Image Denoising process Using Brightness Preserving Bi-Histogram Equalization

Deepa Yadav[1], Dr.Nirupma Tiwari[2]
[1]Dept of Computer Science Engineering
[2]HOD, Dept of Computer Science Engineering
[1, 2] Shri Ram College of Engineering & Management, Banmore , Gwalior-476444, M.P. , India

Abstract- *The image processing is the technology through which information of image get processed. The noises are the extra pixels which get added on the image to reduce image quality. The authors proposed various techniques which work to remove noisy pixels from the image. In this paper, various image de-nosing techniques has been reviewed and discuss in terms of their outcomes. The median filter is a nonlinear image processing operation used to remove impulsive noise from images. The BBHE is a novel extension of a typical histogram equalization, which utilizes independent histogram equalizations over two sub images obtained by decomposing the input image based on its mean. The ultimate goal behind the BBHE is to preserve the mean brightness of a given image while enhancing the given image.*

Keywords- De-noising, Filtering, Histogram equalization, Median filtering, BBHE..

I. INTRODUCTION

Image denoising process consists of a collection of techniques that need to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or machine. The principal objective of image Denoising is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified. Digital Image Denoising techniques gives multiple of choices for improving the visual quality of images. Over the years a variety of methods have been introduced to remove noise from digital images, such as Gaussian filtering, anisotropic filtering, and Total Variation minimization. However, many of these algorithms remove the fine details and structure of the image in addition to the noise because of assumptions made about the frequency content of the image. The non-local means algorithm does not make these assumptions, but instead assumes that the image contains an extensive amount of redundancy. These redundancies can then be exploited to remove the noise in the image. All digital images contain some degree of noise. Often times this noise is introduced by the camera when a picture is taken. Image denoising algorithms attempt to remove this noise from the image. Ideally, the resulting denoised image will not contain any noise or added artifacts.Major denoising methods include Gaussian filtering, Wiener filtering and wavelet thresholding. Many more methods have been developed; however, most methods make assumptions about the image that can lead to blurring. Image Denoising is a classical yet fundamental problem in low level vision, as well as an ideal test bed to evaluate various statistical image modeling methods. One of the most challenging problems in image denoising is how to preserve the fine scale while removing noise. Various natural image priors, such as gradient based prior, nonlocal self-similarity prior, and sparsity prior, have been extensively exploited for noise removal. The denoising algorithms based on these priors, however, tend to smooth the detailed image, degrading the image visual quality. To address this problem, in this paper we propose a enhanced image denoising method by enforcing the distribution of the denoised image to be close to the estimated distribution of the original image. A novel histogram algorithm is developed to enhance the image while removing noise [1].

Exact noise level estimation is very useful in digital image processing. For example, some noise removal algorithms use a noise level estimation to adjust the aggressiveness of noise removal. If an estimated noise level is too low, too much noise will remain in the denoised image. If an estimated noise level is too high, the features of the original images will be removed from the denoised image. Accurate noise level estimation will produce better results in the restored image. A large number of different noise reduction methods have been proposed so far. Traditional denoising methods can be generalized into two main groups: spatial domain filtering and transform domain filtering. Spatial domain filtering methods have long been the mainstay of signal denoising and manipulate the noisy signal in a direct fashion. Conventional linear spatial filters like Gaussian filters try to suppress noise by smoothing the signal. While this works well in the situations where signal variation is low, such spatial filters result in undesirable blurring of the signal in situations where signal variation is high. [2]

Further, this paper is organized as follows. Section II presents various techniques and details of the proposed scheme, Section III presents literature survey of the previous scheme,Section IV presents propose work and Section V presents experiment result analysis and conclusions of the study are presented in section VII.

