supplant the focal degenerate pixel by this great pixel esteem. This guarantees the rebuilding of the given picture by eliminating [2] the ruined pixels.

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*B. Algorithm*

There are following steps as follow as:

1) *Step 1:* Image data set will be 3 grey scale images.
2) *Step 2:* Algorithm to denoise salt and pepper noise
3) *Step 3:* Results will be calculated on 1% to 15% level of noise.
4) *Step 4:* Result of restoration stage will be provided with both mean and median.
5) *Step 5:* MSE and PSNR parameters will be used for result calculation.

## VII. RESULT

As seen in Fig-2, the input image is a noisy image. It has got some degree of noise density in it. The objective of the dissertation is to remove all the noise from the image and make it a good image. The proposed algorithm was tested on several standard test images and the above result was obtained for the image which is corrupted by noise. The resulted image is shown in Figure 2 and each corrupt pixel in it is replaced by the mean and median value of its neighbors. The observation of output image gives an idea that a noisy input image can be restored to a good level [2].

Figure 2: Result for Image 1.

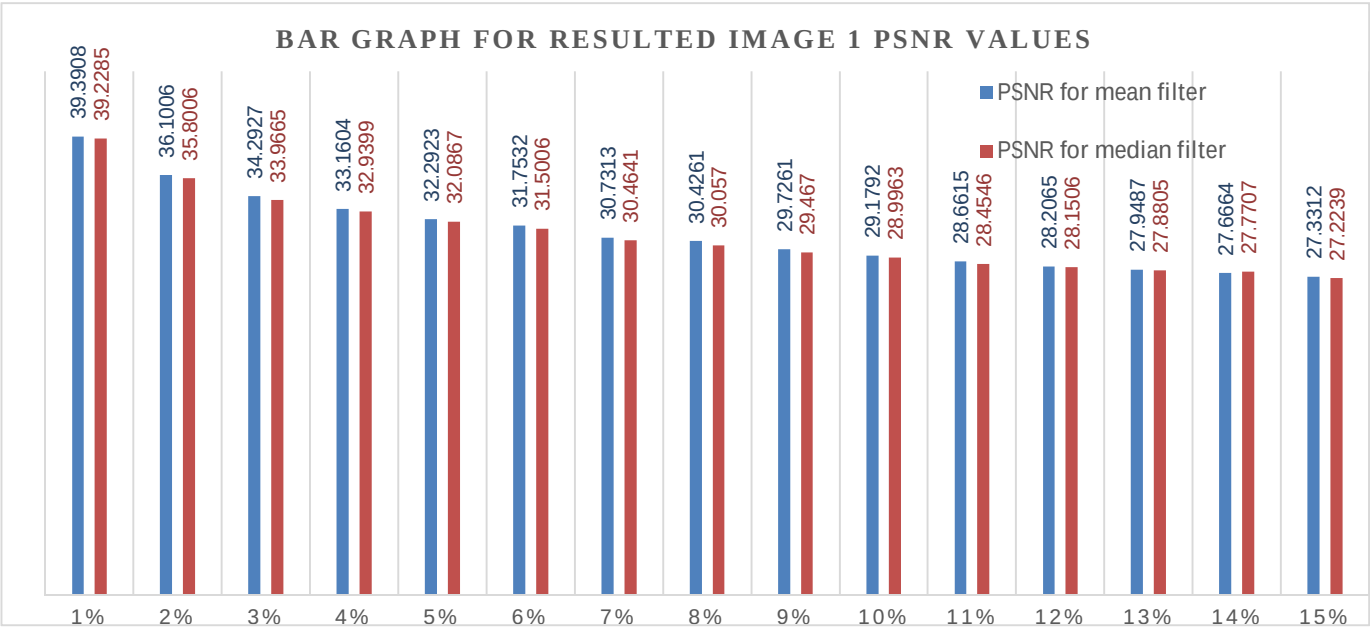


Figure.2.1 Bar graph of PSNR values for resulted image 1.

Figure 2.1 Bar graph of PSNR values for resulted image 1 is shown in the above figure.

