A Review on Image Enhancement Techniques

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Abstract: - Image enhancement plays a vital role in digital image processing. It is a technique used for the adjustment of digital images. It is one of the important vision applications because it has capability to enhance the visibility of images. It is used to improve the quality of poor pictures. For improving the quality of the digital images distinctive procedures have been proposed so far. Image Enhancement can be used for the purpose of conversion of poor quality images into the good quality images so that images can be clear for human perception or machine analysis. Its objective is to open up certain picture description for analysis, conclusion and further use. The main objective of this paper is to explore and determine the shortcomings of the existing image enhancement techniques.

Keywords: Image enhancement, Histogram Equalization, Adaptive Histogram Equalization, Fuzzy Based Image Enhancement, Human visual perception, Visibility.

I. INTRODUCTION

Image enhancement is the method of adjusting digital images so that the result is more suitable for show or more study. For example, you can remove noise or brighten an image, making it easier to identify key features. The enhancement doesn't raise the inbuilt information content of the data, other than it increases the dynamic range of the selected facial appearance as a result that they can be detected simply. Image enhancement techniques can be divided into two broad categories:

A. Spatial Domain Enhancement Method

The name domain refers to the collection of pixels composing an image. Spatial domain techniques are procedures that work directly on these composed pixels.

B. Frequency Domain method

Frequency domain image enhancement is straightforward. The frequency filters developed an image in the frequency domain. This type filtering technique is very simple:

1. Transform the image into the Fourier domain
2. Multiply the image by the filter
3. Take the inverse transform of the image

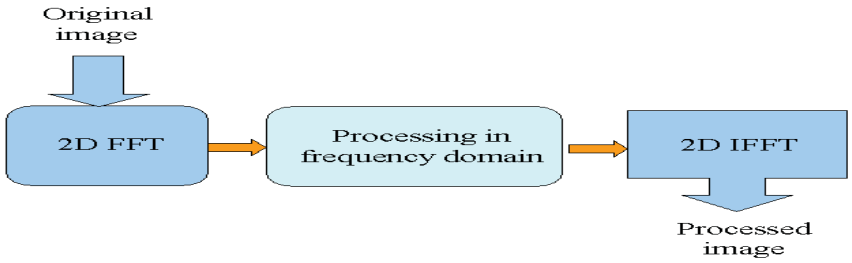

Figure1.The frequency filters process

II. CONTRAST ENHANCEMENT

The Visibility or the whole quality of an image can be improved without introducing unrealistic visual façade and/or irrelevant artifacts. The normal global contrast enhancement method basically increases the luminance for bright pixel and decreases the luminance for the dark pixels. Therefore the neighbourhood dependent contrast enhancement is desirable to get enough contrast for image enhancement without losing the dynamic range compression. It can be classified into different categories are as follow:

A. Linear Contrast Enhancement

Linear contrast enhancement also known as contrast stretching, the original image can be linearly expands into a new distribution. The total range of sensitivity of the digital device can be utilized by expanding the original value of an image. This method of enhancement can mostly used in remote sensing images.

B. Non Linear Contrast Enhancement

Through the use of an algorithm the non linear contrast enhancement involves the histogram equalization method. The limitation of non linear contrast enhancement is that in which the each value of input image have several values in the output image due to this the original object lose their accurate brightness.

III. HISTOGRAM

It is the graphical representation of the allocation of data. It is like a bar chart. Histogram is a instrument that is used in digital photography.

IV. HISTOGRAM EQUALIZATION

Histogram Equalization (HE) is method that is used to enhance the contrast of an image. In this it is not necessary that the contrast of an image will always be increased. In some cases the histogram equalization shows that it can be worse than the contrast of an image is decreased. Before processing histogram equalization, it is necessary to understand the two concepts that are called as PMF (probability mass function) and CDF (cumulative distributive function). For all the pixels in an image first of calculate PMF and CDF then work further.

(a) Input image

(b) Output result of histogram equalization

Figure2. Results of histogram equalization (a) original image (b) output result of histogram equalization

It can be divided into two main categories according to the transformation function that is local and global histogram equalization. In local method the overall contrast of an image enhanced more effectively. Histogram Equalization processing is global method, in the sense that pixels are modified by transformation function based on gray level content of an entire image. The shape of the histogram changes throughout the process of histogram equalization. The general formula for calculation of histogram equalization is:

$$h(v) = round\left(\frac{cdf(v) - cdf_{min}}{(M \times N) - cdf_{min}} \times (L - 1)\right) \qquad (1)$$

Where cdf_{min} is the minimum non-zero value of the cumulative distribution function, M×N gives the image's number of pixels and L is number of gray level used. Advantage of histogram equalization is that is practically straightforward method and invertible operator. It is the most popular algorithm because its effectiveness and simplicity. It is used in the field of digital image processing, medical images, Geographic information System etc.

