IJARSE, Vol. No.2, Issue No.3, March, 2013 ISSN-2319-8354(E)

VISUAL SEARCH

[1]Radhika Tyagi, [2]Rashmi Sharma, [3]Shambhavi Srivastava

UG, [1,2,3] Department of Information Technology Engineering,
Raj Kumar Goel institute of Technology for Women, Ghaziabad,

Gautam Buddh Technical University, Lucknow, (India)

ABSTRACT

The field of Digital Image Processing refers to processing Digital images by means of digital computer. One of the main application areas in Digital Image processing methods is to improve the pictorial information for human interpretation. Most of the Digital images contain noise. This can be removed by many enhancement techniques. Filtering is one of the enhancement techniques which are used to remove unwanted information (noise) from the image. It is also used for image sharpening and smoothening. Some neighbourhood operations work with the values of image pixels in the neighbourhood and the corresponding values of the sub images that has the same dimensions as the neighbourhood. The sub image is called a "Filter".

Keywords: Spatial Filter, Arithmetic Mean Filters, Median Filter, Ranking Filter

I INTRODUCTION

Interest in Visual Search processing methods stems from two principal application areas: improvement of pictorial information for human interpretation; and processing of image data for storage, transformation and representation for autonomous machine perception.

An image may be defined as two dimensional function. f (x, y) where x and y are spatial co-ordinates and the amplitude of f at any pair of co-ordinates (x, y) is called the intensity or gray level of the image at the point. When x, y and the amplitude values of f are all finite, discrete quantities we call the image a digital image. The field of digital Image processing refers to processing digital image by means of digital computer.

Digital image is composed of finite number of elements, each of which has a particular location and values. These elements are refer to as picture elements, Image elements and Pixels. Pixel is a term most widely used to denote the elements of the digital image. Sometime a distinction is made by defining image processing as a discipline in which both the input and output of process are images.

Filters are one of the digital image enhancement techniques used to sharp the image and to reduce noise in the image. There are two types of enhancement techniques called spatial domain and frequency domain techniques which are categorized again for smoothing and sharpening the images

II OBJECTIVES OF FILTERS

Smoothing filters are used for blurring and noise reduction. Blurring is used in pre-processing steps such as removal of small details from an image prior to object extraction and bridging of small gaps in lines or curves.

Noise reduction can be accomplishing by blurring with a linear filter and also by non linear filtering. The principal objective of sharpening is to highlight and fine detail in image or enhance detail that has been blurred either in error or as a natural effect of a particular method image acquisition.

Use of image sharpening vary and include application ranging from electronic printing and medical imaging to industrial inspection and autonomous guidance in military systems.

III FILTRING TECHNIQUES

Filtering is one of the image enhancement technique used for sharpening and smoothening the image by removing noise from it.

3.1 SPATIAL FILTERING

Filtering operations that are performed directly on the pixels of an image. Are referred as Spatial Filtering.

The process of Spatial filtering consist simply of moving the filter mask from point to point in an image. At each point (x, y) , the response of that filter at that point is calculated using a predefined relationship. For linear spatial filtering the response is given by the sum of products of the filter coefficients and the corresponding image pixels in the area spanned by the filter mask. For the 3*3mask the result R, of linear filtering with the filter mask at the point (x, y) in the image is

$$R=w(-1,-1)f(x-1, y-1)+w(-1,0)f(x-1,y)+\ldots\ldots+w(0,0)f(x, y)+\ldots..+w(1,0)f(x+1,y)+w(1,1)f(x+1,y+1),$$

Which we see is the sum of product of the mass coefficients with the corresponding pixels directly under the mask. In particular that the coefficients w(0,0) coincides with the image value f(x, y), indicating that the mask is centred at (x, y) when the computation of the sum of product take place. For a mask of size m*n, we assume that m=2a+1 and n=2b+1 , where a and b are nonnegative integers. All this says is that are focus on following topic will mask of odd sizes. With the smallest meaningful size being 3*3.

