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Removing Salt-And-Pepper Noise from Digital Image Using Unsymmetric Trimmed Median Filter

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Abstract: ***Every digital image has a two-dimensional mathematical representation of the digital image. Digital image is made out of pixels i.e. picture component. Every pixel speaks to the dark level for highly contrasting photographs at a solitary point in the image, so a pixel can be spoken to by a small speck of particular shading. Image restoration is the process of restoring degraded images which cannot be taken again or the process of obtaining the image again is costlier. We can restore the images by prior knowledge of the noise or the disturbance that causes the degradation of the image. Image restoration is done in two domains: spatial domain and frequency domain. In a spatial domain, the filtering action for restoring the images is done by directly operating on the pixels of the digital image. In our research work different format of the same image will be executed for a different level of noise and then we will analyze which format will be best and besides PSNR two more parameters MSE and IEF also considered. In our research work, our main objective is to remove salt and pepper noise from the image. As in base paper, 30% and 70% salt and pepper noise are removed with PSNR value. But in our dissertation work salt and pepper noise at 30%, 50%, 70%, and 75% are removing with three parameters like PSNR, MSE and IEF. After the filtering, the image is remapped into spatial domain by inverse Fourier transform to obtain the restored image. Different noise models were studied. Different filtering techniques in both spatial and frequency domains were studied and improved algorithms were written and simulated using Matlab. Restoration efficiency was checked by taking peak signal to noise ratio (PSNR) and mean square error (MSE) into considerations.***

Keywords: PSNR, MSE, IEF, Probability Density Factor, Quantization, Pixel, Denoise

I. INTRODUCTION

Nowadays the use of digital imaging is implemented in many applications e.g., object recognition, satellite imaginary, biomedical instrumentation, digital entertainment media, the internet etc. In the past decade, the quality of digital images has significantly increased, but the cost of the hardware which is used to produce digital images has decreased. In the present state of development, a flexibility and economy unmatched are offered by digital imaging using film-based imaging [1-2]. As a result, digital imaging has almost completely supplanted film-based imaging which is the preferred method for capturing images.

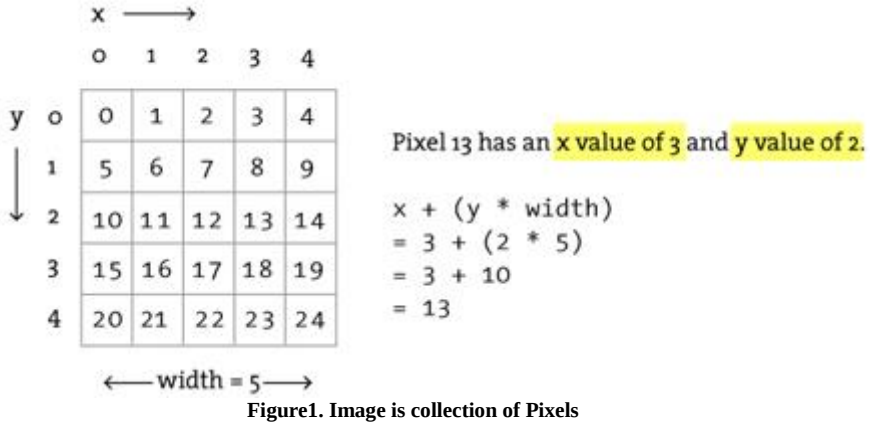

Figure1. Image is collection of Pixels

Digital image processing is to provide the clear picture as per the interest while attenuating detail irrelevant to a given application, and the information regarding the scene is taken out from the improved image [7-8]. With the help of the digital image processing, one can get reversible, a virtually modified image which is noise free and the image is in the form of matrix integers in place of the classical darkroom manipulations or filtration of time-dependent voltages which is necessary for analog images and video signals. Present image processing algorithms are extremely helpful [4-6].