V. ADAPTIVE HISTOGRAM EQUALIZATION

Adaptive Histogram Equalization (AHE) is the method of digital image processing used to improve the contrast of an image. This method is used to reduce the problem of the poor brightness in an image. The main properties of adaptive histogram equalization (AHE) are that in which the size of the neighbouring region is the parameter of the technique.

The main point of AHE is that in which at smaller scales contrast of an image is enhanced, while at larger scales contrast of an image is reduced or decreased.

a) Original image b) Output AHE

Figure3. The results of adaptive histogram equalization (a) original image (b) output results of adaptive histogram equalization

It is appropriate for the local contrast of an image and bringing out more details. If (x,y) is a pixel of intensity i from the image, then we note with $m_{+,-}$ the mapping of right upper $x_{+,-}$,$m_{+,+}$ the mapping of right lower$x_{+,+}$, $m_{-,+}$the mapping of left lower $x_{-,+}$ and $m_{-,-}$ the mapping of the left lower $x_{-,-}$ then

$$m(i) = a[bm_{-,-}(i) + (1-b)m_{+,-}(i)] + [1-a][bm_{-,+}(i) + (1-b)m_{+,+}(i)] \qquad (2)$$

Where

$$a = \frac{y - y_-}{y_+ - y_-},\ b = \frac{x - x_-}{x_+ - x_-}$$

On this by transforming each pixel with a conversion function obtained from a neighbourhood region adaptive histogram equalization improves. The advantage of adaptive histogram equalization is that it is automatic, reducible, and locally adaptive and usually produces superior images.

VI. FUZZY BASED IMAGE ENHANCEMENT

Fuzzy based image enhancement is one of the important techniques of the digital image processing. Fuzzy methods can deal with the improbability and limitation of an image that can be represented as a fuzzy set. Fuzzy logics used to development of human awareness in the form of fuzzy if then rules. This method is one of the most effective and efficient method for improve the image quality based on fuzzy sets. In fuzzy image processing is type of information processing in which both the input and output are images. Fuzzy rules or image processing can be divided into three parts: Image fuzzification (encode image data), membership values modification, and image defuzzification (decode image data). It is used to improve the quality of poor images.

a) Input image b) Output Image

Figure4. The results of Fuzzy Based image enhancement Technique (a) Input image (b) Output Image

VII. LITERATURE SURVEY

For enhancement of remote sensing images (Lee et al. (2013)) [1] on the basis of adaptive intensity transfer function and dominant brightness level analysis has been used. It divide the input image into four wavelet subbands and split the LL subband into low-, middle-, and high-intensity layers by analyzing the log-average luminance of the resultant layer. After that apply adaptive intensity transfer function and then implement contrast enhancement technique then combine the decomposed image by using image fusion method after that at last use inverse discrete wavelet transform method. Then the contrast enhanced image has ready as a result. By using the Discrete Wavelet transform and singular value Decomposition, Discrete Cosine Transform the Histogram equalization, Contrast Enhancement, Bi-histogram equalization; (Veena et al. (2013)) [2] has projected a new method for contrast enhancement based on the dominant Brightness and Adaptive transformation. Without changing original image quality the proposed techniques has an appropriate for enhancement of low contrast satellite image.

Histogram equalization (Srivastava et al. (2013)) [3] has one of the best method that is very effective method to process the digital contrast enhancement but has not been suitable for every image. Sometimes it shows not good outcomes. To overcome this problem it provides a new method to improve the image result. In this interact with histogram that reflects improved outcomes as compare to conservative one. On the basis of Absolute mean brightness error and peak Signal to Noise Ratio values. It has an appropriate for real time applications.

The major limitation of contrast enhancement algorithm (Cheng and Zhang (2012)) [4] has Over-Enhancement which could stimulate the loss of edges, alter the main texture, damage the fine details, and create the image appearance unnatural. It has no efficient reason for Over-enhancement until now. It provides a new technique for the recognition of Over-enhancement. The

outcomes have shown that the projected technique can establish the Over-enhancement areas perfectly and efficiently and give a quantitative method to assess the Over-enhancement levels fine.

