ISSN:0975-9646

Sree Lekshmi A. N. et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 8 (2) , 2017,167-169

CURVELET Based IMAGE COMPRESSION

[1]Sree Lekshmi A.N., [2]Lekshmi Priya A.N.

[1]Amrita Vishwavidyapeeth Schrrol of Engineering, Ettimadai

[2]ArchanaCollege of Engineering, Ulavukad

INTRODUCTION

Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage/transmission requirements. Compression is achieved by the removal of one or more of the three basic data redundancies:

1. Coding Redundancy
2. Interpixel Redundancy
3. Psychovisual Redundancy

Coding redundancy is present when less than optimal code words are used. Interpixel redundancy results from correlations between the pixels of an image. Psychovisual redundancy is due to data that is ignored by the human visual system (i.e. visually non essential information). Image compression techniques reduce the number of bits required to represent an image by taking advantage of these redundancies. An inverse process called decompression (decoding) is applied to the compressed data to get the reconstructed image. The objective of compression is to reduce the number of bits as much as possible, while keeping the resolution and the visual quality of the reconstructed image as close to the original image as possible. Image compression systems are composed of two distinct structural blocks : an encoder and a decoder.

Motivation

It provides a potential cost savings associated with sending less data over switched telephone network where cost of call is really usually based upon its duration. It not only reduces storage requirements but also overall execution time. It also reduces the probability of transmission errors since fewer bits are transferred. .It also provides a level of security against illicit monitoring.

Objective

Uncompressed images can occupy a large amount of memory in RAM and in storage media, and they can take more time to transfer from one device to another. The basic objective of image compression is the reduction of size for transmission or storage while maintaining suitable quality of reconstructed images.

Types of image compression formats

I. **TIFF :** The TIFF (Tagged Image File Format) is a flexible format which can be used for lossless or lossy Compression [4].In practice, TIFF is used as a lossless image storage format in which image compression is not used. For web transmission TIFF files are not used because TIFF files require large size.

II. **GIF :** Graphics Interchange Format (GIF) is useful for images that have less than 256 colors, grayscale.GIF is limited to an 8 bit or 256 colors. so that it can be used to store simple graphics ,logos and cartoon style images. It uses loss less compression.

III. **RAW :** RAW file format includes images directly taken from Digital cameras. These formats normally use loss less or lossy compression method and produce smaller size Images like TIFF. The Disadvantage of RAW Image is that they are not standardized image and it will be different for different manufactures. So these images require manufacture's software to view the images.

IV. **PNG :** The PNG (portable Network Graphics) file format supports 8 bit, 24 bit, 48 bit true color with and without alpha channel. Lossless PNG format is best compare to lossy JPEG. Typically, an image in a PNG file can be 10% to 30% more compressed than in a GIF format .PNG format have smaller size and more colors compare to others.

V. **JPEG :** Joint Photographic Expert Group (JPEG) is a lossy compression technique to store 24 bit photographic images. It is widely accepted in multimedia and imaging industries. JPEG is 24 bit color format so it have millions of colors and more superior compare to others,it is used for VGA(video graphics Array) display.JPEG have lossy compression and it support 8 bit gray scale image and 24 bit color images.

VI. **JPEG2000 :** JPEG 2000 is a compression standard for lossless and lossy storage.JPEG2000 improves the JPEG format. It is nearly same as JPEG.

NEED FOR CURVELET TRANSFORM FOR IMAGE COMPRESSION

Many compression techniques like scalar/vector quantization, differential encoding, predictive image coding, transform coding have been introduced. Among all these, transform coding is most efficient especially at low bit rate. By the introduction of wavelets and related multi-scale representations pervade all areas of signal processing. The reason for the success of wavelets is the fact that wavelet bases represent well a large class of signals, and therefore allow us to detect roughly isotropic.

But wavelets may not be the best choice for presenting natural images recently. This observation is due to the fact that wavelets are blind to the smoothness along the edges commonly found in images. In other words, wavelet cannot provide the ‘sparse’ representation for an image because of the intrinsic limitation of the wavelet.

New transforms have been introduced to take advantage of this property. The ridgelet and curvelet transforms are examples of two new transforms, which are developed to sparsely represent natural images. They are very different from wavelet-like systems that have been developed. Curvelet and ridgelet take the form of basis elements which exhibit very high directional sensitivity and are highly anisotropic. The fast discrete curvelet transform improves upon earlier implementation based upon the first generation of curvelet in the sense that they are conceptually simpler, faster and far less redundant.