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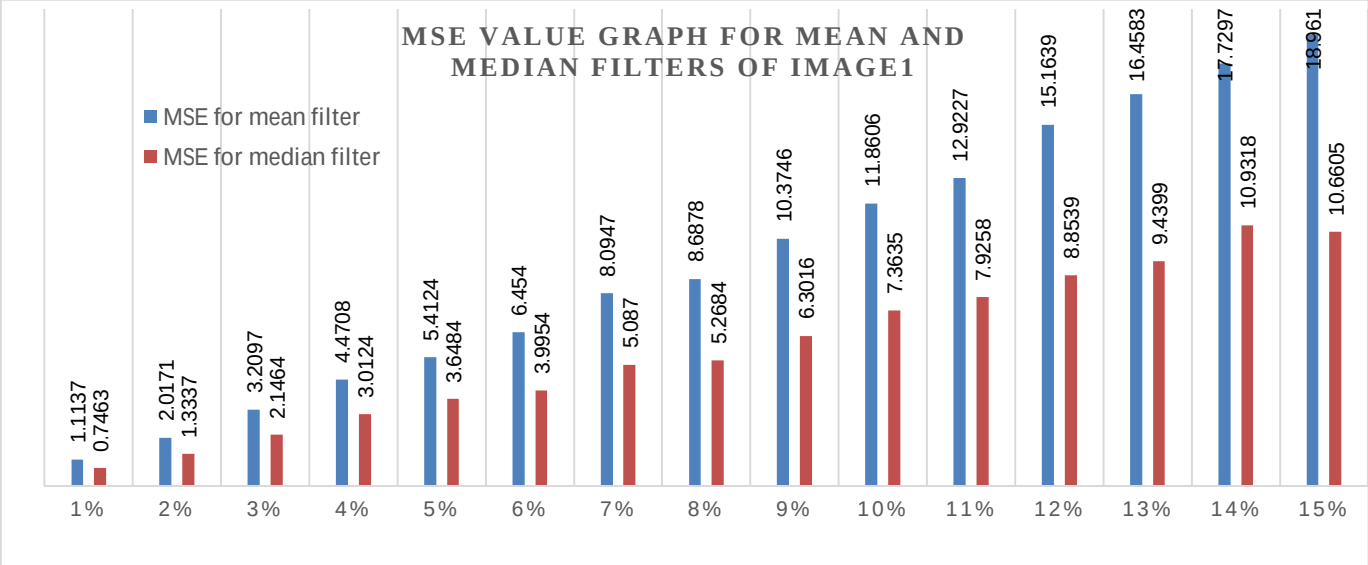


Figure.2.2 Show's bar graph for resulted image 1 MSE values

Figure.2.2 The above bar graph shows the figure of MSE values for resulted image 1

Similar procedure for second resulted image has been done which is seen in Figure 3, the input image is a noisy image. It has got some degree of noise density in it. The objective of the dissertation is to remove all the noise from the image and make it a good image. The proposed algorithm was tested on several standard test images and the result was obtained for the image which is corrupted by noise. The resulted image is shown in Figure 3 and each corrupt pixel in it is replaced by the mean and median value of its neighbors. The observation of output image gives an idea that a noisy input image can be restored to a good level [2].

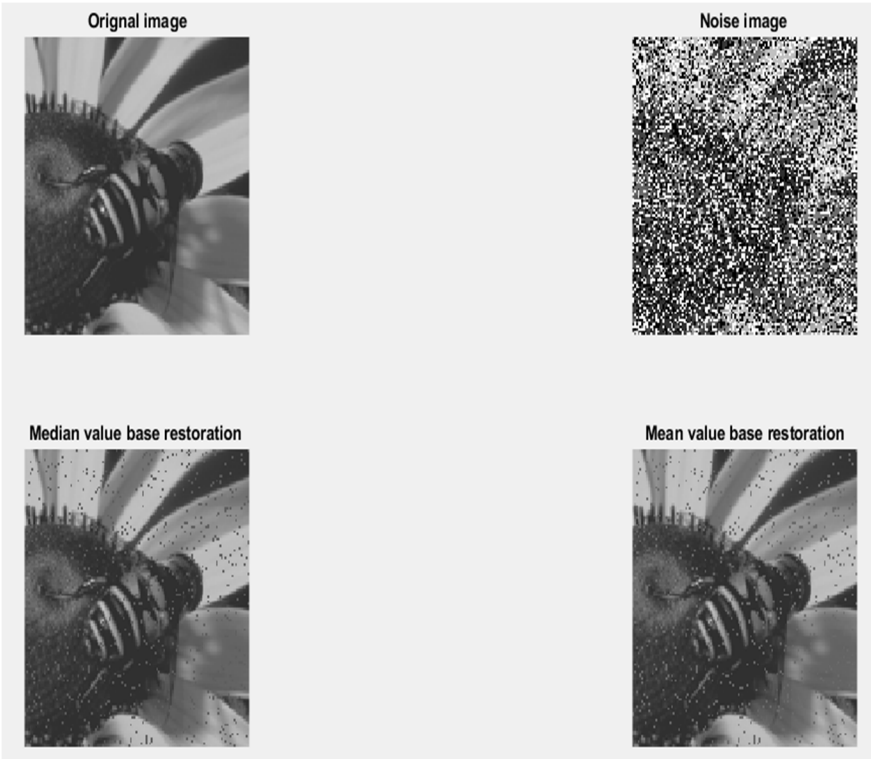


Figure 3: Result for Image 2.