(Ghimire and Lee (2011)) [5] Work has been focused on nonlinear colour image enhancement techniques. The purpose of image enhancement has to get better some features of an image to construct it visually good one. It shows the image enhancement has applied only on the V(luminance value) component of the HSV colour image and H & S component need no modification for enhancement because these components has not been changed. The V element enhanced in two steps. In first step the V element by using non linear transfer function has divided into smaller overlapped blocks and for every pixel within the block the luminance enhancement has accepted out. In the next step the contrast enhancement method has applies on it. At last the H and S element image and V element has converted back to RGB Image. The result shows that enhancement has one of the best methods for the image enhancement.

(Roomi and Prabhu et al. (2011)) [6] Has provided that for better visualization of low contrast images contrast enhancement method has been used. Histogram equalization used for Contrast enhancement. Histogram equalization has not suitable for consumer electronics product straightforwardly. It provides a new method of histogram equalization that tries to found foreground and background pixels of an image and apply bi-histogram equalization on them. Its outcomes shows that this algorithm preserves the original image as compare to other techniques.

Chauhan and Bhadoria (2011) [7] Histogram equalization has predictable technique for contrast enhancement. Histogram equalization has some limitations. Histogram equalization recovers the disparity of an image by altering the intensity level of the pixel based on the intensity of the original image. To overcome these problems apply brightness preserving weight clustering histogram equalization that protect image brightness and enhance visual effects of an image efficiently as compare to histogram equalization technique.

Josephus and Remya S (2011) [11] proved that for local content emphasis that the adaptive histogram equalization has the best and efficient algorithm. But sometimes has a problem of amplification and introduction of the speckle noise due to it information lost. To overcome this problem the multilayered contrast limited adaptive histogram equalization with frost filter that focused on application to medical images. In this on contrast limited adaptive histogram equalization the combination of frost and median filter both has been used. For the removal of speckle noise in images the technique of frost filter has been done. The work has been done on medical images such as mammogram, knee, and brain images.

Demirel et al. (2010) [8] provided a novel satellite image contrast enhancement method based on the discrete wavelet transform and singular value decomposition has been projected. In this method by using discrete wavelet transform divide the input image into the four frequencies subbands and estimates the singular value matrix of low-low subband image and then restructure improved by applying inverse discrete wavelet transform. The illustration results on the finishing image quality show the advantage of the projected technique over the predictable and the state-of-the-art method. The different techniques used for example discrete wavelet transform, Image equalization and satellite image contrast enhancement. Compare the techniques with general histogram equalization and local histogram equalization.

Ke et al.(2010) [9] This provide there are so many types of image enhancement techniques that makes the image results better that associate to the person visual system. It includes the two techniques bilateral tone Adjustment and Saliency Weighted Contrast Enhancement both combined in image enhancement framework. The main scenes that are contained in mid-tone regions enhanced by bilateral tone adjustment in most of the curve-based global contrast enhancement techniques. The saliency-weighted Contrast enhancement integrates the notion of image saliency into an easy filter-based contrast enhancement technique. It performs extra enhancement in regions that persons give larger concentration to. By using the luminance component in this saliency weighted contrast enhancement achieves extra performance. It proved that to achieve higher contrast enhancement with slight sound and huge image quality.

Murahira et al. (2010) [10] proved for improving the disparity in digital images histogram equalization is one of the general technique. On the other hand, it will cause a consequence on the brightness saturation or shadow in several identical areas. To

overcome these things mean preserving bi-histogram equalization technique has been developed. New histogram equalization with variable enhancement degree and bi-histogram equalization with variable degree has developed. By only one parameter the degree of every of these techniques has controlled. Every type of images is enhanced effectively. The outcomes show that especially, bi-histogram equalization with variable degree can recognize the normal enhancement.

VIII. GAPS IN EXISTING STUDY

Following are the major limitations that are found in the related work of image enhancement techniques.

1. The survey has found that the most of the existing methods based on the transform domain techniques, which may introduce the color artefacts.
2. Transform Domain Method may decrease the intensity of the remote sensing input image.
3. The use of adaptive histogram equalization has been ignored by many researchers to reduce the problem of poor brightness which will be presented in the output image due to dominant brightness level analysis.

XI. CONCLUSION AND FUTURE SCOPE

The image enhancements techniques have become important pre-processing tool for digital vision processing applications. It has been shown in this paper that the image enhancements have been successfully used for improving the quality of poor images by using the various linear and non-linear techniques. The review has shown that the most of existing techniques are based upon the transform domain methods, which may introduce the colour artifacts. Also some methods may introduce Gaussian noise.

In near future we will use a modified image enhancement model to enhance the shortcomings of the earlier work. No implementation is considered in this work in near future we will use suitable tool for experimental purpose.

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