Figure2. Noise and Denoise image

II. LITERATURE SURVEY

Noise removal from images is a part of image restoration in which we try to reconstruct or recover an image that has been degraded by using a priori knowledge of the degradation phenomenon. Noises present in images can be of various types with their characteristic Probability Distribution Functions (PDF). Noise removal techniques depend on the kind of noise present in the image rather than on the image itself. This paper explores the effects of applying noise reduction filters having similar properties on noisy images with an emphasis on Signal-to-Noise-Ratio (SNR) value estimation for comparing the results [17-19]. Images are often degraded by noises. Noise can occur during image capture, transmission, etc. Noise removal is an important task in image processing. In general, the results of the noise removal have a strong influence on the quality of the image processing technique. Several techniques for noise removal are well established in color image processing. The nature of the noise removal problem depends on the type of the noise corrupting the image. In the field of image noise reduction, several linear and not linear filtering methods have been proposed. Linear filters are not able to effectively eliminate impulse noise as they have a tendency to blur the edges of an image. [20]. Image filtering attempts to remove the noise from an image while maintaining its perceived visual quality. Noise can be consistent noise, Gaussian noise, salt and pepper noise, gamma noise. The study concentrates on the salt and pepper noise by using improved modified decision based switching median filter. The salt and pepper noise occurs when the pixel value is either 0 or 255.The algorithm will evaluate the center pixel's value i.e. whether or not it equals to 0 and 255. If center pixel is having value 0 or 255 then find out the alternative noise free value for the center pixel [21]. The compound image is a combination of text, picture, and graphs. Noise reduction in the compound image is necessary to maintain the quality of images. Noise is added to an image at the time of image acquisition (or) image capturing. After capturing, image pre processing is necessarily done to correct and adjust the image for further classification and segmentation. From the literature review, different filtering techniques are available to reduce the noise from compound images. Normally the filters are used to improve the image quality, suppress the noise. This paper proposes median filtering technique for removing salt & pepper noise from various types of compound images. Several examples were conducted to evaluate the performance of the median filter on noise [22-24].

III.PLANNING OF WORK/METHODOLOGY

The proposed switching based filter removes impulse noise even for higher noise densities without blurring and retains the edges and fine details. The proposed algorithm contains a new Decision-Based Unsymmetric Trimmed Median (DBUTM) Filter and Unsymmetric Trimmed Mean Filter. Depending on the noise density either Decision Based Unsymmetric Trimmed Median Filter or cascade filter is selected for replacing the corrupted pixel with a new value. The idea behind a trimmed filter is to reject the most probable outliers. The trimming is un-symmetric i.e. the numbers of pixels trimmed at the two ends are not always equal [11-14]. The DBUTM filter checks whether the extreme values of the sorted array, obtained from the 3×3 window, are impulse values and trim only those impulse values. This property of the filter makes it more efficient in noise suppression than the existing other filters. When the noise density is less than 80% the DBUTM filter directly replaces the corrupted pixels with the median value of its

neighbourhood pixels while the uncorrupted pixels are left unchanged. The median value is calculated after trimming the pixel values 144 that are corrupted by impulse noise [16-18]. When the noise density is greater than or equal to 80% DBUTM filter is cascaded with Unsymmetrical Trimmed Mean filter, to further improve the output obtained from the DBUTM filter. The noisy image is first processed using the DBUTM filter and the output of DBUTM filter is given as the input to the Unsymmetrical Trimmed Mean

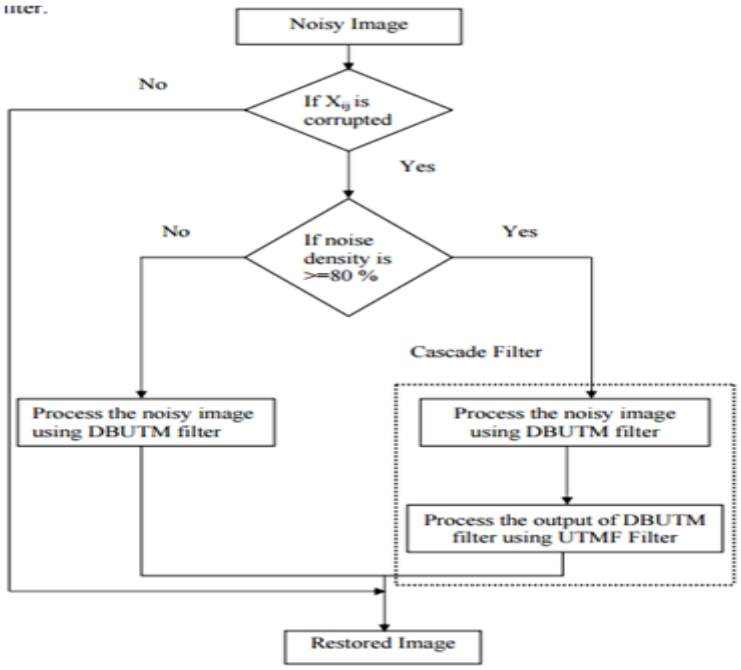

Figure3. Flow Chart of the Proposed Noise Removal Scheme

IV. SOFTWARE USED AND SIMULATION RESULT

Software: MATLAB Version R2015a: It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

