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Review Analysis of RGB Object Restoration Using Morphological and Gabor Wavelet Classifiers

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Abstract— **Today, the medical industry, astronomy, physics, chemistry, forensics, remote sensing, manufacturing, and defense are just some of the many fields that rely upon images to store, display, and provide information about the world around us. The challenge to scientists, engineers and business people is to quickly extract valuable information from raw image data. This is the primary purpose of image processing is converting images to information.This paper concentrates on various image processing techniques and operators such as image enhancement,image restoration,encoding and decoding techniques,Morphological Image Processing,Gabor Wavelets(GWs) .The various applications of image processing techniques have also been studied. When image is transferred from source to the destination,it will take large amount of bandwidth. This bandwidth consumption has to be minimized. This paper gives a literature survey about different image processing algorithms that are used for better performance of parameters such as Absolute mean brightness error (AMBE), Peak signal to noise ratio (PSNR), Normalized absolute error (NAE),contrast improvement, image sharpening, edge detection, noise removal and data security issues.**

IndexTerms—**GaborWavelets(GWs),ImageEnhancement,ImageRestoration,Morphological Image Processing.**

I. INTRODUCTION

Images are produced by a variety of physical devices, including still and video cameras, x-ray devices, electron microscopes, radar, and ultrasound to record or display useful information and and used for a variety of purposes, including entertainment,medical, security, and scientific.

For mathematical analysis, an image may be defined as a two dimensional function f(x,y) where x and y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the intensity values of f are all finite, discrete quantities, we call the image a digital image

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Due to imperfections in the imaging and capturing process, however, the recorded image invariably represents a degraded version of the original scene. The undoing of these imperfections is crucial to many of the subsequent image processing tasks. There exists a wide range of different degradations that need to be taken into account, covering for instance noise, geometrical degradations (pincushion distortion), illumination and color imperfections (under/over-exposure, saturation),and blur. This paper concentrates on various image processing techniques that are used to remove the noise and any kind of irregularities present in an image using the digital computer. The noise or irregularity may creep into the image either during its formation or during transformation etc

Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.Various techniques have been developed in Image Processing during the last four to five decades. Most of the techniques are developed for enhancing images obtained from unmanned spacecrafts, space probes and military reconnaissance flights. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics software.

The various Image Processing techniques are Image representation , Image preprocessing, Imageenhancement, Image segmentataion,Image compression,Image restoration etc.

A. Image Enhancement-

Image enhancement is to improve the interpretability or perception of information in the images to provide better input for other automated image processing steps. Image enhancement is a common approach to improve the quality of those images in terms of human visual perception

For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

Fig:showing the grayscale image enhancement by histogram equalisation

The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. It accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis.The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily. The greatest difficulty in image enhancement is quantifying the criterion for enhancement and,therefore, a large number of image enhancement techniques are empirical and require interactive procedures to obtain satisfactory results.

Image enhancement methods can be based on either spatial or frequency domain techniques.Spatial domain technique enhances an image by directly dealing with the intensity value in an image. Transform domain enhancement techniques involve transforming the image intensity data into a specific domain by using methods such as DFT, DCT, etc. and the image is enhanced by altering the frequency content of the image.

Some useful methods of image enhancement are-

Filtering-with-morphological operators,Histogram equalization,Noise removal using a Wiener filter,Linear contrast adjustment,Median filtering,Unsharp mask filtering,Contrast-limited adaptive histogram equalization (CLAHE), Decorrelation stretch.

B. Image Restoration-

Image restoration is an art to improve the quality of image via estimating the amount of noises and blur involved in the image.Restoration ia an objective process that attempts to recover an image that has been degraded. There is a wide spread application of image restoration in today's world.

- A priori knowledge of the degradation phenomenon
- Restoration techniques generally oriented towards modeling the degradation.
- We have to identify the degradation process and attempts to reverse it to recover the original imagei.e removal of blur by a deblurring function is an example of restoration technique.
- Almost similar to image enhancement but more objective.

Fig(a)Damaged Image (b) Restored Image

Restoration techniques may be formulated in the(a) Frequency domain(b) Spatial domain.The image restoration model is shown in below fig.where given g(x,y),some knowledge about H, and some knowledge about the noise term,the objective is to produce the estimate of the original image.

