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A Review on Image Enhancement using Filtering Techniques

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Abstract— The purpose of this paper is to enhance the colour images using the filtering techniques. Image enhancement is used to improve the quality of an image. In this paper, image enhancement algorithm has implemented for n x n mask, but in this paper, authors have chosen only 3 x 3 which are convoluted with various poorly contrast images. The performance of the algorithm are analyzed and compared with the average filter on the basis of image processing parameters. The experiment will be carried out on various images that prove that proposed image enhancement algorithms enhance poor quality images very effectively.

Keywords— semantic image processing, statistical analysis, image understanding, crowd sourcing, large-scale experimentation.

I. INTRODUCTION

The objective of image enhancement is to improve the quality of image as perceived by a human beings through an enhancement algorithms. Image enhancement can be performed both in the spatial domain as well as in time domain. In spatial domain method median filter is used which works on pixel values of the images. The high-pass filter will works on high-frequency components of images. An enhancement algorithm is one that yields a better quality image for the purpose of some particular application which can done by either suppressing the noise or increasing the image contrast. Image enhancement algorithms are employed to emphasize, sharpen or smoothen the image features for display and analysis. Enhancement methods are application specific and are frequently developed empirically. Image enhancement techniques emphasize specific image features to improve the visual perception of an image. Image-enhancement techniques can be classified into two broad categories as:

Spatial domain method
Spatial domain techniques deals with the manipulation of pixels values.

Transform domain method
The transform domain method operates on the Fourier transform of an image and then transform it back to the spatial domain.
Image enhancement [1,2,3,4] is the processing of image to enhance certain feature of an image. Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing better input for other automated image processing techniques. 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. During this process, one or more attributes of the image are modified. The choice of attributes and the way they are modified are specific to a given task. Moreover, observer-specific factors, such as the human visual system and the observer's experience, will introduce a great deal of subjectivity into the choice of image enhancement methods. Image enhancement is used in the following cases: Removal of noise from image, Enhancement of the dark image and highlight the edges of the objects in an image. The result is more suitable than the original image for certain specific applications. Processing techniques are very much problem oriented [5,6,7,8]. For example, best techniques for enhancement of X-ray image may not be best for enhancement for microscopic images.

II. RELATED WORK

Image enhancement is a common operation in image processing. It's a useful method for processing scientific images such as X-Ray images or satellite images. And it is also useful to improve detail in photographs that are over or under-exposed. Contrast enhancement techniques are widely used for image/video processing to achieve wider dynamic range.
Histogram equalization (HE) is widely used for contrast enhancement in a variety of applications due to its simple function and effectiveness. Examples include medical image processing and radar signal processing. One drawback of the histogram equalization can be found on the fact that the brightness of an image can be changed after the histogram equalization, which is mainly due to the flattening property of the histogram equalization. Thus, it is rarely utilized in consumer electronic products such as TV where preserving original input brightness may necessary in order not to introduce unnecessary visual deterioration. Kim proposed the algorithm [15] that 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.

Histogram equalization is a common technique for enhancing the appearance of images. Suppose we have an image which is predominantly dark. Then its histogram would be skewed towards the lower end of the grey scale and all the image detail is compressed into the dark end of the histogram. If we could `stretch out' the grey levels at the dark end to produce a more uniformly distributed histogram then the image would become much clearer.

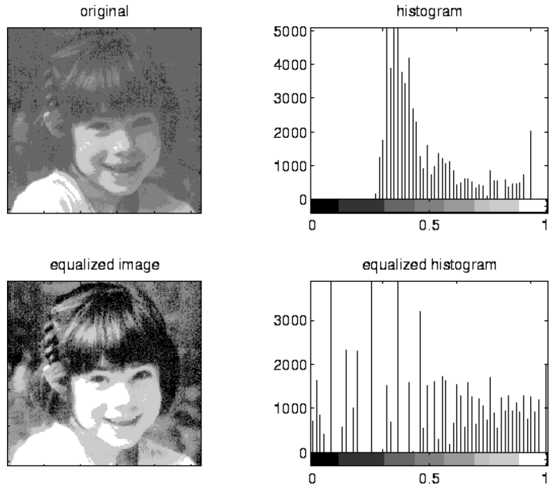

Figure 1: Original image and its Histogram, and the equalized versions.

