Digital Image Denoising using Histogram and Dynamic Filters

Kamlesh Dixit[#1], Mohit Khandelwal[*2]
*M.Tech Scholar[#1], Associate Professor[*2]*
IET, Alwar, India

Abstract**—***Digital Image Denoising is one of the most important and difficult techniques in image research. The aim of image Denoising is to improve the visual appearance of an image, or to provide a "better transform representation for another automated image processing. Many images like medical images, satellite images, aerial images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance the contrast and remove the noise to increase image quality. One of the most important stages in medical images detection and analysis is image Denoising techniques which improves the quality of images for human viewing, removing blurring and noise, increasing contrast, etc.*

Keywords**—** Digital Image Denoising, Histogram, Image filter

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.

II. RELATED WORK

Image Denoising process consists of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for particular application. 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 use. During this process, one or more attributes of the image are modified. Digital Image enhancement techniques provide different methods for improving the visual quality of images. Appropriate choice of such techniques is greatly influenced by the imaging modality, task at hand and viewing conditions. A familiar example of enhancement is in which when we increase the contrast of an image and filters it to remove the noise "it looks better". It is important to keep in mind that enhancement is a very subjective area of image processing. Improvement in quality of these degraded images can be achieved by using application of enhancement techniques.

Authors suggest that Image enhancement algorithms offer a wide variety of approaches for modifying images to achieve visually acceptable images. The choice of such techniques is a function of the specific task, image content, observer characteristics, and viewing conditions. The review of Image enhancement techniques in Spatial domain have been successfully accomplished and is one of the most important and difficult component of digital image processing and the results for each method are also discussed. Based on the type of image and type of noise with which it is corrupted, a slight change in individual method or combination of any methods further improves visual quality. In this survey, we focus on survey the existing techniques of image enhancement, which can be classified into two broad categories as spatial domain enhancement and Frequency domain based enhancement [2].

N.Mohanapriya and B. Kalaavati presented spatial domain Denoising techniques along with their algorithm and also analyzes their performance based on the image quality for medical images [3].

III. PROPOSED WORK

Generally, the digital form of an image is used for computer processing. A digital image f [*m*, *n*] described in a 2D discrete space, is derived from an analog image f(*x*, *y*) in a 2D continuous space through a sampling and quantization process that is frequently referred to as digitization [4].

The 2D continuous image f(*x*, *y*) is divided into x rows and y columns. The intersection of a row and a column is termed a pixel. The value assigned to the integer coordinates [*m*, *n*] with {*m*=0, 1, 2…} and {*n*=0,1,2,...} is f[*m*, *n*].

Histogram is a function, which returns the relative frequency of the pixel values in a given image. The gray-level histogram is plotted on two axes: x-axis represents the gray level values and the y-axis represents the relative frequencies. In other words, a histogram is a list which contains as many elements as quantization levels. The number of pixels in each element show the corresponding gray level value stored. The calculation of a histogram is very straightforward. First, the entire list of the gray levels is set to zero. Then, the pixels of image are scanned; the gray value is taken as the index and the corresponding element of the list is incremented. The histogram gives a simple visual indication as to whether or not an image is properly scaled within the available range of gray levels. For example, if an image has been digitized between the gray level 0 to 255 and it has more brightness range, then the gray levels will be clipped at 0 and/or 255, producing spikes at both the ends of the histogram. The histogram of a digital image is shown in Figure 1.

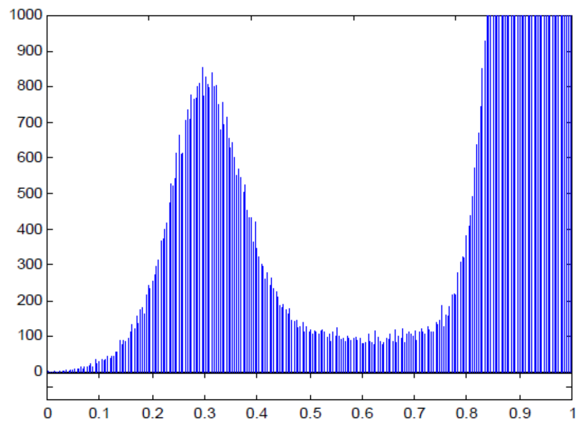
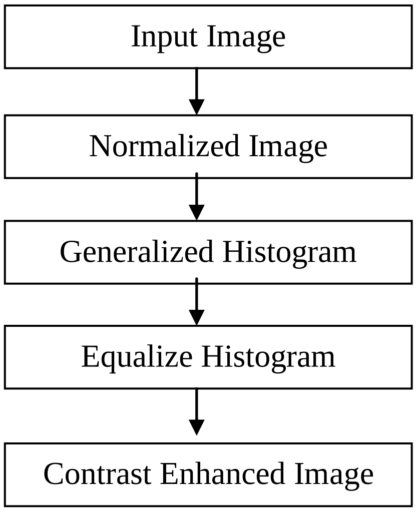


Figure 1 Histogram of a digital Image

Histogram equalization is as a contrast enhancement technique with the objective to obtain a new enhanced image with a uniform histogram. This can be achieved by using the normalized cumulative histogram as the grey scale mapping function.

Modification to enhance the image quality using histogram can be categorised as three basic functions such as Histogram Equalization, Histogram stretching and non linear mapping technique. The idea here to enhance image quality by accessing each pixel (x, y) based on neighbouring pixels. During histogram representation the image produces contrast intensities that are not well distributed. In this step few of the adjustments have been made on the image so it produce a better contrast image. In histogram equalization the intensity values are distributed effectively. This helps areas on the image with low contrast to have a better or higher contrast before filtering steps.