The process of linear filtering is similar to frequency domain concept called convolution. For this reason linear spatial filtering is often referred to as “Convolving a mask with an Image”. Similarly filter mask are called Convolution mask. The term convolution kernel also is in common use. The mechanics of spatial filtering is illustrated in following figure 1

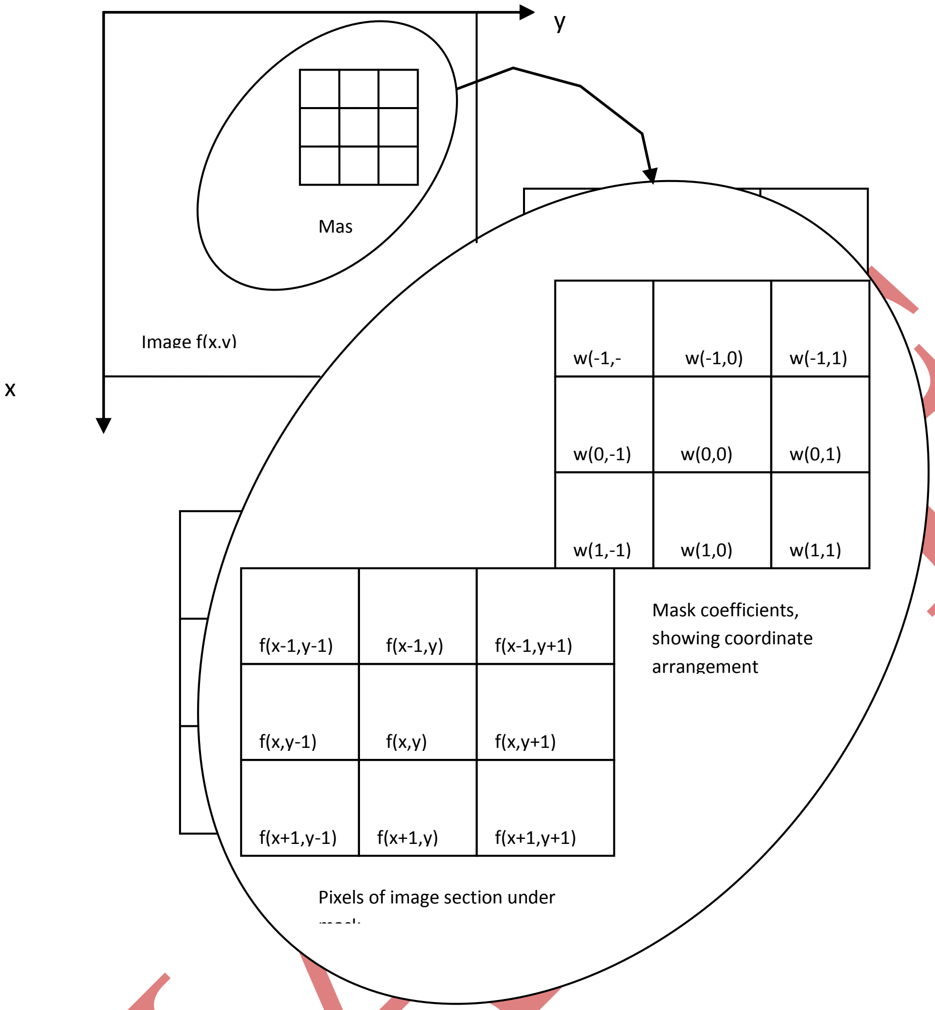

Fig 1: Mechanics of Spatial Filtering

In term of images, consider the pixel in 3*3 mask :

$$\begin{pmatrix} z_1 & z_2 & z_3 \\ z_4 & z_5 & z_6 \\ z_7 & z_8 & z_9 \end{pmatrix}$$

3.2 SMOOTHING SPATIAL FILTERS

Smoothing filters are used for blurring and noise reduction. Blurring is used in pre-processing steps, such as removal of small details from an image prior to object extraction, bridging of small gaps in lines or curves. Noise reduction can be accomplished by blurring with a linear filter and also by non linear filtering.

