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REVIEW ARTICLE

Study of Various Image Enhancement Techniques-A Review

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Abstract— Image Enhancement Is As Much An Art As It Is A Science." Image enhancement is one of the key issues in high quality pictures such as digital cameras. The main purpose of image enhancement is to bring out detail that is hidden in an image increase contrast in a low contrast image, or to process an image so that result is more suitable than original image. As the Image clarity is very much affected by surrounding like lighting, weather, or equipment that was used to capture the image, as a result, many techniques have developed known as image Enhancement techniques to recover the information in an image. Digital image enhancement techniques provide a multiple choices for improving the visual quality of images. This paper presents a review of some significant work in the field of Image De=noising. The brief introduction of some popular approaches is provided and discussed.

I. INTRODUCTION

Image enhancement process consist 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 analysis by a human or machine. Image enhancement means as the improvement of an image appearance by increasing dominance of some features or by decreasing ambiguity between different regions of the image. The objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement is one of the most interesting and visually appealing areas of image processing. Image enhancement is a processing on image in order to make it more appropriate for certain applications. It is mainly utilized to improve the visual effects and the clarity of the image, or to make the original image more conducive for computer to process.

The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. In this process, one or more attributes of the image are modified and processed. The choice of attributes and the way they will be modified are specific to a given task. Here observer-specific factors, such as the human visual system such as human organs and the observer's experience, will introduce the subjectivity for the choice that which image enhancement method should be used.

A. IMAGE ENHANCEMENT

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. A familiar example of enhancement is shown in Fig.1 in which when we increase the contrast of an image and filter 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.

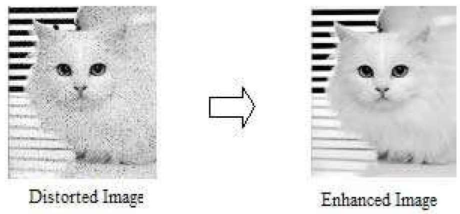

Figure 1: Image Enhancement

B. RGB and GRAYSCALE image:

In RGB images each pixel has a particular color; that color is described by the amount of red, green and blue in it. If each of these components has a range 0–255, this gives a total of 256^3 different possible colors. Such an image is a "stack" of three matrices; representing the red, green and blue values for each pixel. This means that for every pixel there correspond 3 values. Whereas in grayscale each pixel is a shade of gray, normally from 0 (black) to 255 (white). This range means that each pixel can be represented by eight bits, or exactly one byte. Other grayscale ranges are used, but generally they are a power of 2.so, we can say gray image takes less space in memory in comparison to RGB images.

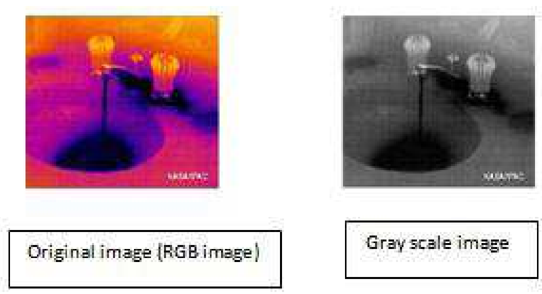

Figure 2: RGB & Grey Scale images

II. NOISE MODEL

Noise is present in image either in additive or multiplicative form.

A. Additive Noise Model

Noise signal that is additive in nature gets added to the original signal to produce a corrupted noisy signal and follows.

The following model:

$$W(x, y) = s(x, y) + n(x, y) \qquad (1)$$

B. Multiplicative Noise Model

In this model, noise signal gets multiplied to the original signal. The multiplicative noise model follows the following

rule:

$$W(x, y) = s(x, y) \times n(x, y) \qquad (2)$$

Where, s(x, y) is the original image intensity and n(x, y) denotes the noise introduced to produce the corrupted signal.

W(x, y) at (x, y) pixel location.

III. IMAGE NOISE AND ITS TYPES

Image noise is random variation of brightness or color information in images, and is usually an aspect of electronic noise. Randomly-spaced speckles, called noise, can appear in digital images. When noise is present, image detail and clarity are reduced, sometimes significantly. Noise is most noticeable in even areas of color such as shadows. Noise in image: $w(x, y) = s(x, y) + n(x, y)$ Where $s(x , y)$ is the original signal, $n(x , y)$ denotes the noise introduced into the signal to produce the corrupted image $w(x , y)$, and (x , y) represents the pixel location.