A. Result of Different Image but for Format (JPEG) Noise 30%

Figure4. Original Image used for S&P Noise

Figure5. Original Image transformed into Gray Image

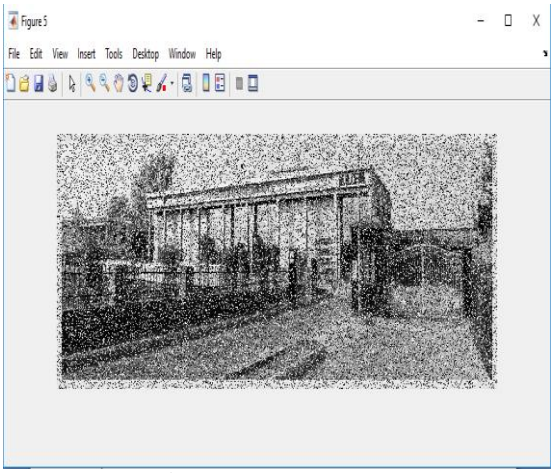

Figure6. After adding 30% S&P Noise

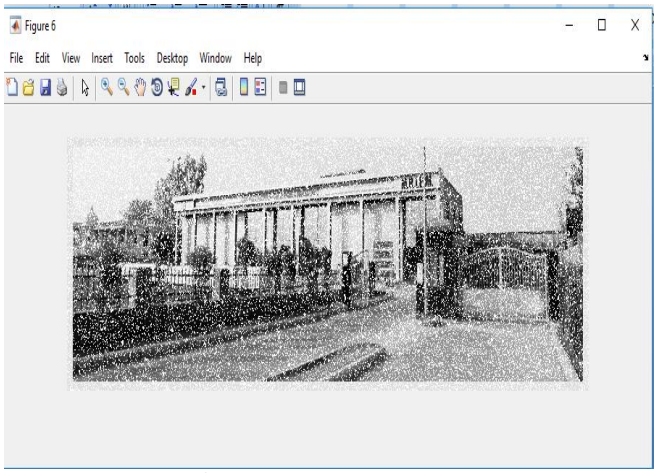

Figure7.Original Image after removing Pepper noise

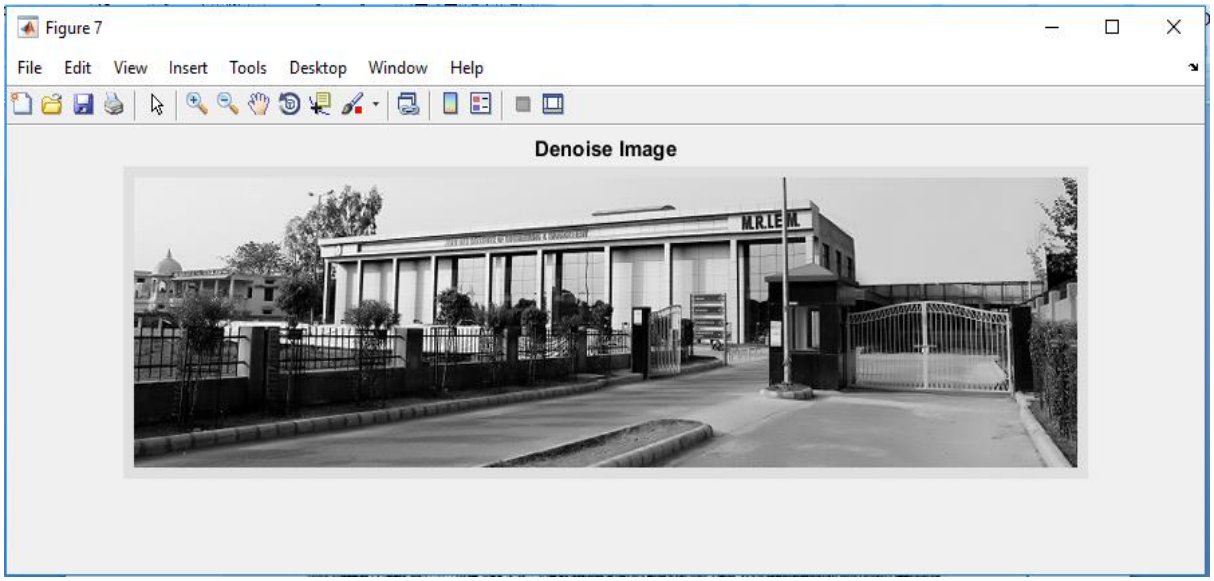

Figure8. Denoised Image after using Unsymmetric trimmed median filter

