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REVIEW ARTICLE

A Review of Various Image Compression Techniques

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Abstract: The overall objective of this paper is to review various image compression techniques. Image compression has become very important tool in digital image processing. The main objective of the compression is to reduce the amount or unwanted data while retaining the information in the image. The goal behind is to save the amount of memory required to save the image(s) or to utilize network bandwidth in efficient manner. Transform-based compression is extensively used for image compression. But transform based methods introduce blocking artifacts in the output image. The compression may also results in ringing artifacts around edges. The ringing artifacts are in general more difficult to characterize and remove than the block transform compression artifacts.

Keywords: Image Compression, Hybrid particle swarm optimization, Genetic algorithm, wavelet transform

1. Introduction

Image compression is use to condense the number of bits vital for representation of an image and consequently, reduce the required bit rate to powerfully broadcast image signal in excess of communication network[1]. It is minimize the size in bytes of a graphics file without mortifying the value of the image to an undesirable point[2]. The decreases in file size allow more images to be stored in a given quantity of disk or memory space[3]. It also reduces the time necessary for images to be send over the Internet or downloaded from Web pages [4].

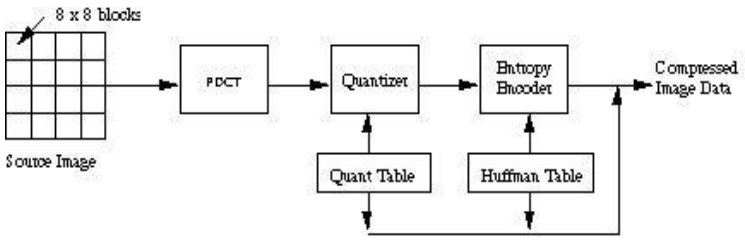

Fig 1.1 Image Compression

There are more than a few diverse way in which image files can be compressed[5]. For Internet use, the two mainly familiar compressed graphic image format are the JPEG format and the GIF format[6]. The JPEG method is more frequently used for photographs, while the GIF method is usually used for line fine art and other images in which numerical shapes are comparatively easy. Additional techniques for image compression comprise the use of fractals and wavelets. These methods have not gain common approval for use on the Internet as of this text[7]. on the other hand, both methods present secure as they suggest higher compression ratio than the JPEG or GIF methods for various types of images. Another original method that may in time restore the GIF format is the PNG format[8].

Types of compression:

1.1 Lossless Compression:

In lossless compression, the algorithm does not lose any part of data. It means exact source data should be generated after decompression. We use lossless compression for text/ data based data information. Lossless compression should be used to compress executable programs. The major purpose, as well as challenge, for lossless algorithm is is to compress data as much as possible and get back the original data by taking minimum time.

1.2 Lossy Compression:

In lossy compression, the algorithm does some loss of data achieve higher compression. You do not get exact original data back in lossy compression. These compression work on those data in which some fidelity in acceptable. Picture, audio or video format data are usually compressed with lossy compression algorithm because among these some loss of data can be tolerated.

2. Methods of compression: compressed either as lossless or lossy method depending on the requirement.

2.1 DWT (Discrete Wavelet Transform)

A wavelet transform decomposes a pointer into its sub-band mechanism of non –uniform bandwidth and can be realize by a filter bank. Like the Fourier transform is relevant to both continuous as well as discrete signals. We can characterize a variety of functions in the appearance of its wavelet expansion. If the signal, scaling functions and wavelets are discrete in time signal is called DWT. DWT of a digital image consist of two sequence expansions: one matching to the estimate(low-pass filter), and the additional linked to the information of the image(high-pass filter). The 2D DWT can be implemented with two divide applications of the one-dimensional decomposition in the straight and perpendicular instructions. The low and high pass filters are useful to the image by the side of rows and columns separately, and the filter outputs are sub-sampled by2,resulting in three full sub-images: horizontal high-pass sub-image(HL),vertical high-pass sub-image(LH),and crosswise high-pass sub-image(HH); and one estimated low-pass sub-image(LL). The decomposition method is then frequent on the low-pass sub-image LL to make the next level of the decomposition. In this way, the creative image is decom- posed into a chain of command of three octave resolutions resultant in ten sub-images:LL3,and (HLi; LHi; HHi), i ¼ 3; 2; 1, where LL3 is the lowest resolution low-pass sub-image at layer3 of the chain of command.