Figur2: Denoising Process using Histogram

Histogram equalization in general takes the intensity levels of an image and calculates the total number of pixel in the image at each pixel intensity level. The intensity levels of the image are then spread over to fill the entire space of available intensities, and thereby it increasing the contrast of the image. This is achieved by allocating the pixels at each intensity level with the percentage of the range that matches there percentage of the total number of pixels in the image. Suppose if we have an image with 20% of the pixels are at a specific intensity within the image, this group of pixels will occupy 20% of the total intensity range in the equalized image. The pixels will still remain in the same order relative to all lighter and darker pixels in the original image, they will just be shifted and or stretched in terms of where and how much of the intensity range they occupy [4].

Image histogram equalization actually deals with averaging and reduction of noise by adding certain other noisy images also. Image denoising can be done in the many ways includes one of the strong techniques called image filter. Filters are commonly used to adjust the rendering of an image, a background, or a border.

Once using histogram, image contrast is increased it can be passed for the filtering process. First average masking is used here for removing the blur of the image as filter. Median filter is used here for removing the noise as it includes salt-and-pepper noise. After median filter input image is passed to the high pass filter for denoising and sharpening. Generally in a blurred the slop at the edge is small with compared to the sharpened image. Therefore by increasing the slope can makes the image more sharpen.

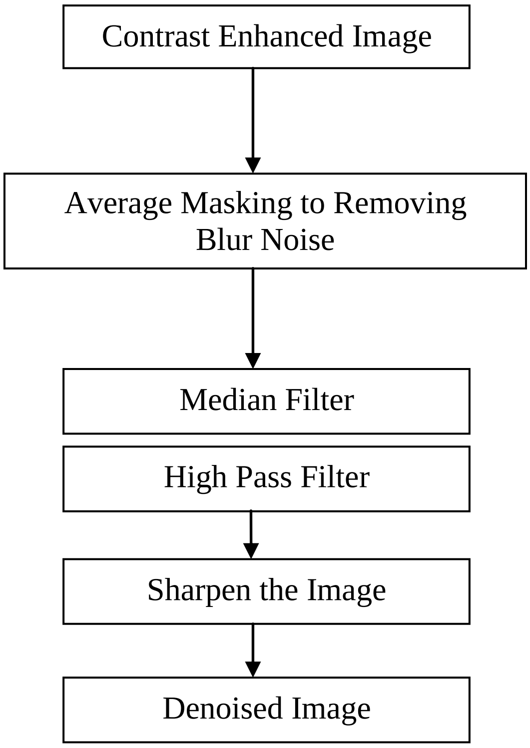


Figure 3: Filtering Process for Denoising

In spatial images filtering concerns with the noise reduction, image sharpening and it can be performed by manipulating the pixels values using certain masks applied on the image. For Noise reduction the masks used are smoothening masks, like the one on figure 4. In figure 4 the image is noise free but the resulting image is blurred. So in order to correct it, sharpening mask is used in order to sharpen the edges of the image.

(a) (b)

Figure 4: (a) Noisy Image (b) Image After masking

However edge sharpening is not the only method that is used. The power-law method is used in order to enhance the contrast by using some gamma correction values. From the above discussion it can be seen that image enhancement in the spatial domain is only done by manipulating the pixels [4, 5].

IV. EXPERIMENTAL RESULT

Different digital images are tested in with system which is implemented in MATLAB. The dataset we use to test our proposed technique includes 40 different images picked from different sources. Some of the images in the testing datasets were color images that we converted to grayscale using MATLAB.

V. CONCLUSION

In this paper we tried to show a different method for image denoising and how it is importance for image processing. The domains discussed here is the spatial domain by which we can enhance the image for visualization and further processing. In this paper we tried to show our implemented method for denoising using two major steps as histogram and then filter it to the different levels.

ACKNOWLEDGMENT

The author is a RTU Research Fellow and the work presented here is done during M.Tech Research at IET, Alwar. Authors are grateful to the all members of the Department of CSE and IT, IET Alwar for their valuable suggestions.

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] T S Cho, C L Zitnic et al. “Image restoration by matching gradientdistributions”, IEEE T-PAMI, 34(4):683–694, 2012.

[3] N.Mohanapriya,B.Kaalavati, “Comparative Study of Enhancement Techniques for Medical Images”, IJCA, vol.61, No.20, January 2013.

[3] B. Klein, S. Rati Khandelwal “Various Image Enhancement Techniques- A Critical Review” International Journal of Advanced Research in Computer and Communication Engineering, Pp. 1605-1609 Vol. 2, Issue 3, March 2013

[4] S S Bedil Saikaley, “Imaging, characterization and processing with laxicon derivatives” The School of Graduate Studies Laurentian University Sudbury, Ontario, Canada 2013.

[5] P.C Rossin. Image processing in frequency Domain. Lehigh UniversityURL:http://www.cse.lehigh.edu/~spletzer/rip_f06/lectures/lec012_Frequency.pdf. Accessed January 2011.

Agaian, SOSS., Blair Silver,Karen A.Panetta. “Transform Coefficient Histogram-Based Image Enhancement Algorithms Using Contrast Entropy”, IEEE Transaction on Image Processing, Vol. 16, No. 3, March 2007.