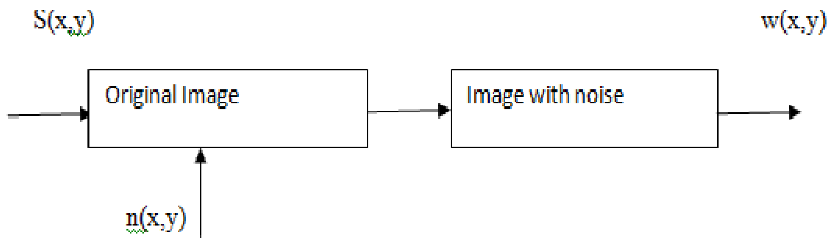

Figure 3: image with Noise

The image s(x , y) is blurred by a linear operation and noise n(x , y) is added to form the degraded image w(x, y).

A. Gaussian noise

Gaussian noise is evenly distributed over the signal. This means that each pixel in the noisy image is the sum of the true pixel value and a random Gaussian distributed noise value.

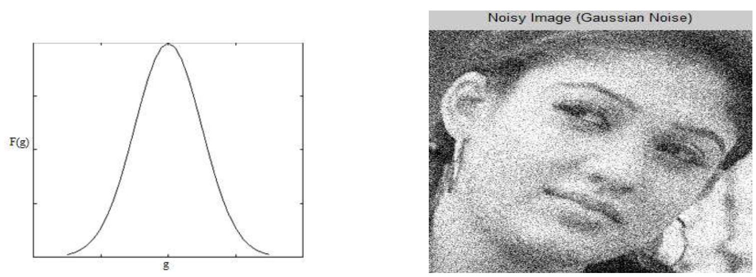

Figure 4: Gaussian Noise

B. Salt-and-pepper noise

Salt and pepper noise is a form of noise typically seen on images. It represents itself as randomly occurring white and black pixels. An effective noise reduction method for this type of noise involves the usage of a median filter or a contra harmonic mean filter.[10] Salt and pepper noise creeps into images in situations where quick transients, such as faulty switching, take place.

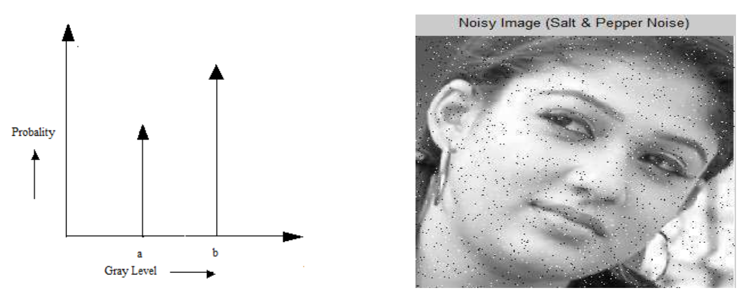

Figure 5: Salt and Pepper Noise

C. Speckle Noise

Speckle noise [4] [5] is multiplicative noise. This type of noise occurs in almost all coherent imaging systems such as laser, acoustics and SAR (Synthetic Aperture Radar) imagery. The source of this noise is attributed to random interference between the coherent returns. Fully developed speckle noise has the characteristic of multiplicative noise.

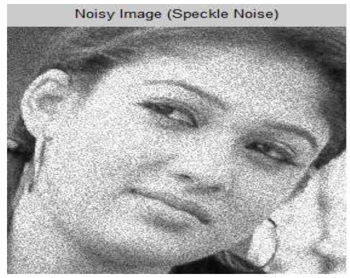

Figure 6: Speckle Noise

IV. IMAGE DE-NOISING

Image de-noising done by filtering. Filtering divide in broad categories. De-noising of images in medical science is still a challenging problem. There have so many techniques and algorithms published. Each has their own assumptions, limitations and advantages. Methods of image de-noising are spatial domain and transform domain. Linear filter such as Weiner, non-linear threshold filtering, wavelet coefficient model, non-orthogonal wavelet transform, wavelet shrinkage, anisotropic filtering, trilateral filtering etc. example of spatial filtering are Mean filtering and Gaussian filtering. Linear filters result is not better because they destroy the fine details and lines and also blur the sharp edges. Bilateral filter recently used for de-noise the images. Its work effectively with high frequency areas but it fails to work at low frequency It fails to remove salt and pepper noise and gives low performance to remove speckle noise. So each technique or filter or algorithm has its own advantages and limitations and drawbacks. So till there are so many filters for images de-noising.