3.3 SMOOTHNING LINEAR FILTERS

The response of smoothing, linear partial filters is simply the average of the pixels contained in the neighbourhood of the filter mask. These filters are sometime called averaging filters. They are also referred to as low pass filters.

The idea behind smoothing filter is straight forward. By replacing of every pixel of the image by the average of the gray levels in the neighbourhood defined by the filter mask. This process results in an image with reduced "sharp" transition in gray levels. Because random noise typically consists of sharp transition in gray levels, so averaging filters have undesirable side effects that blur edges. Another application of this type of process includes the smoothing of false contours that result for using an insufficient number of gray levels.

A major use of averaging filters is in the reduction of "irrelevant" details in the image. By irrelevant we mean the pixel regions that are small with respect to the size of filter mask. A spatial averaging filter in which all the coefficients are equal is sometimes called a box filter.

3.3 SMOOTHING NON-LINEAR SPATIAL FILTERS

Non linear spatial filters are order-statistics filters whose response is based on ordering the pixels contained in the image area encompassed by the filters and then replacing the value of the central pixel with the value determined by the ranking result. The best known example in this category is the Median filter, which as its name implies replaces the value of a pixel by the median of the gray levels in the neighbourhood of that pixel.

3.4 SHARPENING SPATIAL FILTERS

The principal objective of sharpening is to highlight fine details in an image or to enhance details that has been blurred, either in error or as a natural effect of a particular method of image acquisition. Uses of image sharpening vary and include applications ranging from electronic printing and medical imaging to industrial inspection and autonomous guidance in military systems.

In the last section, We saw the image blurring could be accomplished in spatial domain by pixel averaging in the neighbourhood. Since averaging is analogous to integration. It is logical to conclude that sharpening could be accomplished by spatial differentiation. This is in fact, is the case, and the discussion in this section deals with various ways of defining and implementing operators for sharpening by digital differentiation. Fundamentally the strength of the response of a derivative operator is proportional to the degree of discontinuity of the image at the point at which the operator is applied . Thus image differentiation enhances edges and other discontinuities and deemphasizes areas with slowly varying gray-level values.

IV BASICS OF FILTERING IN THE FREQUENCY DOMAIN

The Fourier Transform is composed of all values of the function f(x). The values of f(x), in turn are multiplied but sines and cosines of various frequencies. The domain over which the values of F(u) is called the frequency domain, because 'u' determines the frequency of the component of the transform. Each of the M terms of F(u) range is appropriately called the Frequency domain. Because 'u' determines the frequency of the component of the transform. Use of the terms frequency domain and frequency components is really no different from the terms Time domain and Time Components, Which we would use to express the domain and values of f(x) if x where a time variable. Filtering in the frequency domain is straight forward. It consists of the following steps:-

(i) Multiply the input images by (-1)x+y to center the transform

(ii) Compute F(u, v), the DFT of the image from 1

(iii) Multiply F(u, v) by a filter function H(u ,v)

(iv) Compute the inverse DFT of the result in 3

(v) Obtain the result part of the result in 4

(vi) Multiply the result in 5 by (-1)x+y

The reason that H(u, v) is called a filter is because it suppresses certain frequency in the transformation.

Instead of using filter mask, can work in the frequency space using the convolution theorem. Application of the mask to each pixel (x, y) is basically a convolution process, so can get same result by multiplying the Fourier transforms of the image and the mask and then inverse Fourier transforming the product. The reason for this approach is that it is much easier to specify the filter in frequency space, and for masks of modest size (e. g 7*7 or larger) it is easier to work with the fourier transform.