II. USING TECHNIQUES

Brightness preserving bi-histogram equalization (BBHE)

Brightness Preserving Bi-Histogram Equalization This method divides the image histogram into two parts. In this method, the separation intensity XT is presented by the input mean brightness value, which is the average intensity of all pixels that construct the input image. After this separation process, these two histograms are independently equalized. By doing this, the mean brightness of the resultant image will lie between the input mean and the middle gray level. Histogram equalization is widely used for contrast enhancement in a variety of applications due to its simple function and effectiveness. This is a novel extension of HE to overcome such drawback of the histogram equalization. The essence of the proposed algorithm is to utilize independent histogram equalizations separately over two sub images obtained by decomposing the input image based on its mean with a constraint that the resulting equalized sub images are bounded by each other around the input mean. It will be shown mathematically that the proposed algorithm preserves the mean brightness of a given image significantly well compared to typical histogram equalization while enhancing the contrast and, thus, provides much natural enhancement that can be utilized in consumer electronic products. It preserves the mean brightness of a given image significantly well compared to typical histogram equalization while enhancing the contrast.

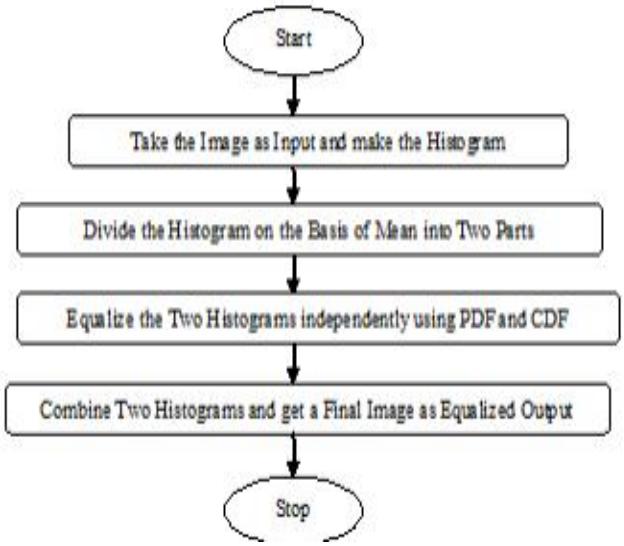

Figure 1: BBHE algorithm.

The ultimate goal behind the BBHE is to preserve the mean brightness of a given image while enhancing the contrast of a given image. Output mean of the BBHE for a given analog image having symmetric distribution, which indicates that the BBHE is capable of preserving the mean brightness of a given image. [3]

Median filtering

The median filter is non-linear filter. It removes noise effectively as well as preserves sharp edges. A median filter is more helpful than convolution when the goal is to simultaneously reduce noise and conserve noise. It basically replaces every pixel value by the median of the intensity level in the neighborhood of the pixel. It proves to be best in removing salt and pepper noise. It is an order statistics filter. [4]

Median filter is an easy implementation of non-linear filter for noise removal. In this, the targeted noisy pixels are replaced by median value of its neighbors. The filtering window size determines the number of neighbors. The median value is simply described as the mid value in a sorted sequence.

Median (P) = Med {Pi}
Median (P) = Med {Pi}
= Pi(k +1)/2, k is odd
= ½[Pi(k/2)+ Pi(k/2)+1], k is

Even P1, P2, P3 ……Pk is the sequence of neighbor pixels. All pixels in the image have to be arranged in either ascending or descending order, before applying

filtering. After performing sorting, the resulting image pixel sequence will be Pi1≤Pi2≤Pi3≤.....Pik, .k is usually odd.

A median filter is an example of a non-linear filter and it is very effective at retaining features of images. But, the window size of filter directly affects the performance of median filter. Smaller window preserves the features but it leads to a curtailment of noise suppression. In case of larger window, noise suppression potential is high but limited image content preservation. With the enhancement in the standard median filters, there were so many filters has designed such as weighted median filter, threshold median filter ,adaptive median filter, rank order median filter and many other advanced filters. [5]

Histogram Equalization

Histogram Equalization (HE) is one of the important techniques to enhance the image. It consists of local Histogram Equalization and Global Histogram Equalization. The histogram of an image is a plot or graph drawn between gray level values (0 to 255) in the X – axis and the number of pixels having the corresponding gray levels in the Y-axis. Various enhancement schemes are used for enhancing an image which includes filtering and Histogram Equalization (HE). Histogram equalization is one of the well known image enhancement technique. This method is simple and effective so it is a popular technique for image enhancement. This method is based on the probability distribution of the input gray levels. It produces a significant change of the brightness. This method is not commonly used in consumer electronics such as TV. [6]