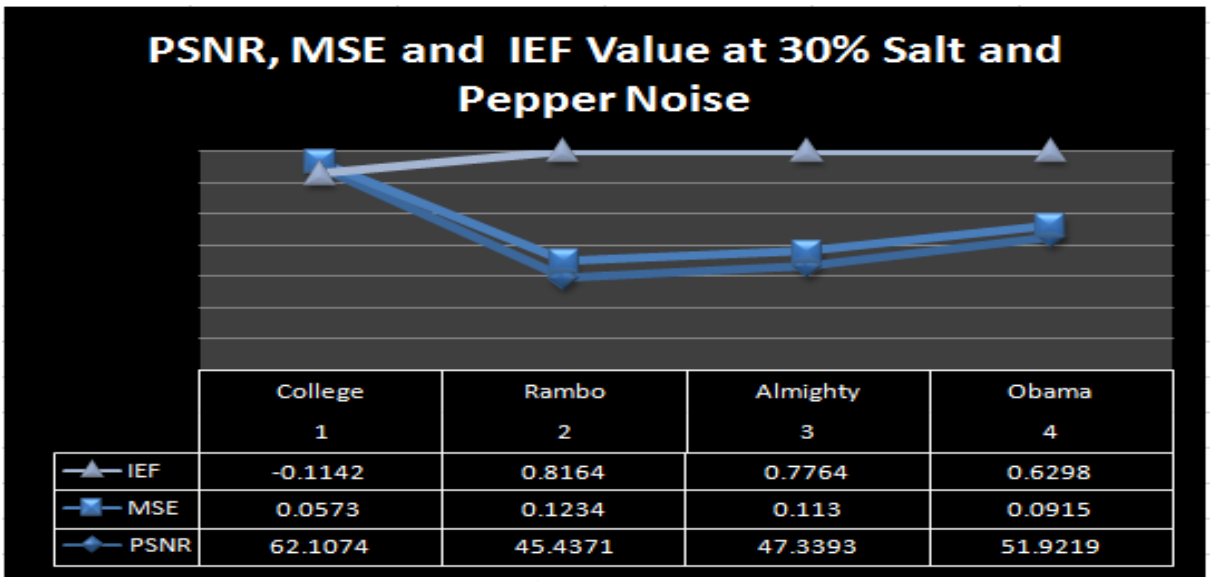

Figure9. Comparison Graph of IEF, MSE & PSNR value at 30 % S&P Noise

B. Result of the Same Image for Different Format 30 % Salt and Pepper Noise

Figure10. Original Image (BMP)

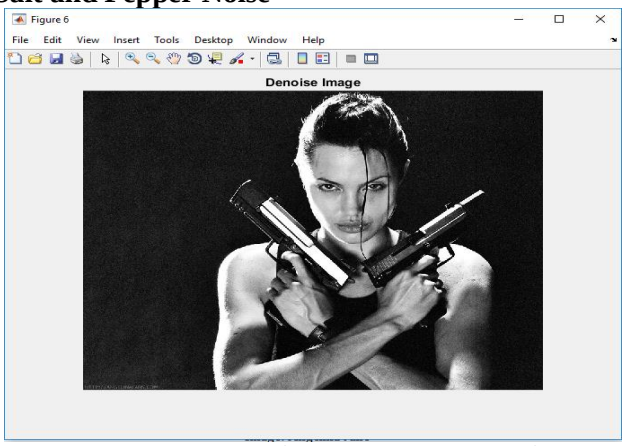

Figure11. Denoised Image after using trimmed median filter

Table I PSNR, MSE and IEF at 30% salt and Pepper Noise for Different Format of Same Image: Angelina Julie