In determining H(n, m) the transfer function which corresponds to h(x, y), the impulse function, the need to preserve phase require that H(n, m) be real, i.e., no imaginary components. This implies that impulse function is symmetric: h(x, y)=h(-x,-y).

In the interest of simplicity, the discussion here will assume circular symmetry. That is,
H(n,m)=>H(ρ) where ρ2= n^2 + m^2.

4.1 SMOOTHING FREQUENCY DOMAIN FILTER

As indicated earlier edged and other sharp transition in the gray levels of an image contributes significantly to the high frequency content of the Fourier transform. Hence smoothing is achieved in the frequency domain by attenuating a specified range of high frequency components in the transform of a given image Our basic model for filtering in the frequency domain is given by G(u, v)=H(u, v)F(u, v) Where F(u, v) is the fourier transform of the image to be smoothed. The objective is to select a filter transfer function H(u, v) that yields G(u, v) by attenuating the high frequency components of F(u, v)

4.2 SHARPENING FREQUENCY DOMAIN FILTERS

Image sharpening can be achieved in the frequency domain by a high pass filtering process, which attenuates the low frequency components without disturbing high frequency information in the Fourier transform.

The transfer function of the high pass filter are $\mathbf{H_{hp}(u, v) = 1- H_{lp}(u, v)}$ **where** $\mathbf{H_{lp}}$ (u, v) is the transfer function of the corresponding low pass filter. That is when low pass filter attenuates frequencies, the high pass filter passes them and vice versa.

4.3 FOURIER TRANSFORMATION

The Fourier transform is linear and associative under addition, but is not associative under multiplication. Thus Fourier methods are suitable for removing noise from images only when the noise can be modelled as additive term to the original image.

However, if defects of the image, e.g., uneven lightning have to be modelled as multiplicative rather than additive, direct application of Fourier method is inappropriate.

In terms of the illuminance and reflectance of an object, an image of the object might be modelled as f(x,y)=i(x,y)r(x,y). In this case some way of converting multiplication into addition must be employed before trying to apply Fourier Filtering the obvious way to do is to take logarithm of both sides q(x,y)=ln[i(x,y)r(x,y)+1]=ln[i (x, y)]+ln[r(x,y)] where 1 has been added to the image value to avoid problems with ln[0].

V TYPES OF FILTERS

5.1 SPATIAL FILTERS

5.1.1 Mean filters

It is a noise- reduction linear spatial filters.

Three types of mean Filters:

(i) Arithmetic mean filters
(ii) Geometric mean filters
(iii) Harmonic mean filter
(iv) Contra harmonic mean filter

5.2 ARITHMETIC MEAN FILTERS

This is the simplest of the mean filters. Let Sx,y represent the set of co-ordinates in a rectangular sub image window of size m*n ,centered at point (x,y).The arithmetic mean filtering process computes the average value of the corrupted image g(x,y)in the area defined by Sx,y. The value of the restored image f' at any point(x,y) is simply the arithmetic mean computed using the pixels in the region defined by Sx,y.

A mean filter simply smoothes local variations in an image. Noise is reduced as a result of blurring.

Arithmetic filters are well suited for random noise like Gaussian or uniform noise.

EXAMPLE

Original image with sharp edge and one outlier:

Image after filtering with a mean filter:

5.3 RANKING FILTER

Order statistics filters are spatial filters whose response is based on ordering or ranking the pixels contained in the image area encompassed by the filter. The response of the filter at any point is determined by the ranking result.

5.4 MEDIAN FILTER

The best known order statistics filter is the median filter, which as its name implies, replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel:

$$\mathbf{F^{\wedge}(x, y) = median_{(s,t)eSx,y}\{g(s,t)\}}$$

The original value of the pixel is included in the computation of the median. Median filters are quiet popular because, for certain types of random noise, they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size. Median filters are particularly effective in the presence of both bipolar and unipolar impulse noise. In fact, the median filter yields excellent result for images corrupted by this type of noise.

