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A REVIEW ON TRANSFORM BASED IMAGE COMPRESSION TECHNIQUES

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ABSTRACT: Image compression has become very important tool in digital image processing. The goal behind is to save the amount of memory required to save the image(s) or to utilize network bandwidth in efficient manner. Image compression can be divided into two parts i.e. spatially and transform based. Transform-based compression is extensively used for image compression. But transform based methods may 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. The overall objective of this paper is evaluate shortcomings of earlier techniques and finding the suitable solution for the same.
Keywords: Image Compression, Transform-based Compression, Lossless Compression

I. INTRODUCTION

As use and reliance on computers continue to cultivate, so does our significance of efficient ways of storing wide range of data. For, example someone with a website or online catalog that uses dozens or it is very likely for a number of images to use image compression in some way or another. This is because the total amount of space required to keep unadulterated images could be prohibitively large in terms of cost.
Although we currently exist in a world of rapidly expanding computing and communication capabilities, with advancement of computer technology and, especially, multimedia, the demand for computer applications to meet up people's needs can also be increasing. Since every *bit* incurs a cost when being transmitted or stored, any technology which can be introduced into our existing systems that may reduce these costs is essential. While processing raw data that could be over 50% redundant, it raises the question – Why pay for that redundant information?

TYPES OF COMPRESSION

In the case of video, compression causes some information to be lost; some information at a depth level is considered not needed for an acceptable reproduction of the scene. This sort of compression is named lossy compression. Audio compression on one other hand, is not lossy. It is named lossless compression.

Lossless Compression

Lossless techniques compress data without destroying or losing anything during the process. When the first document is decompressed, it's bit-for-bit identical to the original. Lossless is really a term applied to image data compression techniques where almost no of the first data is lost. It is typically utilized by the photographic and print media, where high definition imagery is needed and larger file sizes aren't a problem. In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the first image. However lossless compression can only just achieve a modest level of compression.

Lossy Compression

Lossy is really a term applied to data compression techniques in which some level of the first data is lost during the compression process. Lossy image compression applications attempt to remove redundant or unnecessary information when it comes to what the eye can perceive. As the total amount of data is reduced in the compressed image, the file size is smaller than the original. Lossy schemes are capable of achieving higher compression. Under normal viewing conditions, no visible loss is perceived (visually lossless).

Lossy image data compression is ideal for application to World Wide Web images for quicker transmission across the Internet. An image reconstructed following lossy compression contains degradation in accordance with the original. Often this is because the compression scheme completely discards redundant information.

LITERAUTRE SURVEY

Yanxin, Yu et al. [1] presented an image compression method worthy of the space-borne application. To solve the situation of large-size RS images trying out large cache, the compression scheme predicated on overlap blocks was taken. The overlap blocks of the image were multi-levelly decomposed by lifting wavelet. In accordance with human visual characteristics, the lossless encoding method was useful for the low-frequency sub-band most sensitive to human vision, and the bit-plane coding method was take for the rest of the high-frequency sub-bands. Simulation results showed that the algorithm could eliminate the blocking artifacts and realize the high quality image compression.

Shen, Yu et al. [2] discusses that in computer science and information theory, image compression is the procedure of encoding information using fewer bits compared to the original representation would use. Compression pays to because it helps reduce steadily the usage of expensive resources, such as for instance hard disk drive space or transmission bandwidth. Image compression may be lossless or lossy. Lossless image compression is a class of image compression algorithms that enables the actual original data to be reconstructed from the compressed data. The definition of lossless is on the other hand to lossy image compression, which only allows an approximation of the initial data to be reconstructed, as a swap for better compression rates.

Stamm, Matthew C. et al. [3] presented a set of anti-forensic techniques designed to get rid of forensically significant indicators of compression from animage. They did this by first having a generalized framework for the design of anti-forensic techniques to remove compression fingerprints from an image's transform coefficients. This framework operateed by estimating the distribution of an image's transform coefficients before compression, then adding anti-forensic dither to the transform coefficients of a compressed image so that their distribution matches the estimated one. Then they utilize this framework to produce anti-forensic techniques specifically targeted at erasing compression fingerprints left by both JPEG and wavelet-based coders. Additionally, we propose a technique to get rid of statistical traces of the blocking artifacts left by image compression algorithms that divide an image into segments during processing.