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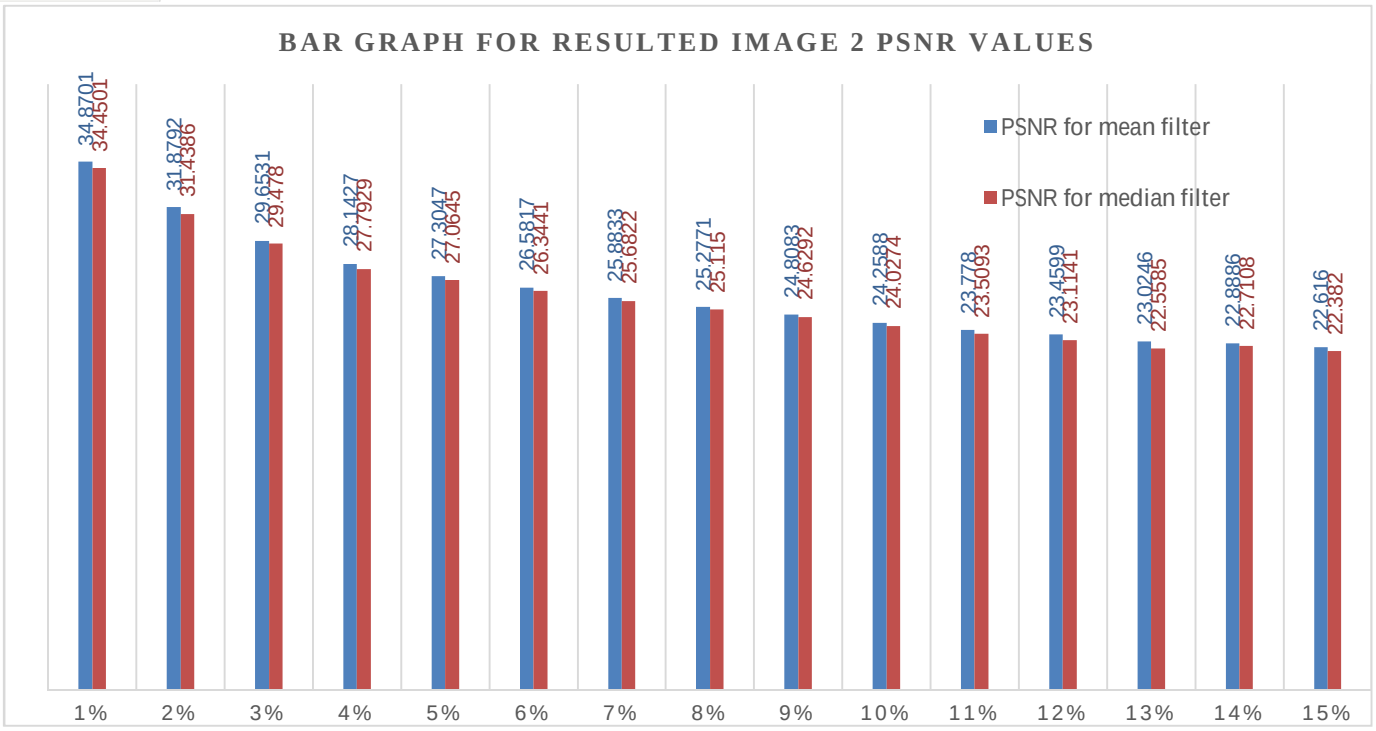


Figure.3.1 Show's bar graph for resulted image 2 PSNR values

Figure.3.1 The above bar graph shows the PSNR values for resulted image

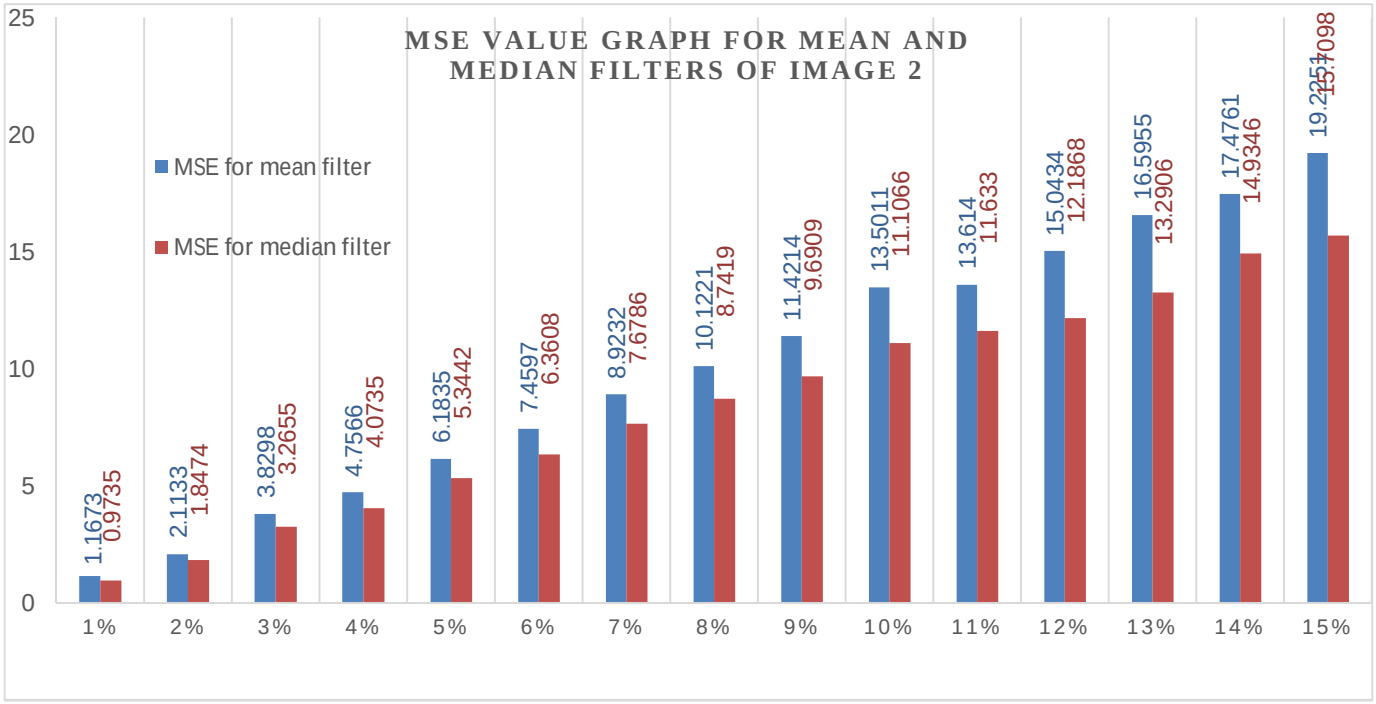


Figure 3.2 Show's bar graph for resulted image 2 MSE values

Figure.3.2 The above bar graph shows the figure of MSE values for resulted image 2.