Histogram equalization applications are commonly implemented for image processing in medical use, voice recognition, synthesizing textures and more. Recently, the implementation of the histogram equalization method to enhance image has been an interesting topic. A technique that has been develops where images manipulated from its pixel intensity to create an image that visually greater, called Image enhancement. The purpose are to enhance images for human visually by improving the interpretation of information contained in it, or also the result can be used as a high quality input for more image processing use. From many proposed image enhancement method over years, equalization of histogram has become the most popular image enhancement used. The method mostly implemented in image enhancement process because of its ease of use, a higher performance and output with almost all kind of image. With the manipulation the level of gray based on the distribution probability, an image can be improved. That changes and improve the level of contrast of the images by manipulating dynamic range from the histogram, where its stretches and flatten based on the method. The equalization of histogram (HE) has become the common used technique in image contrast enhancement. And also become the most popular process because of its ease of use and higher quality output and performance. Histogram equalization method is by recapping image's level of gray according to the input gray level probability distribution.
However, it is well known that traditional HE methods suffer of the following deficiencies:

1) Has no mechanism that adjusts the rate of improvement and sometimes it can't reach a balance on many aspect of the image, for example, the balance between image detail and the background.
2) Sometimes causing an increasing level of noise, undesirable visual artifacts like clipping or level saturation, over enhancement, and imbalance between many aspects.
3) May changes a lot of things, and can dramatically affect the image, like different average of illumination from the image with the result. Due to the side effect pointed above, equalization of histogram becomes rarely implemented on its normal form. Since then, years and year's improvement, manipulation, development and changes result in new type of HE methods that have been proposed. Image contrast enhancement technique is popular method to use in image or video processing to gain a very dynamic and wider range. The most common algorithm which can be implemented to gain the most dynamic range is the Histogram based algorithm. [7]

III. LITRATURE SURVEY

Janarthanam Subramaniam et.al. [2017]The existing two dimensional median filters in the literature are computationally intensive. It is proposed to optimally reduce the amount of data handled at the architecture level realization of the basic median filtering operation on images. The proposed architecture reads 4 pixels at a time in the input image, 4 pixels forming a word on a 32 bit hardware processing system; the subsequent processing is carried out by parallel and pipelined median filter architecture. Two read operations process 8 input pixels which results in the generation of 4 output pixels with an initial latency. The proposed architecture offers reduced number of read operations and increased speed. [8]

Zhijun Yao et.al. [2016]In the paper, we propose a histogram equalization based image enhancement method named Brightness Preserving and Contrast Limited Bi-histogram Equalization (BPCLBHE). Our method includes three steps: (i) First, we use the average intensity value of the image to divide the input original image into two sub-images. (ii) Second, the histogram clipping approach is used to control

enhancement rate. (iii) Finally, we use the individual clipped histogram to equalize each sub image independently and then two enhanced sub images are stitched into an output image. From the simulation results, it can be concluded that BPCLBHE obtains the best enhancement effect compared to other methods, in terms of visual inspection and multiple image quality evaluation measures. [9]

Sunil Khatri et.al. [2016]Impulse noise still poses challenges in front of researchers today. The removal of impulse noise brings blurring which leads to edges being distorted and image thus being of poor quality. Hence the need is to preserve edges and fine details during filtering. The proposed method consists of noise detection and then removal of detected noise by Improved Adaptive Median Filter using pixels that are not noise themselves in gray level as well as color images. The pixels are split in two groups, which are noise-free pixels and noisy pixels. In removing out Impulse noise, only noisy pixels are processed. The noiseless pixels are then sent directly to the output image. The proposed method adaptively changes the masking matrix size of the median filter based on the count of the noisy pixels. Computer simulation and analysis have been carried out eventually to analyze the performance of the proposed method with that of Simple Median Filter(SMF), Simple Adaptive Median Filter (SAMF) and Adaptive Switched Median Filter (ASMF). The proposed filter proves to be more efficient in terms of both objective and subjective parameters. [10]