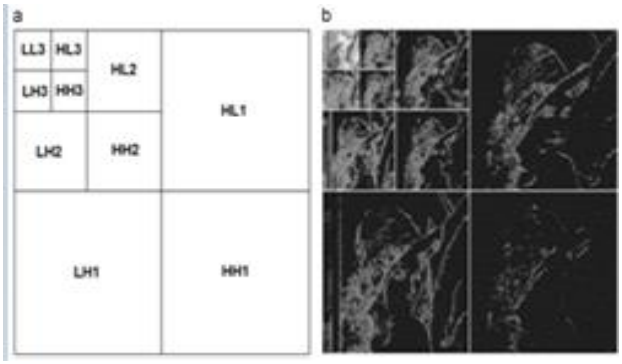

Fig 1.2 Applying DWT for 3-levels

The DWT transformation equations :

$f(u,v) = \frac{2c(u)c(v)}{N}\sum_{m=0}^{N-1}\sum_{n=0}^{N-1} f(m,n)\cos(\frac{2m+1}{2N}ux)\cos(\frac{2n+1}{2N}vx)$

Where u = 0,1,2……..N-1, v = 0,1,2,……N-1

Where c(k) = $1/\sqrt{2}$ for k=0

=1 otherwise

2.2 DCT (Discrete Cosine Transform)

DCT helps divide image into parts (or spectral sub-bands) of opposed significance (with respect to the images visual quality).DCT state a fixed series of data points in expressions of a sum cosine functions oscillating at unlike frequencies. DCTs are most important to many applications in science and engineering, from lossy compression of audio (MP3) and image (JPEG)(where small high –frequency mechanism are useless), to spectral methods for the geometric key of incomplete differential equations. The use of cosine slightly than sine functions is important for compression, because it turns out that less cosine functions are required to estimated a typical signal ,but for differential equations the cosines state a particular option of edge form. In particular, a DCT is a Fourier –associated transform like to the discrete Fourier transform (DFT), it transforms a signal or image as of the spatial domain to the occurrence domain. In DCT each one block of the image is compressed during quantization. The array of compressed blocks that form the image is stored in a significantly summary quantity of gap.

The 2D-DCT transformation equation:

$$c(u,v) = D(u)D(v)\sum_{x=0}^{N-1}\sum_{y=1}^{N-1} f(x,y)\cos[(2x+1)u\pi/2N]\cos(2y+1)v\pi/2N]$$

Where, u,v,=0,1,2,3……..N-1

The inverse 2D-DCT transformation equations:

$$f(x,y) = \sum_{x=0}^{N-1}\sum_{y=1}^{N-1} D(u)D(v)D(u,v)\cos[(2x+1)u\pi/2N]x\cos(2y+1)v\pi/2N]$$

Where D(u) = (1/N)^1/2 for u=0

D(u) = 2(/N)^1/2 for u=0,1,2,3……(N-1)

2.3 PSO (Particle Swarm Optimization)

PSO give a few in sequence regarding its completion in our algorithm. We also talk about how PSO is used to compute the position of optimal threshold values. In the valid number gap, all person likely answer can be model as a particle that move

in the course of the problem hyperspace. every particle at that time determine its progress in the parameter space by combine various aspects of the history of its possess strength, with individuals of single or additional fitter members of the group. A particle move throughout the factor space with a speed determined by the locations and form values of persons other member, next to with some perturbations. Particle Swarm Optimization behave as a set of particles that shift in the search space influenced by three components: (i)current velocity,(ii)distance connecting its present position and its own local top position, and(iii) distance connecting its present position and the global best position of the fittest particle in the whole swarm initiate so.

2.4 GA(Genetic Algorithm)

GA are adaptive heuristic search algorithm based lying on the evolutionary thoughts of usual collection and inheritance. As such they stand for an bright development of a random investigate used to explain optimization problems. The basic technique of the Gas are planned to stimulate process in usual system essential for progress ,particularly those go after the standard laid down.GA are based on an similarity with the genetic structure and performance of chromosomes within a population of those. In the genetic algorithm crossover and mutation operators are used for to generate the optimized production in the crossover which represent the mate among those.

