Enhancement and Pre-Processing of Images using Filtering

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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 is used to remove unwanted information (noise) from the image. It is also used for image sharpening and smoothening. The aim of this project is to demonstrate the filtering techniques by performing different operations such as smoothening, sharpening, removing the noise etc. This project has been developed using Java language because of its universal acceptance and easy understandability. Interest in digital image 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

Index Terms—Digital Image processing, Filltering echniques, Image enhancement.

I. INTRODUCTION

Interest in digital image 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.

The objective of image enhancement is to improve the quality of image as perceived by human beings through enhancement algorithms. Image enhancement can be performed both in the spatial domain as well as in time domain

An image may be defined as a two-dimensional function, f(x, y), where x and y are spatial coordinates, and the amplitude of f at any pair of coordinates (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 images by means of digital computers. But some digital images are blurred due to noise and henceforth images are needed to be enhanced for further processing. Therefore Filtering technique is widely used to enhancing the images by reducing the noise and further sharpening them.

Filters are one of digital image enhancement technique used to sharp the image and to reduce the 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. FILTERING IN SPATIAL DOMAIN

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

The process of spatial filtering consists simply of moving the filter mask from point to point in an image. At each point(x, y), the response of the filter at that point is calculated using a predefined relationship. Spatial Filters can be distinguished as Smoothing linear filters.

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

III. FILTERING IN FREQUENCY DOMAIN

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.

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V. TYPES OF FILTERS

Low pass Filters: A low pass filter is the basis for most smoothing methods. An image is smoothed by decreasing the disparity between pixel values by averaging nearby pixels Using a low pass filter tends to retain the low frequency information within an image while reducing the high frequency information.

The low-pass filtered image looks a lot blurrier. But the question is why we would want a blurrier image. Often images can be noisy, no matter how good the camera is, it always adds an amount of “snow” into the image. The statistical nature of light itself also contributes noise into the image.

Noise always changes rapidly from pixel to pixel because each pixel generates its own independent noise. The image from the telescope isn't "uncorrelated" in this fashion because real images are spread over many pixels. So the low-pass filter affects the noise more than it does the image.

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By suppressing the noise, gradual changes can be seen that were invisible before. Therefore a low-pass filter can sometimes be used to bring out faint details that were smothered by noise.

High pass filters: A high pass filter is the basis for most sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with little variation in brightness or darkness.

High-boost Filtering: A high-boost filter 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 h (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 h (p, q) – low pass

Adding and subtracting 1 with the gain factor, we get

High boost = (A - 1) x h (p, q) + h (p, q) - low pass.

VI. RESULTS

Figure 1: Illustrating the low pass filter removing the noise from the foreground

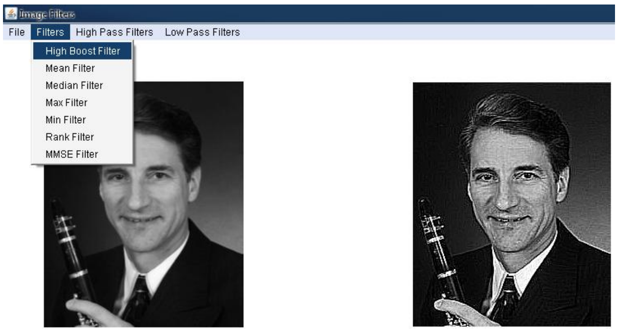

Figure 2: Illustrating the high pass filter intensifying the more contrast parts.

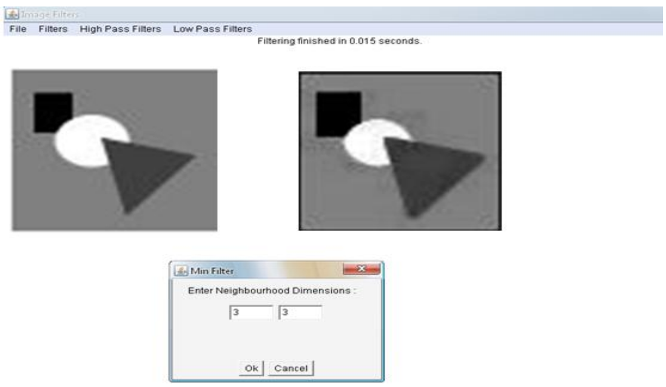

Figure 4: Illustrating min filter enhancing the size of dark parts.

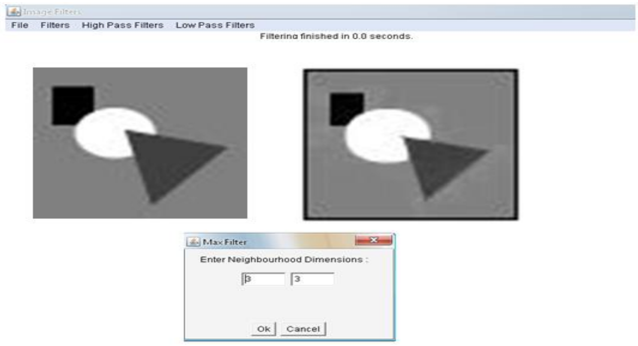

Figure 5: Illustrating the max filter enhancing the size of brighter parts.

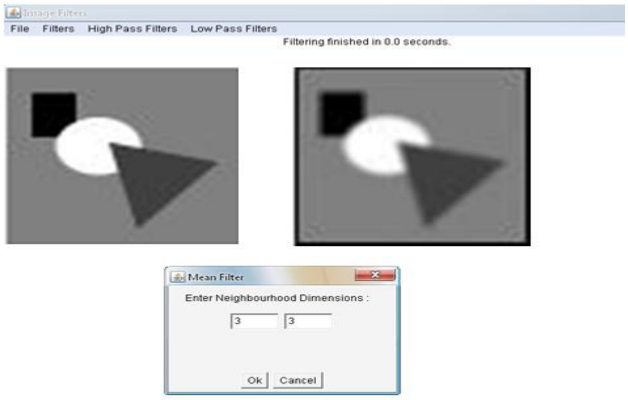

Figure 6: Illustrating the mean filter reducing the contrast difference.

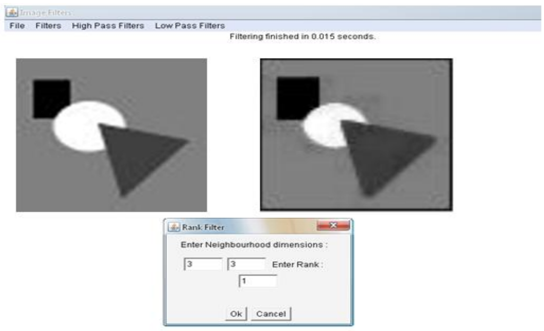

Figure 7: Illustrating the rank filter increasing the size according to background

VII. CONCLUSION AND FUTURE WORK

The objective of the paper is to smooth and sharp the images by using various Filtering techniques, where Filtering techniques are one of the enhancement techniques in the Digital image processing and thus help the beginners of image processing to introduce to various filtering techniques.

In this paper we had implemented few spatial domain filters and frequency domain filters to remove various types of noises. All results are simulated in java background since in previous projects we had worked on mat lab versions.

Emphases on various types of noises are not discussed in this paper and in future work that area will be explored.

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