Ramandeep Kaur [2015] Sundry improvement plans are used for improving a picture which incorporates ash scale control, sifting and Histogram Equalization (HE). The issue with pictures is that, their quality depends upon a number of different variables like lighting in the picture catching area, commotion and capability of the administrator. The writing addresses the verbalized issue widely and presents answers for them. Contrast improvement systems are used for correcting visual nature of low difference pictures. Histogram Equalization (HE) is one such procedure used for difference upgrade. The proposed illustrations have a few shared traits in their procedures. Approximately every one of them is at fluctuation either in histogram leveling strategies or in picture quality estimation instruments. An instrument is lost in the writing that is proficient to improve the picture and even perform the examination. In this paper, a GUI apparatus is composed which is coupled with different procedures of picture improvement through histogram balance. Opening-by recreation is a standout amongst the most effective picture division strategy is used to attain to the craved results. To assess the adequacy of the delineated systems; PSNR, Tenengrad, and Absolute Mean Brightness mistake (AMBE) are used as parameters. The results are decently backed by the parameter estimations toward the end. [11]

Susanta Kumar Rout et.al. [2015]Histogram equalization (HE) is a popular techniques used for digital image enhancement. In case of Color image processing, brightness of the color is to be preserved. In this paper, author has taken an attempt to restore the skin color in the color image. Existing method for enhancement have been verified and implemented for restoration. The control parameter has also been formulated. According to the control parameter, the existing BBHEwVED method has been modified and applied for skin color restoration. After comparison of all the method, it has been found that method 5 shows excellent results. Our proposed method is able to control the enhancement degree, where the mean of image is preserved; hence all kinds of images are enhanced adequately. We mainly consider the natural color images like human face to restore the original skin color. Thus, wead just the parameter of BBHEwVED, in order to restore the skin color of human face. [12]

IV. PROPOSE WORK

Problem statement:

The main disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal. If there are gray values that are physically far apart from each other in the Image, then this method fails.

Propose methodology:

In this paper, the input image is decomposed and two sub-images. These two images are formed on the basis of gray level mean value. The drawback introduced by HE method is overcome by this method. Then HE method is applied on each of the sub-images. This method equalizes both the images independently. Their respective histograms with a constraint that samples in the first sub image are mapped in the range from minimum gray level to input mean and samples in second sub-image are mapped in the range from mean to maximum gray level.

ProposeAlgorithm:

1. First we browse image from dataset.
2. Then resize image into 256x256.
3. Apply median filter on this resize image.
4. Use histogram Equalization on this median image.
5. Use BBHE on this median image.
6. Calculate parameter MSE and PSNR.

7. Exit.

Flow chart:

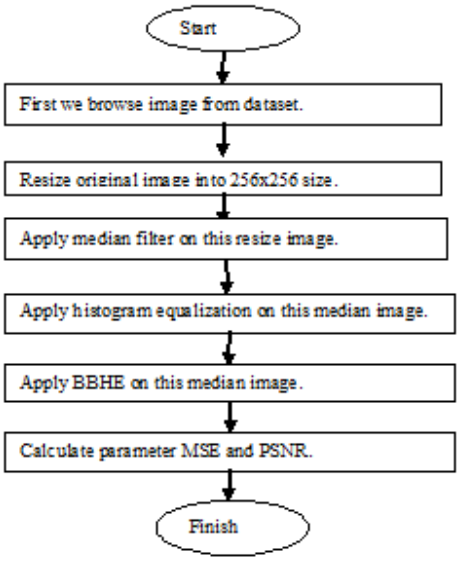

Fig 1. Flow chart of propose work.

V. EXPERIMENT RESULT ANALYSIS

In our experiment first we take an image from dataset then in original image we resize the original image into 256x256sizes and after that applied median filter on the resized images. Histogram equalization is applied to the median image and finally our propose method BBHE is applied. The experiments turn out that the performance of the improved algorithm is better, compared to the traditional method. First we run this code and obtained this type of menu bar:

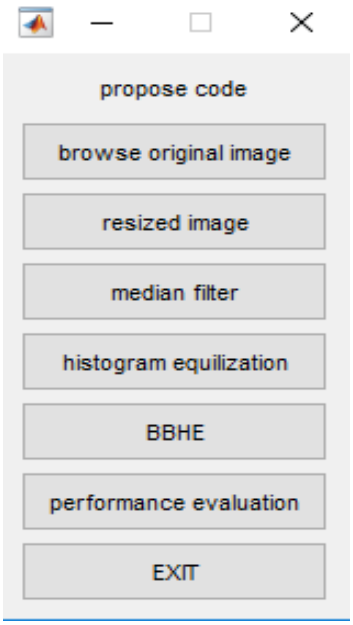

Fig 2.There are 5 steps in this menu bar.