Boopathi, G. et al. [4] proposed popular neural network technique called Radial Basis Function (RBF) method of be properly used to generate the code book. A combined approach of image compression predicated on vector quantization and wavelet transform was proposed using RBF neural network. This process would be very useful for medical imaging, criminal investigation where high precision reconstructed image was required. The experimental result showed that the proposed technique provided better PSNR value and also reduces the Mean Square Error value.

Yue,Huanjing et al. [5] proposed a novel image compression scheme based on the local feature descriptor - Scale Invariant Feature Transform (SIFT). The SIFT descriptor characterizes an image region invariantly to scale and rotation. It is used widely in image retrieval. By using SIFT descriptors, our compression scheme has the capacity to utilize external image contents to reduce visual redundancy among images. The proposed encoder compresses an input image by SIFT descriptors as opposed to pixel values. It separates the SIFT descriptors of the image into two groups, a visible description which is really a significantly sub sampled image with key SIFT descriptors embedded and some differential SIFT descriptors, to reduce the coding bits.

Pinto, Smitha Joyce et al. [6] presented a highly effective algorithm to compress and to reconstruct digital imaging and communications in medicine (DICOM) images. Various image compression algorithms exist in today's commercial market. This paper outlined the comparison of compression methods such as for instance JEPG, JEPG 2000 with SPIHT encoding on the cornerstone of compression ratio and compression quality. The comparison of these compression methods were classified according to different medical images like MRI and CT. For JPEG based image compression RLE and Huffman encoding techniques were utilized by varying the bits per pixel.

Huber-Lerner et al. [7] dedicated to the lossy compression of images that have subpixel targets. This target type required minimum compression loss within the spatial dimension to be able to preserve the goal, and the most possible spectral compression that could still enable target detection. Because of this target type, they proposed the PCA-DCT (principle component analysis followed by the discrete cosine transform) compression method. It combined the PCA's power to extract the background from the few components, with the person spectral compression of each pixel of the residual image, obtained by excluding the background from the HSI, using quantized DCT coefficients. The compression method was kept simple for fast processing and implementation, and considered lossy compression only on the spectral axis. The spectral compression achieved a compression ratio of over 20. The popular Reed-Xiaoli (RX) algorithm and the improved quasi-local RX (RX_{QLC}) were used as target detection methods. The detection performance was evaluated using receiver operating characteristics (ROC) curve generation. The proposed compression method achieved maintained and enhanced detection performance, compared to the detection performance of the initial image, mainly because of its inherent smoothing and noise reduction effects. The proposed method was also in contrast to two other compression methods: PCA-ICA (independent component analysis) and band decimation (BandDec), yi- lding superior results for high compression rates.

Huber-Lerner et al. [8] proposed the PCA-DCT (principle component analysis followed by discrete cosine transform) compression method. It combined the PCA power to extract the background from the few components, with the person spectral compression of each pixel of the residual image, using quantized DCT coefficients. The compression method was kept simple for fast processing and implementation, and considers lossy compression only on the spectral axis. It achieved compression ratio of over 20, while using only spectral compression (before applying spatial compression and bit-stream-encoding). The popular RX (Reed Xiaoli) algorithm and the improved quazi-local RX (RX_{QLC}) were used as target detection methods. The detection performance was evaluated using ROC (receiver operating characteristics) curve generation. The proposed compression method showed improved detection performance, compared to the detection performance of the initial image, and of two other compression methods: PCA-ICA and band decimation.

Porwal, Janak [9] proposed a story transform that converted a 3 component RGB image to a 4 component cGST (color, gray, shade, tinge) image and vice-versa, and showed its suitability for image compression. The transform was fully reversible (and hence, is ideal for lossy along with lossless image compression) and preserves the bit-length for the GST components (allowing existing algorithms to be placed on the components). They developed an encoder-decoder tool using the transform and JPEG-LS prediction scheme, and demonstrated its efficiency (upto 35% better compression ratios over JPEG-LS, 2-5 times less runtime than JPEG 2000 with similar compression ratios) on a varied pair of test images. The transform works especially well for satellite images, computer generated animations and real images with shadows. The task also opens the scope for studying color transforms not limited to matrix multiplication or n→n dimensional conversions for imagecompression. The task also enhances the understanding of the impact of shadows on color components and pays to in image analysis in general.