And mutation which represent random modification, selection operator provide liking to better individuals, allow them to pass on their genes to the next generation. The honesty of all individual depends leading its fitness. In crossover operator main famous factor of GA from extra optimization techniques.

Let us suppose we have the chromosome:

$$C = x+y*y-x/y$$

And the appliance of mutation operator affect the genes .Then a new obtained chromosome can be:

$$C = x+x*y+x/y$$

The value of the gene corresponding to the third position has been changed from y to x and the value of the gene corresponding to the sixth position ("-") has been changed to the value "+".

3. Literature Survey

Kaveh Ahmadi et al.(2015)[1]has discussed that Image compression is one of the mainly significant study area in the field of image processing suitable to its great number of application such as aerial surveillance, reconnaissance, medicine and multimedia communication. still while high data rates are accessible, image compression is essential in organize to reduce the transmission cost. For applications relating information protection, a fast release also reduce the probability of compromise more a communication channel. The opportunity of using one of the computational intelligence techniques, namely, Particle Swarm Optimization (PSO), for optimal thresholding in the 2-D discrete wavelet transform (DWT) of an image has been explored. To this conclusion, a position of optimal thresholds is obtain by the PSO algorithm. Finally, a variable length coding scheme, such as arithmetic coding is used to code the outcome

Camara Lerner et al.(2014)[2] has discussed the difficulty of bit allocation in lossy image set compression. Instead of treating each one image separately, image set compression algorithms study the relations amongst related images and eliminate inter-image redundancies to recover compression presentation. These algorithms map the unique image place into a number of calculation remaining images to be coded. Characteristically the same bit rate is used to code each remaining. We illustrate that a rate-distortion move toward based on Lagrangian optimization can show the way to more improvement in image set compression algorithms.

Victor Sanchez et al. (2013) [3] has discussed that DNA microarrays are high-tech tools in biological and medical research. The correctness of lossy compression for DNA microarray images and underline the requirement for a distortion metric to review the loss of applicable information. We also suggest one feasible metric that consider the essential image features employed by most DNA microarray analysis techniques. Tentative outcome be a sign of that the proposed metric can classify and distinguish essential and insignificant change in DNA microarray images.

Hitoshi Kiya et al.(2012) [4] has discussed that a lossy data compression for a thin Histogram image signal is planned. It is extended from an accessible lossless coding which is base on a lossless histogram packing and a lossless coding. We establish a lossy mapping, which has fewer computational weights than the rate-distortion optimized Lloyd-Max quantization, and join it with a lossless coding. It was established that the planned way attains high performance in the rate bend plane than accessible methods. This is as it can develop histogram sparseness of images, and also its inverse mapping does not increase quantization sound.

Ming-Ming Li et al. (2011) [5] has discussed that to decrease the memory rations of the
Video application, we here a lossy Bayer image compression pipeline perform improved set-partitioning in hierarchical trees (SPIHT) coding as the center of the creative data compression algorithm. The future technique encodes and decodes images accessible in the CFA arrangement. Once concluding the image coding phase, a demosaicking period frequently follow to make a full color image. Simulation outcome prove that: pipelines which utilize a SPIHT coding format attain important compression piece improvements and comparatively little artifact Compare to comparable giving out pipelines set with a JPEG.

Hengjian li et al. (2010)[6] has discussed the points to facilitate the lossy image compression has lying for the performance aggressive codes of palmprint verification algorithms. Connection between lossy compression on palmprint appreciation presentation are worth focusing on in applications where image space for storing and program instance are of great meaning. To eliminate that objective featuring its inference for bandwidth and storage, we experiment the connection between image lossy compression on competitive code in dissimilar transforms, quantization and encoding algorithms utilizing a publicly available palmprint database. Experiments performing recognition directly from the compressed domain reveal that the extracted feature template variation in the compressed palmprint image seriously isn't like image distortion. What exactly is interesting, the issue for the JPEG is rather more serious in contrast to JPEG2000 as soon as the compression ratio is larger than about 11 while the issue on JPEG2000 is rather more serious in contrast to JPEG as soon as the compression ratio is less space-consuming than about 11. Plus the trellis coded quantized technique unsuitable for compressing palmprint images.