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Also, the same procedure for third resulted image has been done which is seen in Figure 4.9, the input image is a noisy image. It has got some degree of noise density in it. The objective of the dissertation is to remove all the noise from the image and make it a good image. The proposed algorithm was tested on several standard test images and the above result was obtained for the image which is corrupted by noise. The resulted image is shown in Figure 4.9 and each corrupt pixel in it is replaced by the mean and median value of its neighbors. The observation of output image gives an idea that a noisy input image can be restored to a good level.

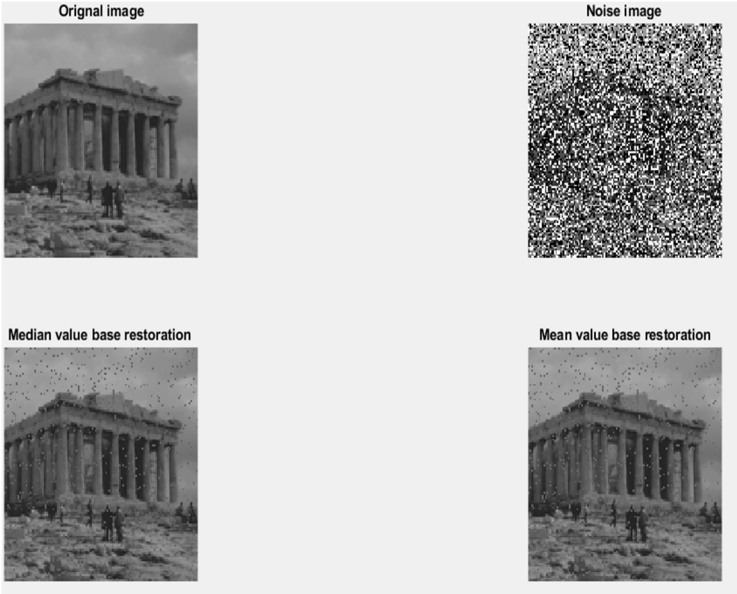


Figure. 4 Result for image 3

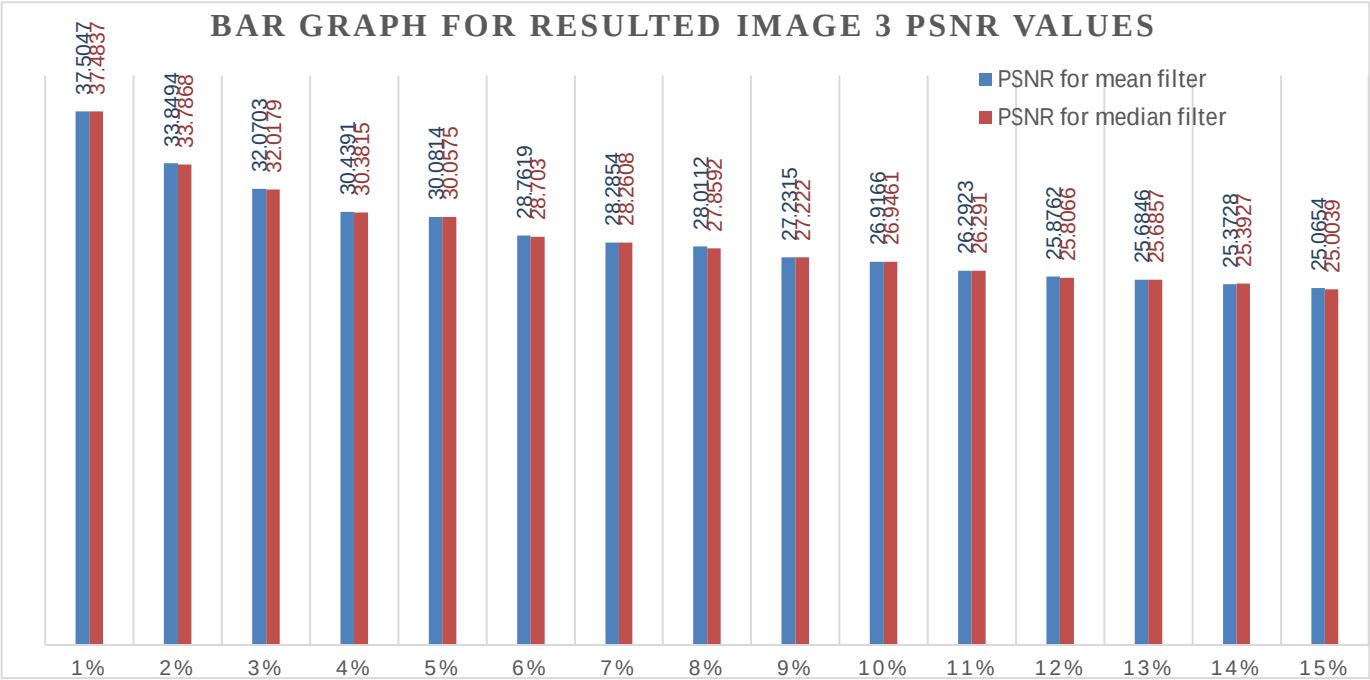


Figure.4.1 Show's bar graph for resulted image 3 PSNR values

Figure.4.1The above bar graph shows the figure of PSNR values for resulted image 3