LITERATURE SURVEY

Image Compression Techniques

The image compression techniques are broadly classified into two categories depending whether or not an exact replica of the original image could be reconstructed using the compressed image . These are:

1. Lossless technique
2. Lossy techniqhe

1.Lossless compression technique

In lossless compression techniques, the original image can be perfectly recovered form the compressed (encoded) image. These are also called noiseless since they do not add noise to the signal (image).It is also known as entropy coding since it use statistics/decomposition techniques to eliminate/minimize redundancy. Lossless compression is used only for a few applications with stringent requirements such as medical imaging.

Following techniques are included in lossless compression:

1. Run length encoding
2. Huffman encoding
3. LZW coding
4. Area coding

2. Lossy compression technique

Lossy schemes provide much higher compression ratios than lossless schemes. Lossy schemes are widely used since the quality of the reconstructed images is adequate for most applications .By this scheme, the decompressed image is not identical to the original image, but reasonably close to it. Major performance considerations of a lossy compression scheme include:

1. Compression ratio
2. Signal - to – noise ratio
3. Speed of encoding & decoding.

Lossy compression techniques includes following schemes:

1. Transformation coding
2. Vector quantization
3. Fractal coding
4. Block Truncation Coding
5. Subband coding

LOSSLESS COMPRESSION TECHNIQUES

Run Length Encoding

This is a very simple compression method used for sequential data. It is very useful in case of repetitive data. This technique replaces sequences of identical symbols (pixels) ,called runs by shorter symbols. The run length code for a gray scale image is represented by a sequence { Vi , Ri } where Vi is the intensity of pixel and Ri refers to the number of consecutive pixels with the intensity Vi as shown in the figure. If both Vi and Ri are represented by one byte, this span of 12 pixels is coded using eight bytes yielding a compression ration of 1: 5

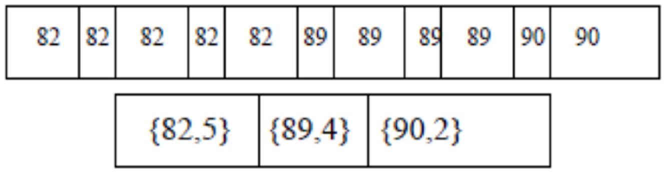

Figure 10: Run –Length Encoding

Huffman Encoding

This is a general technique for coding symbols based on their statistical occurrence frequencies (probabilities). The pixels in the image are treated as symbols. The symbols that occur more frequently are assigned a smaller number of bits, while the symbols that occur less frequently are assigned a

relatively larger number of bits. Huffman code is a prefix code. This means that the (binary) code of any symbol is not the prefix of the code of any other symbol. Most image coding standards use lossy techniques in the earlier stages of compression and use Huffman coding as the final step.

LZW Coding

LZW (Lempel- Ziv – Welch) is a dictionary based coding. Dictionary based coding can be static or dynamic. In static dictionary coding, dictionary is fixed during the encoding and decoding processes. In dynamic dictionary coding, the dictionary is updated on fly. LZW is widely used in computer

industry and is implemented as compress command on UNIX.

Area Coding

Area coding is an enhanced form of run length coding, reflecting the two dimensional character of images. This is a significant advance over the other lossless methods. For coding an image it does not make too much sense to interpret it as a sequential stream, as it is in fact an array of sequences, building up a two dimensional object. The algorithms for area coding try to find rectangular regions with the same characteristics. These regions are coded in a descriptive form as an element with two points and a certain structure. This type of coding can be highly effective but it bears the problem of a nonlinear method, which cannot be implemented in hardware. Therefore, the performance in terms of compression time is not competitive, although the compression ratio is.

LOSSY COMPRESSION TECHNIQUES

Transformation Coding:

In this coding scheme, transforms such as DFT (Discrete Fourier Transform) and DCT (Discrete Cosine Transform) are used to change the pixels in the original image into frequency domain coefficients (called transform coefficients).These coefficients have several desirable properties. One is the

energy compaction property that results in most of the energy of the original data being concentrated in only a few of the significant transform coefficients. This is the basis of achieving the compression. Only those few significant

coefficients are selected and the remaining are discarded.The
selected coefficients are considered for further quantization and entropy encoding. DCT coding has been the most common approach to transform coding.It is also adopted in the JPEG image compression standard.