Median filters are quiet popular because for certain type of random noise, they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size. Median filters are particularly effective in the presence of impulse noise, also called salt and pepper noise because of its appearance as white and black dots superimposed on an image.

EXAMPLE

Original image with sharp edge and one outlier.Image after filtering with a median filter.

Although the median filter is by far the most useful order statistics filter in image processing, it is by no means the only one. The median represents the 50^{th} percentile of a ranked set of numbers, but the reader will recall from basic statistics that ranking lends itself to many other possibilities. Using 100^{th} percentile results in the max filter which is useful in finding brightest points in an image.0^{th} percentile filter is the min filter, used for opposite purpose.

5.5 MAX AND MIN FILTERS

Although the median filter is by far the most useful order statistics filter in image processing, it is by no means the only one. The median represents the 50^{th} percentile of a ranked set of numbers, but the reader will recall from basic statistics that ranking lends itself to many other possibilities. Using 100^{th} percentile results in the max filter which is useful in finding brightest points in an image.0^{th} percentile filter is the min filter, used for opposite purpose.

Max filter is given by

$$\mathbf{f^{\wedge}\ (x, y) = max_{(s,t)eSx,y}\{g(s,t)\}.}$$

This filter is useful for finding the brightest points in an image. Also, because pepper noise has low values, it is reduced by this filter as a result of the max selection process in the sub image area Sx,y. The 0^{th} percentile filter is Min Filter:

$$\mathbf{f^{\wedge}\ (x, y) = min_{(s,t)eSx,y}\{g(s,t)\}.}$$

VI MINIMUM MEAN SQUARE ERROR (WIENER)FILTERING IMAGE RESTORATION

If an image f(x,y) is degraded going through an optical system and the detected image g(x,y) represents the effect of the point function h(x,y) of the system, then in the frequency domain the process can be represented by G=HF ,where it is assumed that there is no noise. If it is further assumed that H(w,z) is either known or can be determined, then it is possible to regain the original image by the process.

All of this work is done in the frequency domain and the result Fourier transformed back to real space. The idea is good, however this process is susceptible to noise{although a more complicated effort using Wiener filters might help if there is noise)and demands very accurate knowledge of the transfer function H.

The method is founded on considering images and noise as random processes, and the objective is to find an estimate f^ of the uncorrupted image f such that the mean square error between them is minimized. This error measure is given by

$$\mathbf{e^2 = E\ \{\ (f - f^{\wedge}\ )^2\ \}}$$

Where E(.) is the excepted value of the argument. It is assumed that the noise and the image are uncorrelated ; that one or the other has zero mean ;and that the gray levels in the estimate are a linear function of the levels in the degraded image.

VII FREQUENCY FILTERS

Low frequencies in the Fourier transform are responsible for the general gray level appearance of an image over smooth areas, while high frequencies are responsible for detail, such as edges and noise.

A filter that attenuates high frequencies while “Passing” low frequencies is called a low pass filter. A filter that has opposite characteristic is appropriately called a big pass filter.

VIII CONCLUSION

The objective of this paper is to define methods to smooth and sharp the images by using various Filtering Techniques. Where filtering techniques are one of the enhancement techniques in visual search. Here in this paper we have illustrated few spatial domain filters and frequency domain filters. Where spatial domain filters removes the noise and blurs the images and frequency domain filters are use to sharpen the inside details of an image. Filters are used in many applications areas as medical diagnosis, Army and Industrial areas.

REFRENCES

[1] "*Digital Image Processing", ,* Rafael C Gonzalez,Richard E. Woods-Pearson Education
[2] "*Applied Digital Image Processing*", G.W. Awlock, R Thomas -McGraw Hill
[3] "*Introductory Computer Vision and Image Processing"*, -McGraw Hill
[4] "*Image Processing Analysis and Machine Design"* ,M. Sonka,-Thomson Learning
[5] Roger S. Pressman, "*Software Engineering*" Tata McGraw Hill, 2000