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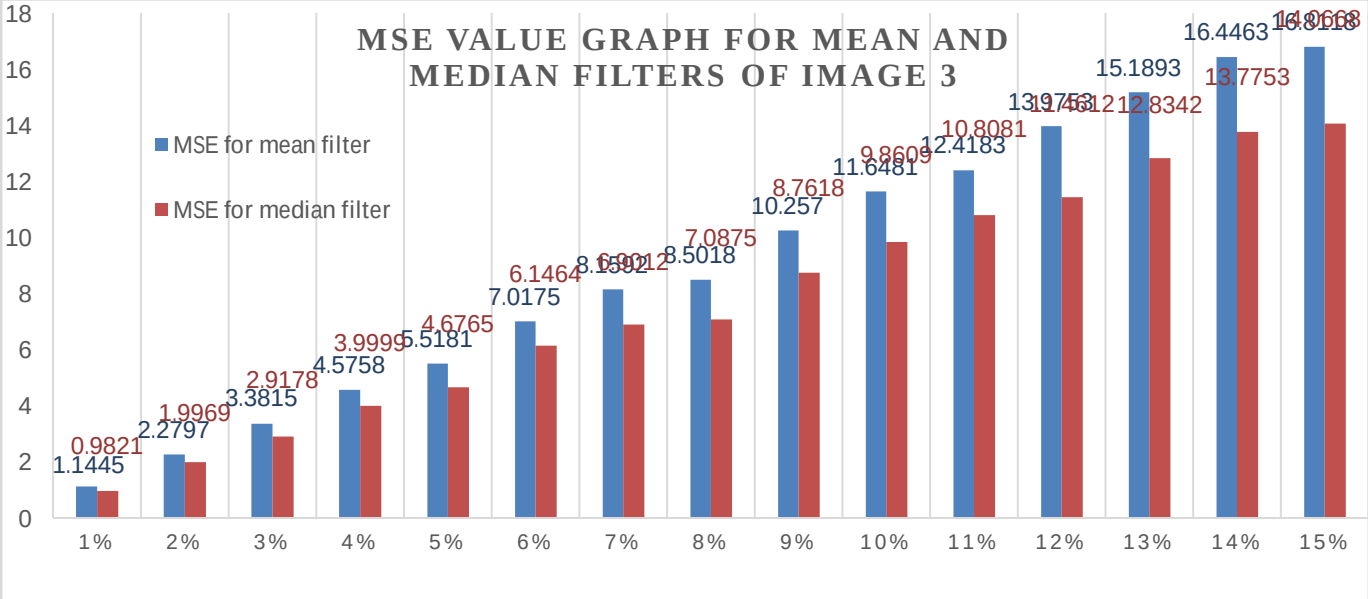


Figure.4.2 Show's bar graph for resulted image 3 MSE values.

Figure.4.2The above bar graph shows the figure of MSE values for resulted image 3

Table 1: -Comparison of PSNR and MSE of image 1 using mean and median filter for different percentage of noises.

| PSNR | | | MSE | | |
|---|---|---|---|---|---|
| % of salt and pepper noise | Mean Filters values | Median Filters Values | % of salt and pepper noise | Mean Filters values | Median Filters values |
| 1% | 39.3980 | 39.2285 | 1% | 1.1137 | 0.7463 |
| 2% | 36.1006 | 35.8006 | 2% | 2.0171 | 1.3337 |
| 3% | 34.2927 | 33.9665 | 3% | 3.2097 | 2.1464 |
| 4% | 33.1644 | 32.9399 | 4% | 4.4708 | 3.0124 |
| 5% | 32.2923 | 32.0867 | 5% | 5.4124 | 3.6484 |
| 6% | 31.7532 | 31.5006 | 6% | 6.4540 | 3.9954 |
| 7% | 30.7313 | 30.4641 | 7% | 8.0947 | 5.0870 |
| 8% | 30.4261 | 30.0570 | 8% | 8.6878 | 5.2684 |
| 9% | 29.7261 | 29.4670 | 9% | 10.3746 | 6.3016 |
| 10% | 29.1792 | 28.9963 | 10% | 11.8606 | 7.3635 |
| 11% | 28.6615 | 28.4565 | 11% | 12.9227 | 7.9258 |
| 12% | 28.2065 | 28.1506 | 12% | 15.1639 | 8.8539 |
| 13% | 27.9487 | 27.8805 | 13% | 16.4583 | 9.4399 |
| 14% | 27.6664 | 27.7707 | 14% | 17.7297 | 10.9318 |
| 15% | 27.3312 | 27.2239 | 15% | 18.9610 | 10.6605 |

Table 1 shows Comparison of PSNR and MSE of image 1 using mean and median filter for different percentage of noises.