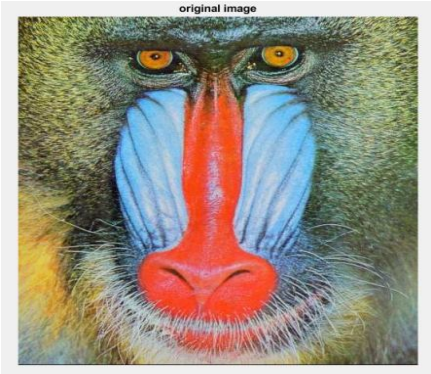

Fig 3. First we browse image from dataset.

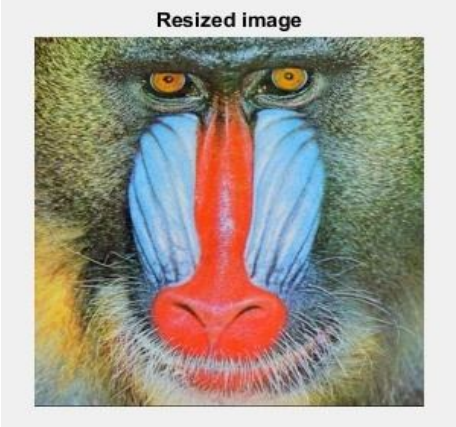

Fig 4. Then resize image into 256x256.

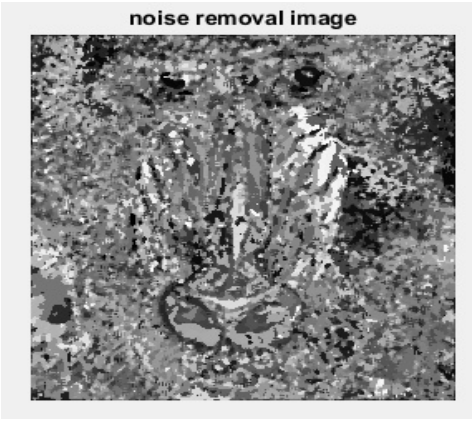

Fig 5. Apply median filter on this resize image.

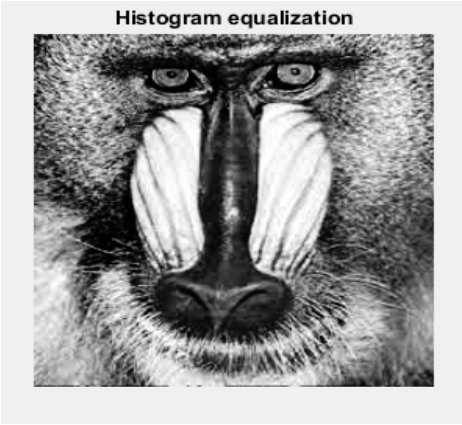

Fig 6. Use Histogram Equalization on this median image.

Fig 7. BBHE apply on above image.

Result:

Image name	Base PSNR	Propose PSNR
1.jpg	37.8188	48.9843
2.jpg	38.0534	45.7654
peppers	37.9893	47.8944

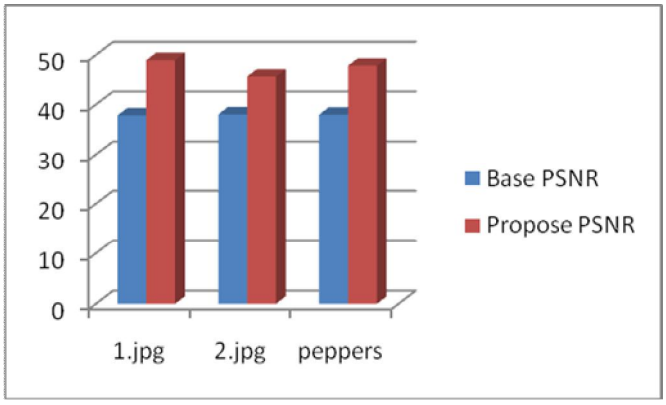

Fig 8. Graph comparison of Base and Propose PSNR in different images.