Vector Quantization:
The basic idea in this technique is to develop a dictionary of fixed-size vectors, called code vectors. A vector is usually a block of pixel values. A given image is then partitioned into non-overlapping blocks (vectors) called image vectors. Then for each in the dictionary is determined and its index in the dictionary is used as the encoding of the original image vector. Thus, each image is represented by a sequence of indices that can be further entropy coded.

Fractal Coding:
The essential idea here is to decompose the image into segments by using standard image processing techniques such as color separation, edge detection, and spectrum and texture analysis. Then each segment is looked up in a library of fractals. The library actually contains codes called iterated function system (IFS) codes, which are compact sets of numbers. Using a systematic procedure, a set of codes for a given image are determined, such that when the IFS codes are applied to a suitable set of image blocks yield an image that is a very close approximation of the original. This scheme is highly effective for compressing images that have good regularity and self-similarity.

Block truncation coding:
In this scheme, the image is divided into non overlapping blocks of pixels. For each block, threshold and reconstruction values are determined. The threshold is usually the mean of the pixel values in the block. Then a bitmap of the block is derived by replacing all pixels whose values are greater than or equal (less than) to the threshold by a 1 (0). Then for each segment (group of 1s and 0s) in the bitmap, the reconstruction value is determined. This is the average of the values of the corresponding pixels in the original block.

Sub band coding:
In this scheme, the image is analyzed to produce the components containing frequencies in well-defined bands, the sub bands. Subsequently, quantization and coding is applied to each of the bands. The advantage of this scheme is that the quantization and coding well suited for each of the sub bands can be designed separately.

REFERENCES

[1] Fundamentals of remote sensing –A Canada centre for remote sensing tutorial.

[2] Mohamed Elhabiby, Ahmed Elsharkawy & Naser El-Sheimy. “Second Generation Curvelet Transforms Vs Wavelet transforms and Canny Edge Detector for Edge Detection from WorldView-2 data”. *International Journal of Computer Science & Engineering Survey (IJCSES)*, Vol.3, No.4, August 2012 DOI :

[3] B. R. Corner, R. M. Narayanan and S. E. Reichenbach. ” *Noise estimation in remote sensing imagery using data masking* ”. INT. J. REMOTE SENSING,2003, vol 24,NO.4,689-709

[4] D. Mary sugantharathnam Dr. D. Manimegalai.” *The Curvelet Approach for Denoising in various Imaging Modalities using Different Shrinkage Rules* ”. International Journal of Computer Applications (0975 – 8887) Volume 29– No.7, September 2011

[5] Binh NT, Khare.” *A. Multilevel threshold based image denoising in curvelet domain*”. journal of Computer science and Technology 25(3): 632640 May 2010

[6] Lakhwinder Kaur Savita Gupta R.C. Chauhan .” *Image Denoising using Wavelet Thresholding* “

[7] Naga Sravanthi Kota, G. Umamaheswara Reddy. “*Fusion Based Gaussian noise Removal in the Images Using Curvelets and Wavelets With Gaussian Filter* “. International Journal of Image Processing (IJIP), Volume (5) : Issue (4) : 2011

[8] D.Gnanadurai, and V.Sadasivam.” *An Efficient Adaptive Thresholding Technique for Wavelet Based Image Denoising* ” International Journal of Information and Communication Engineering 2:2 2006

[9] C. Patvardhan, A. K. Verma, C. V. Lakshmi.” *Denoising of Document Images using Discrete Curvelet Transform for OCR Applications* “. International Journal of Computer Applications (0975 – 8887) Volume 55– No.10, October 2012

[10] Dr Jyoti Singhai, Preety D Swami.” *Modified Cubic Threshold Denoising Technique using Curvelet Transform* “.

[11] JIANG Tao, ZHAO Xin. “ Research and application of image denoising method based on curvelet transform”.

[12] M. M. Mokji, S.A.R. Abu Bakar.” Adaptive Thresholding Based On Co-Occurrence Matrix Edge Information “.journal of Computers, VOL. 2, NO. 8, October 2007