PSNR, MSE and IEF at 30% Salt and Pepper Noise For Different Format of Same Image: Angelina Joulie				
Sr. No	Input Image	PSNR	MSE	IEF
1	BMP	48.9835	0.1048	0.6891
2	JPG	48.9116	0.1051	0.6915
3	PNG	49.0177	0.1046	0.6921
4	TIFF	51.9219	0.1056	0.687

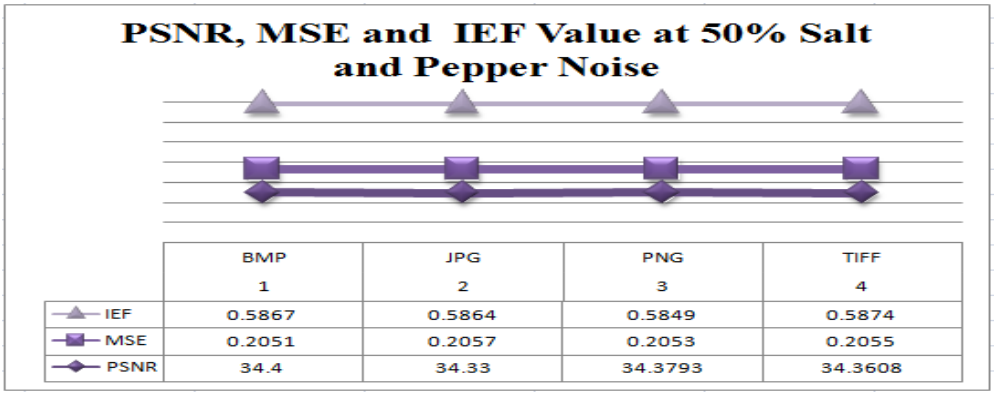

Figure12. Comparison Graph of IEF, MSE & PSNR value at 50 % S&P Noise

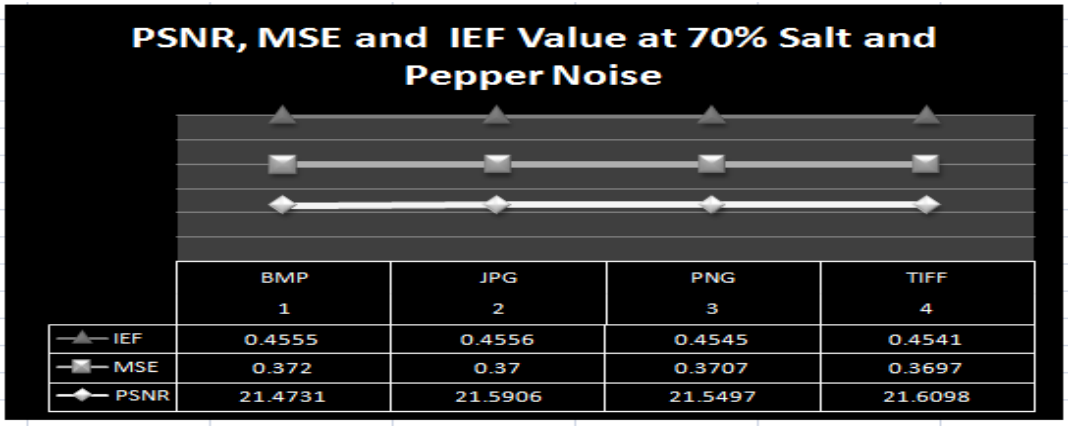

Figure13. Comparison Graph of IEF, MSE & PSNR value at 70 % S&P Noise

C. Different Images used in our test for PSNR value and of the different format:

(a) Noise= 75%; JPEG Format

(b) Noise= 75%; PNG Format

(c) Noise= 75%; BMP Format

(d) Noise= 75%; TIFF Format

Figure14. Different Images used in our test for PSNR value and of different format