VI. CONCLUSION

In this paper, it is been concluded that noise are the extra pixels which get added to the original image to reduce its quality. The image de-noising is the technique which is applied to remove noisy pixels from the image. The traditional median filter algorithm using the improved method to process, it is hard to find noise points, and has good effect on saving the detail as well. Analysis on the output mean of the BBHE for a given analog image having symmetric distribution, which indicates that the BBHE is capable of preserving the mean brightness of a given image. Simulation results also demonstrate the brightness-preserving function of the BBHE while enhancing contrasts.

REFERENCES

[1] M.Elad and M.Aharon, Image Denoising via sparse and redundant representation over learned dictionaries, IEEE T IP 15(12) Pp. 3736-3745, 2006.

[2] Kamlesh Dixit and Mohit Khandelwal, "Digital Image Denoising using Histogram and Dynamic Filters", International Journal of Computer & Organization Trends –Volume 4 Issue 1 January to February 2014.

[3] Sandeep Kaur and Parminder Kaur, "A Novel Brightness Preserving Histogram Equalization Technique for Image Contrast Enhancement", International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor : 6.391 2015.

[4] Usha Tigga and Jaimala Jha, "Image Deblurring with Impulse Noise using Alternating Direction Method of Multipliers and Lucy-Richardson Method", 2016 8th International Conference on Computational Intelligence and Communication Networks 978-1-5090-1144-5/16 $31.00 © IEEE DOI 10.1109/CICN.2016.52 2016.

[5] Ginu George, Rinoy Mathew Oommen, Shani Shelly, Stephie Sara Philipose and Ann Mary Varghese, "A Survey on Various Median Filtering Techniques For Removal of Impulse Noise From Digital Image", Proc. IEEE Conference on Emerging Devices and Smart Systems (ICEDSS 2018)2-3 March 2018, Mahendra Engineering College, Tamilnadu, India.

[6] S.SUBATHRA, M.SUMATHI and G.BHARATHA SREEJA, "Imageenhancement and analysis of various images using standard techniques of image processing", International Journal of Science, Engineering and Technology Research (IJSETR) Volume 4, Issue 4, April 2015.

[7] Bogy Oktavianto and Tito Waluyo Purboyo, "A Study of Histogram Equalization Techniques for Image Enhancement", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 2 pp. 1165-1170 2018.

[8] Janarthanam Subramaniam, Raju Jagadeesh Kannan and David Ebenezer, "Parallel and Pipelined 2D Median Filter Architecture", IEEE Embedded Systems LettersDOI 10.1109/LES.2017.2771453, 2017.

[9] Zhijun Yao, Zhongyuan Lai, Chun Wang and Wu Xia, "Brightness Preserving and Contrast Limited Bihistogram Equalization for Image Enhancement", 978-1-5090-5521-0/16/$31.00 © IEEE 2016.

[10] Sunil Khatri and Hemant Kasturiwale, "Quality Assessment of Median Filtering Techniques for Impulse Noise Removal from Digital Images", 2016 3rd International Conference on Advanced Computing and Communication Systems (*ICACCS* -2016), Jan. 22 & 23, , Coimbatore, INDIA 2016.

[11] Ramandeep Kaur, "Histogram Equalization Tool: Brightness Preservation and Contrast Enhancement using Segmentation with Opening-by-Reconstruction", International Journal of Computer Applications (0975 – 8887) Volume 111 – No 2, February 2015.

[12] Susanta Kumar Rout, Mrutyunjaya Sahani and Mihir Narayan Mohanty, "Modified Color Brightness preserving Bi-Histogram Equalization with Variable Enhancement Degree for Restoration of Skin Color", 978-1-5090-0487-4/15 $31.00 © IEEE DOI 10.1109/ICIT.2015.42 2015.