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Table 2: -Comparison of PSNR and MSE of image 2 using mean and median filter for different percentage of noises.

| PSNR | | | MSE | | |
|---|---|---|---|---|---|
| % of salt and pepper noise | Mean Filters values | Median Filters Values | % of salt and pepper noise | Mean Filters values | Median Filters Values |
| 1% | 34.8701 | 34.4501 | 1% | 1.1673 | 0.9731 |
| 2% | 31.8792 | 31.4386 | 2% | 2.1133 | 1.8474 |
| 3% | 29.6531 | 29.4780 | 3% | 3.8298 | 3.2655 |
| 4% | 28.1427 | 27.7929 | 4% | 4.7566 | 4.0735 |
| 5% | 27.3047 | 27.0645 | 5% | 6.1835 | 5.3442 |
| 6% | 26.5817 | 26.3441 | 6% | 7.4597 | 6.3608 |
| 7% | 25.8833 | 25.6822 | 7% | 8.9232 | 7.6786 |
| 8% | 25.2771 | 25.1150 | 8% | 10.1221 | 8.7419 |
| 9% | 24.8038 | 24.6292 | 9% | 11.4214 | 9.6909 |
| 10% | 24.2588 | 24.0274 | 10% | 13.5011 | 11.1066 |
| 11% | 23.7780 | 23.5093 | 11% | 13.6140 | 11.6330 |
| 12% | 23.4599 | 23.1141 | 12% | 15.0434 | 12.1868 |
| 13% | 23.0246 | 22.5585 | 13% | 16.5955 | 13.2906 |
| 14% | 22.8886 | 22.7108 | 14% | 17.4761 | 14.9346 |
| 15% | 22.6160 | 22.3820 | 15% | 19.2251 | 15.7098 |

Table 2 Shows comparison of PSNR and MSE of image 2 using mean and median filter for different percentage of noises.

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Table 3: -Comparison of PSNR and MSE of image 3 using mean and median filter for different percentage of noises.

| PSNR | | | MSE | | |
|---|---|---|---|---|---|
| % of salt and pepper noise | Mean Filters values | Median Filters Values | MSE | Mean Filters values | Median Filters Values |
| 1% | 37.5047 | 37.4837 | 1% | 1.1445 | 0.9821 |
| 2% | 33.8494 | 33.7868 | 2% | 2.2797 | 1.9969 |
| 3% | 32.0703 | 32.0179 | 3% | 3.3815 | 2.9178 |
| 4% | 30.4391 | 30.3815 | 4% | 4.5758 | 3.9999 |
| 5% | 30.0814 | 30.0575 | 5% | 5.5181 | 4.6765 |
| 6% | 28.7619 | 28.7030 | 6% | 7.0175 | 6.1464 |
| 7% | 28.2854 | 28.2608 | 7% | 8.1592 | 6.9012 |
| 8% | 28.0112 | 27.8592 | 8% | 8.5018 | 7.0875 |
| 9% | 27.2315 | 27.2220 | 9% | 10.2570 | 8.7618 |
| 10% | 26.9166 | 26.9461 | 10% | 11.6481 | 9.8609 |
| 11% | 26.2923 | 26.2190 | 11% | 12.4183 | 10.8081 |
| 12% | 25.8762 | 25.8666 | 12% | 13.9753 | 11.4612 |
| 13% | 25.6846 | 25.6857 | 13% | 15.1893 | 12.8342 |
| 14% | 25.3728 | 25.3927 | 14% | 16.4463 | 13.7753 |
| 15% | 25.0654 | 25.0039 | 15% | 16.8118 | 14.0668 |

Table 3 shows Comparison of PSNR and MSE of image 3 using mean and median filter for different percentage of noises.

Table 4 Comparison between previous and proposed work of PSNR values.

| Parameters | Previous work | Proposed work | | |
|---|---|---|---|---|
| % of noise | Median filter1 | Median filter for image 1 | Median filter for image 2 | Median filter for image 3 |
| 10% | 19.17 | 7.3635 | 9.8609 | 13.5011 |
| 20% | 18.01 | 26.1537 | 20.9206 | 23.6313 |
| 30% | 15.56 | 22469 | 19.0710 | 21.9937 |
| 40% | 14.72 | 23.0646 | 17.9701 | 20.8528 |
| 50% | 13.83 | 22.1160 | 16.9259 | 19.7656 |

Table 4 shows Comparison between previous and proposed work of PSNR values.

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Table 5 Comparison between previous and proposed work of MSE values.

| Parameters | Previous work | Proposed work | | |
|---|---|---|---|---|
| % of noise | Median filter1 | Median filter for image1 | Median filter for image 2 | Median filter for image 3 |
| 10% | 785.53 | 7.3635 | 11.1066 | 9.8609 |
| 20% | 1027.1 | 14.7642 | 20.6483 | 18.8856 |
| 30% | 1806.8 | 23.4326 | 31.7200 | 28.8236 |
| 40% | 2190.6 | 31.1394 | 42.5411 | 39.2272 |
| 50% | 387.5 | 39.0464 | 52.9241 | 48.8280 |

Table 5 shows Comparison between previous and proposed work of MSE values.

## VIII. CONCLUSION

In this paper, an image restoration algorithm based on the mean and median calculation of a pixel has been implemented. We have used a grey-level image restoration method which has been implemented on the intensities of the nearest neighbors of a pixel. The proposed restoration algorithm works on finding out the mean value of all the neighbors which come in a window (3X3), and thereby calculating the probability of occurrence of each pixel value. We focused on a certain iterative process to carry out restoration. The algorithm has been tested on different images with different percentage of salt and pepper noise by using mean and median filtering technique. The improved PSNR and MSE values has been obtained.