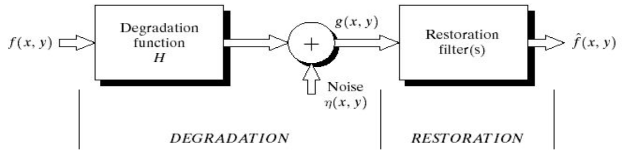


Fig –showing model of the image restoration process

Now from the model given above if H is linear,position invariant process,then the degraded image can be described as the convolution of h and f with an added noise term-

$$g(x,y)=h(x,y)*f(x,y)+n(x,y)$$

where h(x,y) is the spatial domain representation of the degradation function.

In the frequency domain,the representation is

$G(u,v)=H(u,v)F(u,v)+N(u,v)$ where each term in this expression is the fourier transform of the corresponding terms in the equation above.

Noise Models-.

1)Common sources of noise are-

- Acquisition-which includes environmental conditions(heat,light),imaging sensor quality
- Transmission-includes noise in transmission channel

2)Spatial and frequency properties of noise-

- Frequency properties of noise refer to the frequency content of noise in the fourier sense.
- For example-if the fourier spectrum of the noise is constant,the noise is usally called the white noise

Expecting spatially periodic noise,we will assume that the noise is independent of spatial coordinates and uncorrelated to the image

II. Overview of Operators

There are variety of operators that are used in image processing techniques such as morphological operator ,power law transformation-technique,histogram equalization,gabor wavelet operator.

These operators are particularly useful for the analysis of binary images and common usages include edge detection, noise removal, image enhancement , image segmentation and encoding and decoding process . The following gives the overview about the operators.

A. Morphological Image Processing-

The field of mathematical morphology contributes a wide range of operators to image processing, all based around a few simple mathematical concepts from set theory. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size.

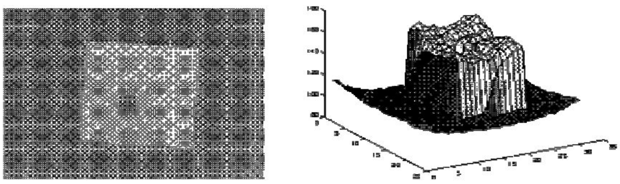
In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as a dilation or an erosion. This table lists the rules for both dilation and erosion.

Rules for Dilation and Erosion-

Operation	Rule
Dilation	The value of the output pixel is the *maximum* value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to the value 1, the output pixel is set to 1.
Erosion	The value of the output pixel is the *minimum* value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0.

For a grayscale image, the intensity value is taken to represent height above a base plane, so that the grayscale image represents a surface in three-dimensional Euclidean space. Figure shows such a surface.



B. *Gabor Wavelets(GWs)-*

Gabor wavelet had been used in past for object detection in Infrared Images, 3D object recognition and object tracking. The main aim to use GWs is due to their multi-resolution, multi-orientation properties. The use of Gabor wavelet approach has several advantages such as
robustness against facial expression, illumination, image noise and invariance to some degree with respect to small changes in head pose,selectivity in scale,as well as selectivity in orientation
Gabor Wavelets (GWs) with good characteristics of space-frequency localization are used for extracting local features for various applications such as object detection, recognition and tracking, face tracking, optical character recognition, iris recognition, fingerprint recognition, and texture analysis. The Gabor wavelet representation of an image is the convolution of the image with a family of Gabor Wavelets. GWs use Gabor functions which was first proposed in 1946 by Dennis Gabor.Gabor transform is the short-time Fourier transform, used to determine the sinusoidal frequency and phase content of a signal which changes with time. A complex Gabor filter is defined as the product of a Gaussian kernel times a complex sinusoid which is then transformed with a Fourier transform to derive the time-frequency analysis. The Gabor transform of a signal x(t) is defined by this formula

$$G_x(t,f) = \int_{-\infty}^{\infty} e^{-\pi(T-t)^2} e^{-j2\pi f^T} x(T)\,dT$$

The Gabor representation was first introduced for the 1-D then extending the representation to 2-D by Ebrahimi, et al show usefulness in image sequence coding where high compression ratios and modest image quality are required.