Figure 7: De-noising Image

V. CLASSIFICATION OF IMAGE DE-NOISING TECHNIQUES

A. Histogram Equalization (HE)

Histogram equalization is a technique by which the dynamic range of the histogram of an image is increased. It flattens and stretches the dynamic range of the image's histogram and resulting in overall contrast improvement [7]. Histogram equalization assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. It improves contrast by obtaining a uniform histogram (Figure 3). This technique can be used on a whole image or just on a part of an image [5].

1. Local Enhancement Equalization (LHE) technique

The Histogram Equalization discussed above is global method, which means it increases the overall contrast of the image. So this method is suitable for overall enhancement. This method can be easily adapted to local enhancement. The procedure is to define the neighborhood and move the centre of this area from pixel to pixel. At each location, calculate histogram of the points in the neighborhood. Obtain histogram equalization/specification function. Finally this function is used to map gray level of pixel cantered in neighborhood [6]. It can use new pixel values and previous histogram to calculate next histogram [3].

B. Contrast Stretching

Contrast stretching enhances image by enhancing contrast between various parts of the original image. The basic idea is to improve the image quality by increasing the dynamic range of gray levels [4] (see graph in figure 1). A typical change in contrast enhancement can be seen from the Figure 1.

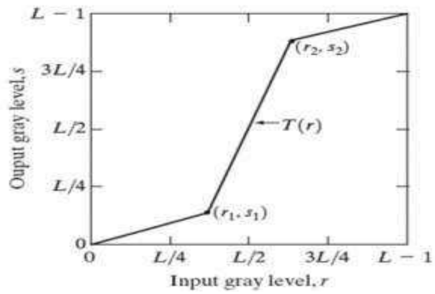

Figure 8: Shows the result of contrast stretching obtained using a simulation tool MATLAB

C. SPATIAL FILTERING

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. Spatial domain techniques like the logarithmic transforms, power law transforms, histogram equalization, are based on the direct manipulation of the pixels in the image. Spatial techniques are particularly useful for directly altering the gray level values of individual pixels and hence the overall contrast of the entire image.

Spatial filters can be broadly classified into two types:

1 Smoothing Spatial Filters

2 Sharpening Spatial Filters

1. Smoothing Filters

They are used for blurring and for noise reduction. They replace each pixel by the average of pixels contained in the neighborhood (filter mask). They are also called averaging or low-pass filters. It reduces the noise such as bridging of small gaps in the lines or curves in the image [6]. Their response is based on ordering the pixels contained in the image area encompassed by the filter, and then replacing the centre with the value determined by the ranking result [2].The well-known median filter is a Non-Linear filter.

2. Sharpening Spatial Filters

The principle objective of sharpening is to highlight transitions in intensity. Its applications ranging from electronic printing and medical imaging to industrial inspection [2]. It can provide more visible details that are poor, hazy and of obscured focus in the original image [6]. The well-known sharpening filter is High pass filter.

D. Discrete Wavelet Transform

Discrete wavelet transform of an image produces a non-redundant image representation that provides better spatial and spectral localization of image formation, compared to other multi scale representation [5]. The Discrete Wavelet Transform (DWT) analysis, is based on the assumption that the amplitude rather than the location of the spectra of the signal to be as different as possible from the amplitude of noise. This allows clipping, thresholding, and shrinking of the amplitude of the coefficients to separate signals or remove noise. It is the localizing or concentrating properties of the discrete wavelet transform that makes it particularly effective when used with this nonlinear filtering method [6][7]. Wavelet transform uses hard thresholding and soft Thresholding for de-noising.

Classical Wavelet-Based De-noising Methods Consist of Three Steps

1. Compute the discrete wavelet transforms (DWT).
2. Remove noise from the wavelet coefficients.
3. Reconstruct the enhanced image by using the **INVERSE DWT.**

Fuzzy logic based algorithm has been used for removal of noise. Many of the wavelet based de-noising algorithms use DWT (Discrete Wavelet Transform) in the decomposition stage which is suffering from shift variance. Decimated wavelet transform has been used for several reasons:-

1. The ability to compact most of the signals energy into a few transformation coefficients which is called energy compaction.