Vladimir V.Lukin et al.(2010)[7] has discussed that images be capable to exist susceptible to lossy compression in their normal technique that initiate distortion are usually not observable. Because of this, two current visual quality metrics, MSSIM and PSNR-HVS-M, could be use. Their principles can absolutely be provide not a reduced amount than 0.99 and 40 dB, respectively, as well as equivalent lossy compression might be approved out. Attained compression ratio (CR) relies on image properties and also a coder used. The proposed methodology of lossy compression could be successfully exploited in remote sensing and medical imaging with producing CR by a number of times bigger the ideal lossless image compression techniques.

Tomoo Inoue et al.(2011)[8] has discussed that Test compression / decompression is one kind of effective options for testing today's VLSI. In test compression with image compression algorithms, e.g., JPEG algorithm. Image compression algorithms can not simply achieve considerably high compression but additionally require no additional decompression circuity on the chip under test in the event the chip includes image decoders has been explored . Moreover, we propose a way for generating seeds (or compressed test data) in case when a JPEG decoder must be used as an experiment decompressor. Although JPEG algorithm performs lossy compression, given an experiment data, the proposed algorithm can search seeds that could be decompressed to a different one test data preserving the exam expertise of the given test data, and create a smaller number of seeds with good fault coverage. Experimental results show the proposed method can do compression ratio comparable with several previous test compression methods without larger hardware overhead.

Nadeem Akhtar et al.(2014)[9] has discussed that individuals propose and implement a fresh lossy technique to compress are just looking for image. We perform technique like quantization, smoothing before you apply our novel, simple addition based way to compress the image. The whole picture is split up into range of 4*4 blocks. The outcomes are good and

similar to JPEG compression algorithm, specifically when image quality is high. The compression ratio inside the proposed technique high when adjacent pixel values inside the image are close, that is usual in actual images.

Ran Hu et al.(2014)[10] has discussed that Compression of encrypted data has attracted considerable research interests nowadays caused by distributed processing and cloud computing. A novel lossy compression scheme for encrypted gray-scale images. The main image is first split into non-overlapping blocks. Then, it really is encrypted with a modulo-256 addition and block permutation. In compression phase, the spatial correlation and quantization are exploited to cut back the compression ratio. With the decoder side, context-adaptive interpolation through an image dependent threshold is needed for making image reconstruction precise. Experimental results demonstrate that the proposed scheme achieves better performance when compared to previous work.

Amir Akhavan et al.(2011)[11]has discussed we present a brand new contourlet based lossy image compression opportunity for medical ultrasound images. On this algorithm we use contourlet transform for image decomposition. Then, we apply a brand new thresholding process for the coefficients before quantization. We find the threshold as a result of coefficients occurrence within the contourlet domain. This algorithm has ale simultaneous speckle reduction using another thresholding. For this time saving ability, the algorithm may be used in online image transmission systems. We implement our method on a genuine ultrasound images and ultrasound phantom image. Results proved our proposed method has acceptable performance and good performance over common compression methods just like wavelet based SPIHT in the matter of PSNR.

Kai- Jencheng et al.(2014)[12]has discussed that a lossless to lossy compression scheme for hyperspectral images dependant on dual-tree Binary Embedded Zerotree Wavelet (BEZW) algorithm has been explored. The algorithm adapts Karhunen–Loève Transform and Discrete Wavelet Transform to attain 3-D integer reversible hybrid transform and decorrelate spectral and spatial data. Since statistics of your hyperspectral image are usually not symmetrical, the asymmetrical dual-tree structure is introduced. The 3-D BEZW algorithm compresses hyperspectral images by implementing progressive bitplane coding. The lossless and lossy compression performance is in contrast to other state-of-the-art predictive coding and transform-based coding algorithms on Airborne Visible/Infrared Imaging Spectrometer images. Results show the 3-D-BEZW lossless compression performance is comparable while using the best predictive algorithms, while its computational price is comparable with that surrounding transform based algorithms.