Different neighborhood size in an image can either worsen or improve the restoration level and due to this, there exists a drawback of the algorithm. The drawback is that it cannot be applied to restore the elements which are at the boundaries. For this, we need to carry out certain edge detection techniques like Sobel Edge Detection Technique and Canny Edge Detection Technique.

## IX. FUTURE WORK

Since selection of the right denoising procedure plays a major role, it is important to experiment and compare the methods. As future research, we would like to work further on the comparison of the denoising techniques. If the features of the denoised signal are fed into a neural network pattern recognizer, then the rate of successful classification should determine the ultimate measure by which to compare various denoising procedures in image restoration.

## REFERENCES

[1] Vimal Chauhan and Chandni Thakur, “Review of Denoising Techniques in Image Restoration”, published in International Journal of Scientific Research and Engineering Development-– Volume 3 - Issue 5, Sep - Oct 2020.
[2] Vimal Chauhan and Chandni Thakur, “Image Restoration using Local Value”, published in International Journal of Scientific Research and Engineering Development—Volume 4 - Issue 1, Jan - Feb 2021.
[3] Rafael C. Gonzalez and Richard E. Woods “Digital Image Processing”, Pearson Education, Second Edition 2005.
[4] Kenneth, R., “Digital Image Processing”, Prentice Hall, New Jersey, 1979.
[5] S.Arivazhagan, S.Deivalakshmi, K.Kannan, “Performance Analysis of Image Denoising System for different levels of Wavelet decomposition”, International Journal of Imaging Science and Engineering (IJISE), Vol.1, No. 3, 2007.
[6] Umbaugh, S. E., “Computer Vision and Image Processing,” Prentice Hall PTR, New Jersey, 1998.
[7] Robert D. Nowak, “Wavelet Based Rician Noise Removal”, IEEE Transactions on Image Processing, vol. 8, no. 10, pp.1408, October 1999.
[8] Kenny Kal Vin Toh,Nor, Ashidi Mat Isa, “Noise Adaptive Fuzzy Switching Median Filter for Salt-and- Pepper Noise Reduction”, IEEE Trans. Image Processing, Vol. 17, No. 3, March 2010.
[9] Sheng-Fu Liang, Shih-Mao Lu, Jyh-Yeong Chang, and Chin-Teng Lin, “A Novel Two-Stage Impulse Noise Removal Technique Based on Neural Networks and Fuzzy Decision”, IEEE Trans. Image Processing, Vol. 16, No. 4, August 2008.
[10] H. Guo, J. E. Odegard, M. Lang, R. A. Gopinath, I.W. Selesnick, and C. S. Burrus, “Wavelet based speckle reduction with application to SAR based ATD/R,” First International Conference on Image Processing, vol. 1, pp. 75-79, Nov. 1994.
[11] Gagnon, L., “Wavelet Filtering of Speckle Noiseome Numerical Results,” Proceedings of the Conference Vision Interface, TroisReveres, 1999.
[12] Goodman, J. W., “Some fundamental properties of Speckle,” J. Opt. Soc. Am., pp. 1145–1150, 1976.
[13] Pawan Patidar, Manoj Gupta, Sumit Srivastava, Ashok Kumar Nagawat,“ Image De-noising by Various Filters for Different Noise”, International Journal of Computer Applications, Vol. 9, No.4, pp. 975- 887, 2010.

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[14] Yousef Hawwar and Ali Reza, "Spatially Adaptive Multiplicative Noise Image Denoising Technique", IEEE Transaction On Image Processing, Vol.-11, No. 12, 2002.
[15] Motwani, M.C., Gadiya, M. C., Motwani, R.C., Harris, F. C Jr. "Survey of Image Denoising Techniques," IEEE Conference Digital Communication System, pp. 11-16, 2012.
[16] Windyga, S. P., "Fast Impulsive Noise Removal," IEEE transactions on image processing, Vol. 10, No. 1, pp.173178, 2001.
[17] Kailath, T., "Equations of Wiener-Hopf type in filtering theory and related applications," in Norbert Wiener: Collected Works vol. III, P.Masani, Ed. Cambridge, MA: MIT Press, pp. 63–94, 1976.
[18] S.Arivazhagan, S.Deivalakshmi, K.Kannan, "Performance Analysis of Image Denoising System for different levels of Wavelet decomposition", International Journal of Imaging Science and Engineering (IJISE), Vol.1, No. 3, 2007.
[19] Idan Ram, Michael Elad, and Israel Cohen, "Generalized Tree-Based Wavelet Transform", IEEE Transactions On Signal Processing, Vol. 59, No. 9, 2011.
[20] Rakesh Kumar and B. S. Saini , " Improved Image Denoising Technique Using Neighboring Wavelet Coefficients of Optimal Wavelet with Adaptive
[21] Thresholding", International Journal of Computer Theory and Engineering , Vol. 4, No. 3, 2012.
[22] Sachin D Ruikar, Dharampal D Doye, "Wavelet based image denoising technique", International Journal of Advanced Computer Science and Applications, Vol.2, No.3, 2011.
[23] Sethunadh R and Tessamma Thomas ,"Spatially Adaptive Image Denoising using Undecimated Directionlet Transform", International Journal of Computer Applications (IJCA), Vol.8, No.11, 2013.
[24] S.Kother Mohideen, Dr. S. Arumuga Perumal, Dr. M.Mohamed Sathik, "Image De-noising using Discrete Wavelet transform", International Journal of Computer Science and Network Security (IJCSNS), Vol.8, No.1, 2008.
[25] S.S.Patil, A.B.Patil, S.C.Deshmukh, M.N.Chavan, "Wavelet Shrinkage Techniques for Images", International Journal of Computer Applications, Vol.7, No.1, 2010.
[26] Venkata Ranga Rao Kommineni, Hemantha Kumar Kalluri, "Image Denoising Techniques", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-7, Issue-5S4, February 2019.
[27] Rajneesh Mishra, Priyanka Pateriya, D.K. Rajoriya and Anand Vardhan Bhalla, "Comparative Analysis of Various Image Denoising Techniques: Review Paper", International Journal of Computer Sciences and Engineering, Vol.-3(6), PP(35-39) June 2015, E-ISSN: 2347-2693.
[28] Manonmani S Lalitha V.P, Shantha Ranga Swamy,"Survey of Image Denoisng Techniques", International Journal of Science, Engineering and Technology research (2278-7798) Volume 5, Issue 9 September 2016.
[29] Venkata Ranga Rao Kommineni, Hemantha Kumar Kalluri, "Image Denoising Techniques," Published in International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-7, Issue-5S4, February 2019.