2. The ability to capture and represent effectively low frequency components as well as high Frequency transients.

3. The variable resolution decomposition with almost uncorrelated coefficients.

E. Wavelet domain

Filtering operations in the wavelet domain can be adaptive filtering and non adaptive threshold filtering techniques.

1. Non Adaptive threshold

VISU Shrink [15] is non-adaptive universal threshold, which depends only on number of data points. It has asymptotic equivalence suggesting best performance in terms of MSE when the number of pixels reaches infinity. VISU Shrink is known to yield overly smoothed images because its threshold choice can be unwarrantedly large due to its dependence on the number of pixels in the image.

2. Adaptive threshold

SURE Shrink [15] uses a hybrid of the universal threshold and the SURE [Stein's Unbiased Risk Estimator] threshold and performs better than VISU Shrink. Bayes Shrink [16, 17] minimizes the Bayes ‟ Risk Estimator function assuming Generalized Gaussian prior and thus yielding data adaptive threshold. Bayes Shrink outperforms SURE Shrink most of the times. Cross Validation [18] replaces wavelet coefficient with the weighted average of neighborhood coefficients to minimize generalized cross validation (GCV) function providing optimum threshold for every coefficient. The assumption that one can distinguish noise from the signal solely based on coefficient magnitudes is violated when noise levels are higher than signal magnitudes. Under this high noise circumstance, the spatial configuration of neighboring wavelet coefficients can play an important role in noise-signal classifications. Signals tend to form meaningful features (e.g. straight lines, curves), while noisy coefficients often scatter randomly.

VI. CONCLUSIONS

The purpose of this paper is to present a survey of digital image de-noising approaches. As images are very important in each and every field so Image De-noising is an important pre-processing task before further processing of image like segmentation, feature extraction, texture analysis etc. The above survey shows the different type of noises that can corrupt the image and different type of filters which are used to recover the noisy image. Different filters show different results after filtering .Some filters degrade image quality and remove edges. Performance of de-noising algorithms is measured using quantitative performance measures such as peak signal-to-noise ratio (PSNR), signal-to-noise ratio (SNR) as well as in terms of visual quality of the images.

REFERENCES

[1] Vijay A. Kotkar , Sanjay S. Gharde, "Review Of Various Image Contrast Enhancement Techniques" , Vol. 2, Issue 7, July 2013.

[2] Prof.Gayathri.R, Dr. Sabeenian.R.S , "Modern Techniques in Image Denoising: A Review" , Vol. 2, Issue 4, April 2013.

[3] Deepak K. Pandey, Prof. Rajesh Nema , "Selective Review on Various Images Enhancement Techniques", Vol. 2, Issue 6, June 2013.

[4] Nancy, Er. Sumandeep Kaur, " Image Enhancement Techniques: A Selected Review", Volume 9, Issue 6 (Mar. - Apr. 2013) .

[5] Rajesh Garg, Bhawna Mittal, Sheetal Garg , "Histogram Equalization Techniques For Image Enhancement" , IJECT Vol. 2, Issue 1, March 2011 .

[6] Ms.Seema Rajput , Prof.S.R.Suralkar , "Comparative Study of Image Enhancement Techniques" , Vol. 2, Issue. 1, January 2013.

[7] Manpreet Kaur* Sunny Behal , " Study of Image Denoising and Its Techniques" , Volume 3, Issue 1, January 2013 .

[8] Jyotsna Patil1, Sunita Jadhav, "A Comparative Study of Image Denoising Techniques", Vol. 2, Issue 3, March 2013.

[9] Usha Rani, Charu Narula & Pardeep, "Image Denoising Techniques A Comparative Study", Vol.2, Issue 3 Sep 2012.

[10] Kanika Gupta, S.K Gupta, "Image Denoising Techniques- A Review paper " , Volume-2, Issue-4, March 2013.

[11] Er. Mandeep Kaur Er. Kiran Jain Er Virender Lather, " Study of Image Enhancement Techniques: A Review" , Volume 3, Issue 4, April 2013.