Image Enhancement based on Spatial Domain

In image processing, airspace is composed of pixels of space. The spatial enhancement refers to a direct effect on the pixels of the enhancement methods. It can be expressed as:

g(x,y)=EH[f(x,y)]

The f (x,y) and g (x,y) means before and after images were enhanced. If the EH is defined in each (x, y), then it get the point of operation EH; if EH is defined in the (x, y) of a neighborhood, then EH is called the template operation. EH can either act as an image f (x,y), it can also act on a series of images {f1 (.), f2 (.),..., fn (.)}. Based on the spatial domain approach can make histogram equalization better. This is a significant enhancement way in statistics. But in the image processing field, it will be underexposed or overexposed. An image histogram is the corresponding image pixel gray level of each approximation of the distribution of the probability density function. Histogram equalization is a classical image enhancement technology. [13]

The histogram equalization process is based on distribution function of transform. It is like the basis of the histogram correction method. The basic idea is to use the cumulative distribution function as a transformation function to transform the original image histogram form for the uniform distribution, thus increasing the dynamic range of pixel gray values to achieve the effect of enhancing the overall image contrast. [13] In fact, histogram is the approximate probability and density function. With discrete gray levels for the transformation can be completely. This is the inevitable result of the pixel gray. For these reasons, the digital image can only be an approximate histogram equalization. [13]

Image Enhancement based on Frequency Domain

In order to effectively and quickly process and analysis the image, it is necessary to require the original image defined in the image control in some form of conversion to other controls. And it is necessary to use the unique nature of these controls convenient for certain processing. Finally, it need convert back to image space, and then obtain desired result. The most commonly used way is the frequency space transformation to another space. The spatial frequency enhancement methods have two rules:

(1) The original image from the image space to frequency space, the lock needs change (indicated by T). Next, it need convert back to frequency space images from the image space (indicated by T2);

(2) In the frequency space, it is needed to enhance image processing operations. Corresponding increase at this time can be expressed as:

g(x,y)=T2{EH[T[f(x,y)]]}

The frequency enhancement methods are: low-pass filter, high pass filter, band pass and band stop filtering and homomorphic filtering and so on. Homomorphic filtering solution is non-uniform illumination. The image in the dynamic range is not clear images. The high-pass filter method always ignores image part and highlighting details. That can represent high frequency components, enhancing the part of the edge detail. This method is suitable for edge detection of objects in the image. Due to the low frequency method, the visual effect of the processed image is not good. [14]

Median Filter

Median filters are statistical non-linear filters[5] that are often described in the spatial domain. A median filter smoothens the image by utilizing the median of the neighborhood. Median filter performs the following tasks to find each pixel value in the processed image:

- All pixels in the neighborhood of the pixel in the original image which are identified by the mask are stored in the ascending (or) descending order.
- The median of the stored value is computed and is chosen as the pixel value for the processed image.

Median Value

Median value is calculated by eliminating the pixel values which are very different from their neighboring pixels. By eliminating the effect of such odd pixels, the values are assigned to the pixels that are representative of the values of the typical neighboring pixels in the original image.

Adaptive Median Filter

The standard median filter performs well as long as the spatial noise density of the salt and pepper noise is not large. The filter performance degrades when the spatial noise variance of the salt and pepper noise increases [10]. Further with larger image and as the size of the kernel increases, the details and the edges becomes obscured [11]. The standard median filter does not take into account the variation of image characteristics from one point to another. The behaviour of adaptive filter changes based on statistical characteristic of the image inside the filter region defined by the mxn rectangular window Sxy [11]. The adaptive median filter differs from other adaptive filter as the size of the rectangular window Sxy is made to vary depending on:
(a) zmin =Minimum gray level value in=Minimum gray level value in Sxy
(b) zmax =Maximum gray level value in=Maximum gray level value in Sxy
(c) zmed =Medians of gray level inin Sxy
(d) zxy =Gray levels at coordinate=Gray levels at coordinate (x,y)
(e)Smax = Maximum allowed size of Maximum allowed size of Sxy [12].

Spatial domain high-pass filtering

High-pass filtering [9],[6],[7] is used for sharpening the image. The objective of high-pass filtering or image sharpening is to high light fine details in the image through enhancing the high frequency components. The spatial filter or spatial mask which performs image sharpening.

High-boost Filtering

A high-boost filter [2] is also known as a high-frequency emphasis filter. A high-boost filter is used to retain some of the low-frequency components to aid in the interpretation of an image. In high-boost filtering input image f(m, n) is multiplied by an amplification factor A before subtracting the low-pass image. Thus, the high-boost filter expression becomes-
High boost = A x f(m, n) – low pass
Adding and subtracting 1 with the gain factor, we get
High boost = (A - 1) x f(m, n) + f(m, n) - low pass
But f(m, n) – low pass = high pass
High boost = (A -1) x f(m, n) + high pass

III. PROPOSED METHODLOGY

The original test image is corrupted with simulated salt and pepper noise with different noise variance ranging from 0.1 to 0.9. In the proposed denoising approach, the noisy image is first applied to an adaptive median filter. The maximum allowed size of the window of the adaptive median filter is taken to be 5X5 for effective filtering. The choice of maximum allowed window size depends on the application but a reasonable value was computed by experimenting with various sizes of standard median filter. In the second stage the resultant image is subjected to NL-means filtering technique.

IV. CONCLUSION

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