W.K.Yeo et al.(2010)[13] has discussed that a novel image compression algorithm is proposed by introducing the feed forward neural network (FFN) instead of the quantization block of a general image compression algorithm. In this new method, after the spatial information of the target image is transformed into the equivalent frequency domain, the FFN stores each of the transformed coefficients in the network synaptic weights. By storing just the network weight values, the amount of information need to be retained for decompression purpose is much lesser compared to lossless method which stores information pertinent to each pixel in the image. As a consequence, a better compression ratio can be achieved by the FFN compression method as compare to loss less compression. Furthermore, during the decompression stage the FFN is capable of reproducing every single frequency component (coefficient values) with small margin of error due to the fact that no information is reduced unlike in lossy methods where some psychovisual redundancies are removed in the quantization. Results show that this new proposed compression algorithm (FFN compression) is capable of achieving the competitive advantage of lossy methods which is the compression ratio without compromising the image quality, the advantage of loss less methods.

Lei Wang et al.(2008)[14] has discussed that a progressive image compression scheme is investigated using reversible integer discrete cosine transform (RDCT) which comes from the matrix factorization theory. Previous techniques dependant on DCT are afflicted with bad performance in lossy image compression in contrast to wavelet image codec. And lossless compression methods for example IntDCT, I2I-DCT and so forth cannot equate to JPEG-LS or integer discrete wavelet transform (DWT) based codec. A lossy to lossless image compression might be implemented by our proposed scheme featuring its RDCT, coefficients reorganization, bit plane encoding, and reversible integer pre- and post-filters has been

explored. Simulation results show our technique is competitive against JPEG-LS and JPEG2000 in lossless compression. Moreover, our method outperforms JPEG2000 (reversible 5/3 filter) for lossy compression, plus the performance is even comparable with JPEG2000 which adopted irreversible 9/7 floating-point filter (9/7F filter).

Nathan Schemm et al.(2007)[15] has discussed that a CMOS image sensor has long been intended to accomplish the front-end image decomposition within a Prediction-SPIHT image compression scheme. The prediction circuitry based upon charge sharing is integrated through the sensor array to carry out a 3-level image decomposition. A CMOS test chip has long been prototyped and tested. The examination results justify the pixel design and demonstrate that lossy prediction based focal plane image compression can be realized through the sensor pixel array to achieve a higher frame rate though with a great deal less data readout volume. Also, the sensor allows you to achieve comparable compression performance with dramatically reduced computational complexity in comparison to 2D discrete wavelet transform (DWT) based image compression

Raul Pinto Elias et al.(2006)[16] has discussed that a good edge preserving lossy image coder is presented. A footing image is purchased from an original with an electronic digital image processing module using four different filters: Canny, Sobel, Roberts and Prewitt, then an original image is domain transformed with wavelets or contourlets, as well as a pixel mapping from original domain to transformed is done. With the compression, the sides points as well as approximation image (which determines the compression factor) are selected; finally the picture is decompressed as a way to view the reconstruction quality and edge preserving. Additionally, final results purchased from comparisons of error measures between original and decompressed images are shown and ultimately conclusions around the coder are presented.

Xiang Xie et al.(2005)[17] has discussed that the analysis of exist compression-first methods, this presents a novel means of lossy image compression for digital colorful image sensors with Bayer Color Filter Arrays (CFAs). In using this method, an optimized compression and decompression structure is presented, plus the captured CFA raw info is firstly low-pass filtered in RGB space using a smooth filter then the down-sampling operation. Then, the info are transformed from RGB space to YCbCr space. Lastly, the filtered data in YCbCr are compressed directly before full color interpolation that introduces redundancy.

4. Gaps in Literature

1. The performance of the particle swarm optimization depends upon the initial particles, poorly selected particles lead poor results.
2. The genetic algorithm does not guarantee the global optimized results but rich because of its mutation and crossover operators.
3. The use of the hybrid PSO/GA is ignored in the image compression techniques.

5. Conclusion and Future Scope

This paper has shown that the still image compression techniques suffer from various issues. In rear future compressed images will be proposed compression technique will integrate PSO and GA based compression in wavelet domain for reduction of blocking artifacts in images. The proposed technique will also be verified by using the various standard images for compression. The comparison will also be drawn among the proposed and the existing technique based upon the various standard quality metrics of the compression techniques. No techniques is acceptable in every case. The performance of the particle swarm optimization depends upon the initial particles, poorly selected particles lead poor results. The genetic algorithm does not guarantee the global optimized results but rich because of its mutation and crossover operators.

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