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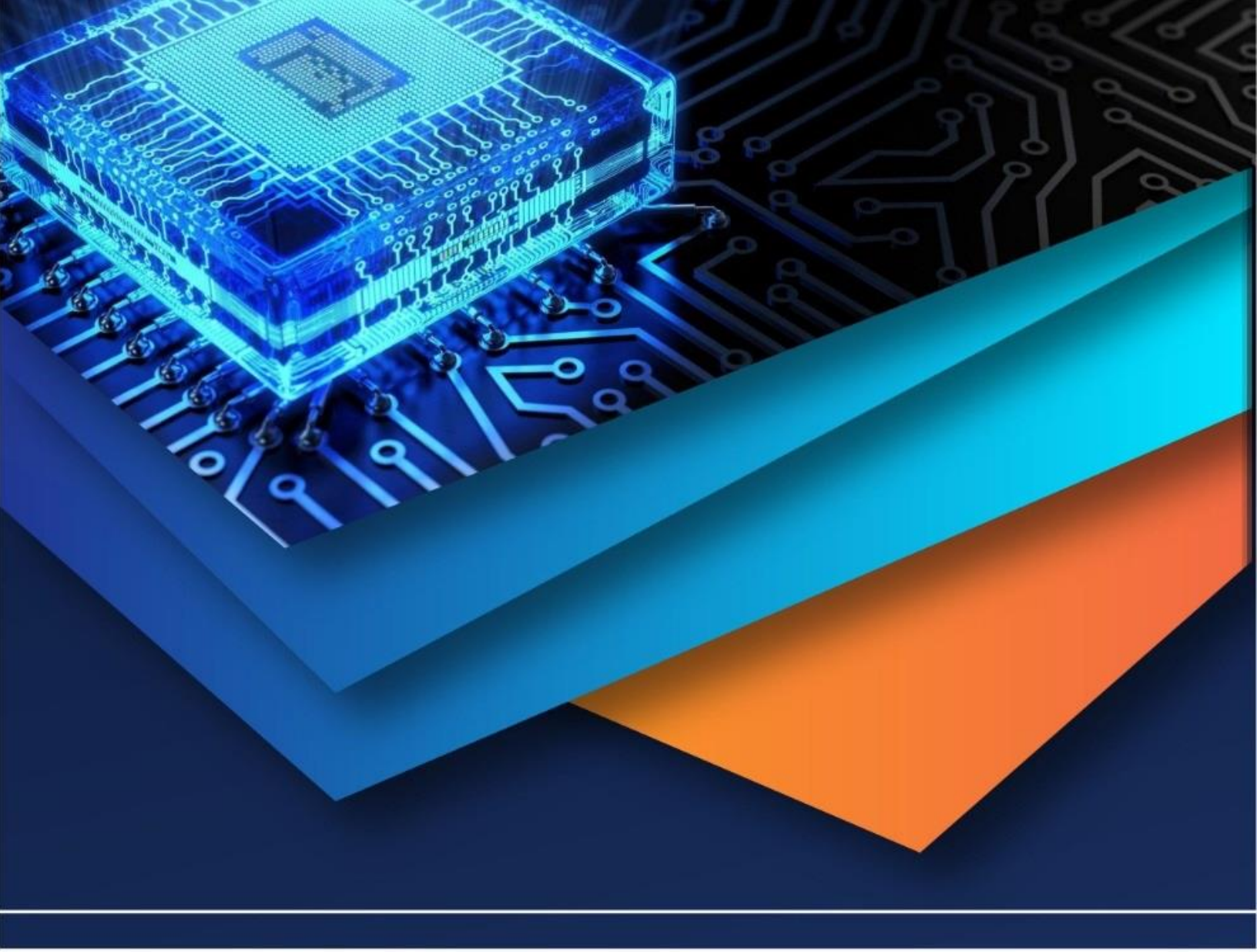

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