Patil, Neelamma K. et al.[10] proposed an efficient color and texture feature based adaptive color image compression. Color conversion from RGB to YCbCr was performed to extract color and texture features. The extracted features were used to pick non-zero (significant) DCT coefficients. The storage space and bandwidth during transmission was efficiently utilized by encoding non-zero DCT coefficients and thereby preserving texture and color information in the reconstructed image. Experimentation has been carried from different image formats successfully. The proposed technique is easy and straight forward. A great compression has been achieved with good MSE and PSNR. Experimental results for adaptive, using all coefficients and RGB color model with 20 coefficients were computed in terms of compression ratio and quality of reconstructed image are compared. The proposed adaptive method had achieved good compression ratio by retaining color and texture features.

Ernawan, Ferda et al. [11] presented a generating of the quantization tables from the psychovisual threshold on gray-scale TMT image compression. It introduced the idea of psychovisual threshold into TMT image compression. TMT image compression has been shown to do better compared to the standard JPEG image compression. This model has been implemented on TMT image compression. The experiment results showed a psychovisual threshold for TMT basis function provided better image compression performance.

Mousa, Hamdy M. et al. [12] proposed image compression technique centered on conformal mapping transformation. The newest standard compression technique, JPEG2000 compression algorithm, is used. The proposed technique was tested with various images types. Two categories of image compression techniques (lossless and lossy) and with/without conformal mapping were studied. The experimental results showed that the compression ratio improves by 14% in average, and in case lossy image compression using JPEG2000 image quality gains over 2 dB in average.

Thepade, Sudeep D. et al. [13] presented the extended performance comparison of HWT for image compression with varying the constituent transforms and the proportions of the constituent transforms to check the consequence on quality of image compression. The experimentation was done on group of 20 images by varying the constituent transforms, proportion of constituent transforms and compression ratios (CR). The constituent transforms used to generated HWT are Cosine transform, Sine transform, Slant transform, Kekre transform, Walsh transform and Haar transform.

Zhiqianga, Li et al. [14] made a degree analysis of JEPG image compression algorithm. Moreover, they focused on the JPEG encoding algorithm and made reveal description of JEPG encoder, decoder control processes. They also selected the original image to complete the Mat lab simulation analysis centered on JEPG algorithm. Thirdly, using the DSP host processor, we can complete the hardware implementation of image acquisition and compression easily. Last however not least, this article selected a much better compressed image in order to complete image encryption process. Experimental results showed that JPEG image compression encryption algorithm was effectively guaranteed for the actual engineering applications and would be widely found in secure communication.

Donapati, Srinivas et al. [15] analysed and compared the compression ratios of the images of different input formats particularly to RGB input format and YUV 444 format have been carried out to explore the results of CSC on the image compression when using the JPEG XR. An analysis of effective compression (bettercompression ratio) have been carried on various images of unique visual characteristics in numerous input formats when processed using JPEG XR

Leung, Tony et al. [16] investigated the effects of window level and window width adjustments on visibility thresholds. A JPEG2000 based image compression method to accomplish visually lossless compression for confirmed window level and width was then proposed. A validation study was performed to ensure that theimages obtained using the proposed method can not be distinguished from original windowed images. The proposed compression method was also extended to a client-server setting where in actuality the server transmits incremental data to the client to ensure visually lossless representation after adjustments to the window level and width are manufactured at the client side. The proposed incremental compression method was compared to a reference compression system where an 8-bit image corresponding to the required window settings is created from a 12-bit CT image first at the encoder.

LIMITATIONS OF EARLIER WORK

1. **Blocking artifacts:** Transform-based compression is extensively used for image compression. But transform based methods introduce blocking artifacts in the output image.
2. **Ringing artifacts:** The compression ringing artifacts around edges can be efficiently removed using edge restoration as a post- processing.
3. **Post processing:** Blocking artifacts can be reduce by using the post processing to compressed images like filtering.

CONCLUSION AND FUTURE SCOPE

The main objective of the compression is to reduce the amount or unwanted data while retaining the information in the image. The aim is to preserve the memory needed to save the image(s) or to utilize network bandwidth in efficient manner. Transform-based compression is used widely for image compression. But transform based methods introduce blocking artifacts in the output image. Ringing artifacts around edges can be the aftereffects of compression. The ringing artifacts are in general more difficult to characterize and remove than the block transform compression artifacts. This paper has not proposed any new method in order to reduce blocking and ringing artifacts in compressed images. Therefore in near future a new technique will be proposed which will integrate SVD-WDR compression with Gradient-based optimization approach for reduction of blocking artifacts in images. The edge restoration method will also be used as a post processing technique to remove the ringing artifacts from the compressed images. The proposed technique will also 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.

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