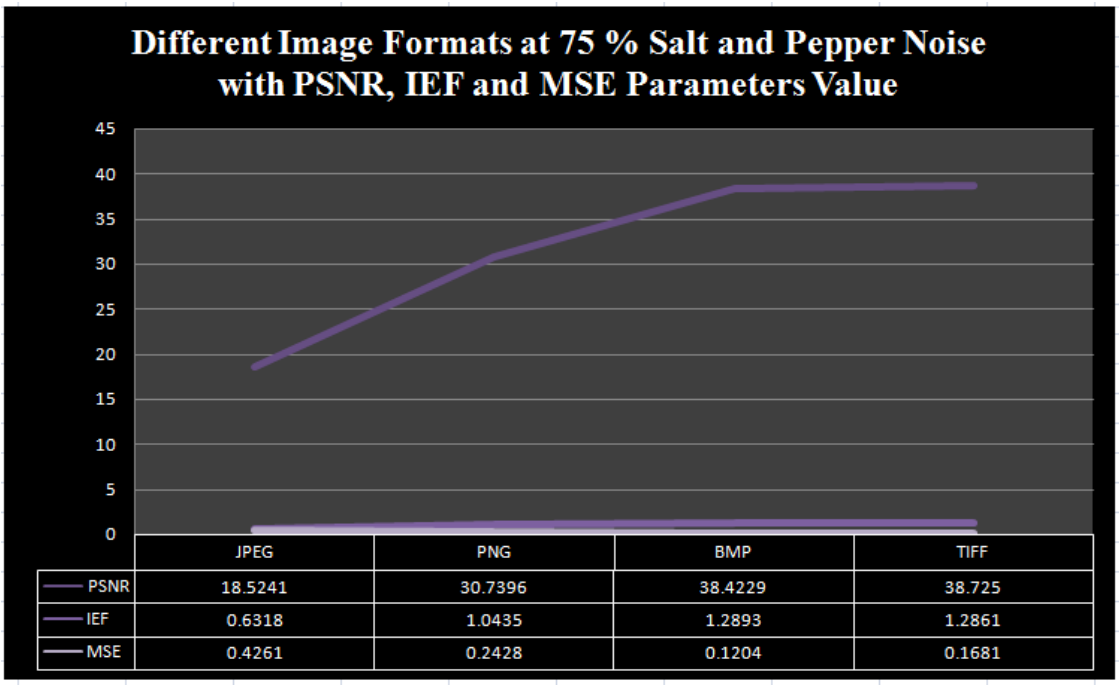

Figure15. Comparison Graph of IEF, MSE & PSNR value at 75 % S&P Noise for different image and for different format

D. Result of Webcam Image for Format (JPEG) @ 30 % Noise

Figure16. Original Image from Web Cam

Figure17. Denoise Image

Noise 70%

V Figure18. Original Image from Web Cam

Figure19. Denoise Image

Table II PSNR, MSE and IEF at 30% & 70% salt and Pepper Noise for Webcam Image

Results of Webcam Images					
Sr. No.	**Image type**	**Noise %**	**PSNR**	**MSE**	**IEF**
1	JPEG	30	65.9800	0.0479	1.7114
2	JPEG	70	36.5738	0.1856	1.1595

CONCLUSION

In our research work, our main objective is to remove salt and pepper noise from the image. As in base paper, 30% and 70% salt and pepper noise are removed with PSNR value. But in our dissertation work salt and pepper noise at 30%, 50% and 70% are removing with three parameters like PSNR, MSE, and IEF. There are various types of noises and various types of filter available and each filter is specific to particular types of noise. For example among mean filters, geometric mean filters smooth images and loses less image detail. Min filter is useful for finding darkest points and thus reduces salt noise. The harmonic filter works best with salt noise only. Median filters are effective in presence of bipolar impulse noise. Max filter is useful for finding brightest points and thus reduces pepper noise. Midpoint filters work best for randomly distributed noise like Gaussian noise or uniform noise. Alpha-trimmed mean filter is useful in situations involving multiple noises, such as a combination of salt and pepper noise and Gaussian noise. Low pass filters are used in image smoothening. In our research work first, we convert a color image into the gray image so that information cannot be lost and after that two more operations carried out like convert into double data types and resize. The work done is only on gray scale images. It can be extended to colored images. Image restoration mainly required prior knowledge of the degradation function. Techniques can be developed to estimate these degradation functions more accurately. After applying median trimmed filter our result is far superior to base paper and at noise level 30 our PSNR value is almost double to base paper PSNR value which is 48 PSNR and 24 PSNR respectively. Besides this real time application was also considered in our work that is from laptop webcam pictures clicked and salt and pepper noise added and removed successfully.

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