III. LITERATURE REVIEW

Sunita Dhariwal et al. [1] proposed some techniques in the area of image enhancement for brightness preservation as brightness preservation is in great demand in the consumer electronics field, when the image is effectively enhanced. The best results had been given in order to illustrate the best possible technique that can be used as powerful image enhancement. The performance of several established image enhancement techniques were presented in terms of different parameters like Absolute mean brightness error (AMBE), Peak signal to noise ratio (PSNR), Normalized absolute error (NAE), contrast, correlation and visual quality to make real-time image-processing applications more feasible and easier In this paper, a frame work for image enhancement based on prior knowledge on the Histogram Equalization had been presented. Many image enhancement schemes like Contrast limited Adaptive Histogram Equalization (CLAHE), Equal area dualistic sub-image histogram equalization (DSIHE), Dynamic Histogram equalization (DHE) algorithms had been implemented and compared. From the experimental results, it is found that all the three techniques yields different aspects for different parameters.

Enming Luo,Stanley H.Chan,Truong Q Nguyen et al. [2] proposed an adaptive learning procedure to learn patch-based image priors for image denoising. They proposed a new algorithm, called the expectation-maximization (EM) adaptation, derived from a Bayesian hyper-prior perspective. takes a generic prior learned from a generic external database and adapts it to the noisy image to generate a specific prior.Different from existing methods that combine internal and external statistics in ad hoc ways, the proposed There are two contributions of this paper. Firstly,they gave full derivation of the EM adaptation algorithm and demonstrate methods to improve the computational complexity. Second, in the absence of the latent clean image, they showed how EM adaptation can be modified based on pre-filtering. The experimental results showed that the proposed adaptation algorithm yields consistently better denoising results than the one without adaptation and is superior to several state-of-the-art algorithms and the results demonstrated its superiority over some existing denoising algorithms, such as EPLL and BM3D

Manjit Sandhu,Jaipreet kaur,Sukhdeep Kaur et al. [3] proposed a new technique for the data security issues while sending the data over the network using steganographic techniques.They gave an overview about encoding the image using Steganography which is art and science of writing hidden messages in such a way that no one apart from the sender and the intended recipient can realize that hidden data. Firstly the binary representations of hidden data are taken and then overwrite the LSB of each byte within the cover image and get the encoded image i.e. cover image with message image. Then from histogram of cover, message and encoded images respectively difference between original cover and encoded image is made clear. At the last extraction of message image from encoded image is done by shifting the bits in opposite direction. They showed that steganography is simplest method which provide privacy and secrecy both in case of hiding image within image. Steganography applies not only to digital images but to other media as well, such as audio files, communication channels, and other text and binary files.

Yap Keem Siah, Tay Yong Haur, Marzuki Khalid and Tahir Ahmed et al. [4] used an iterative threshold to fully exploit the large contrast between the black color and background and with color characters of the license plate, They used the blob analysis method to identify the connected regions of pixels in the image and then the basic features (such as height, width, top and left) of the region is calculated. These regions are commonly known as blobs, they used a fuzzy art map neural to cluster these basic features into different classes, the clustering produced blobs that satisfy the original features, which are considered as the characters of the image

Bh. P., et al. [5]. proposed the Elliptic Curve Cryptography. In this method encoding and decoding a text in the implementation of Elliptic Curve Cryptography is a public key cryptography using Koblitz's method. In their work, each point on the curve represents one character in the text message. When the message is passed each character is encoded by its ASCII code then the ASCII value is encoded to one point on the curve and so on. Our work differs from their work. In their work they used public-key technique whereas in our work we use private key technique. They encoded each character by its ASCII value but we encode each character by one pixel (three integer values - R for Red, G for Green and B for Blue).

IV. Conclusion

In this paper we have study different papers on image enhancement ,denoising and encoding and decoding techniques. Image restoration is an active research area and various researchers work to improve the efficiency of the different algorithms by developing more efficient algorithms.In this paper we provide an overview of operators such as morphological and gabor wavelet classifiers(GWs). The multi-resolution and multi-orientation properties of the Gabor wavelet transform makes it a popular method for feature extraction. Among all the works based on Gabor wavelet, face recognition and texture representation are the most noticeable applications.

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