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A Comparative Study on Compression of Color Image

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Abstract-In recent years, the headway and solicitation of sight and sound thing turns out to be continuously fast, adding to lacking bandwidth of network and limit of memory contraption. Along these lines, the theory of data compression ends up being progressively increasingly colossal for decreasing the data abundance to save greater hardware space and transmission bandwidth. In software engineering and information hypothesis, information pressure or source coding is the way toward encoding information utilizing less bits or other information bearing units than an un-encoded delineation. The improvement and solicitation of intuitive media thing turns out to be dynamically fast, adding to lacking bandwidth of network and limit of memory contraption. As such, the theory of data compression ends up being progressively increasingly colossal for decreasing the data overabundance to save greater gear space and transmission bandwidth.

Keywords – compression, image, study, review, file size.

I. INTRODUCTION

The increasing demand for multimedia content such as digital images and video has led to great interest in research into compression techniques. The development of higher quality and less expensive image acquisition devices has produced steady increases in both image size and resolution, and a greater consequent for the design of efficient compression systems. Although storage capacity and transfer bandwidth has grown accordingly in recent years, many applications still require compression.

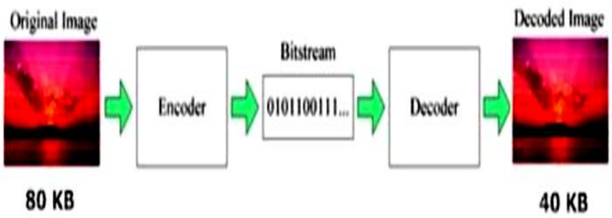

Fig. 1.1 Simple Block Diagram of Image Compression.

In general, this study investigates still image compression in the transform domain. Multidimensional, multispectral and volumetric digital images are the main topics for analysis. The main objective is to design a compression system suitable for processing, storage and transmission, as well as providing acceptable computational complexity suitable for practical implementation. The basic rule of compression is to reduce the numbers of bits needed to represent an image. In a computer an image is represented as an array of numbers, integers to be more specific, that is called a digital image‖. The image array is usually two dimensional (2D), If it is black and white (BW) and three dimensional (3D) if it is color image. Digital image compression algorithms exploit the redundancy in an image so that it can be represented using a smaller number of bits while still maintaining acceptable visual quality.

Signal processing is a type of Image processing, where the input and output signals are images. Images can be thought as 2-D signals via a matrix representation. Earlier, image processing was mostly carried out using analog devices. Now a day, images are processed in digital domain.

Digital image processing overcomes issues for example the inflexibility of system to change noise, distortion during processing, and difficulty of implementation. Image processing is a method that enhances original images got from camera and sensors in day -to-day life.

A different method has been implemented for image processing during the past few decades. Image processing systems are becoming popular because of the availability of powerful personal computers and devices of large memory, availability of graphics software etc. A wide range of application of image processing includes the following:

- Remote Sensing
- Medical Imaging
- Forensic Studies
- Textiles
- Material Science
- Military etc.

A data compression system mainly consists of three major steps and that are removal or reduction in data redundancy, reduction in entropy, and entropy encoding. A typical data compression system can be labeled using the block diagram shown in Figure 1.2 It is performed in steps such as image transformation, quantization and entropy coding.

JPEG is one of the most used image compression standard which uses discrete cosine transform (DCT) to transform the image from spatial to frequency domain. An image contains low visual information in its high frequencies for which heavy quantization can be done in order to reduce the size in the transformed representation. Entropy coding follows to further reduce the redundancy in the transformed and quantized image data.

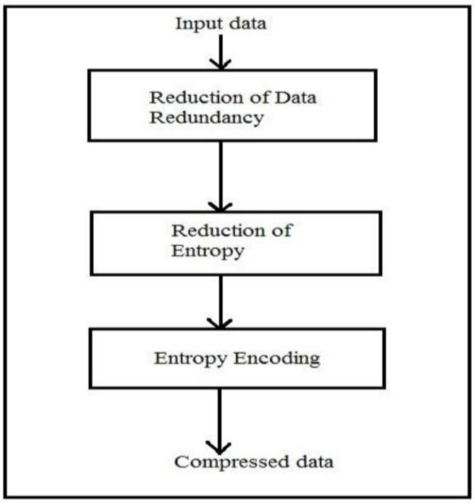

Fig. 1.2 Data Compression Model.

Compression algorithms are methods that reduce the number of symbols used to represent source information, therefore reducing the amount of space needed to store the source information or the amount of time necessary to transmit it for a given channel capacity. The mapping from source symbols into fewer target symbols is referred to as _compression‘. The transformation from the _target symbols‘back into the source symbols representing a close approximation form of the original information is called _decompression‘. Compression system consists of two steps, sampling and quantization of a signal. The choice of compression algorithm involves several conflicting considerations. These include degree of compression required, and the speed of operation. Obviously if one is attempting to run programs direct from their compressed state, decompression speed is paramount. The other consideration is size of compressed file versus quality of decompressed image. Compression is also known as encoding process and decompression is known as decoding process. Digital data compression algorithms can be classified into two categories-

a) Lossless Compression

In lossless image compression algorithm, the original data can be recovered exactly from the compressed data. It is used generally for discrete data such as text, computer generated data, and certain kinds of image and video information. Lossless compression can achieve only a modest amount of compression of the data and hence it is not useful for sufficiently high compression ratios. GIF, Zip file format, and Tiff image format are popular examples of a lossless compression.

The Lossless compression methods mean receiving the data without loss. The initial data might be retrieved exactly from the data compressed. It is used in various fields that can't ensure any variation between the original data. Lossless compressed image has a larger size compared with lossy one. In a power constrained applications like wireless communication, lossless compression is not preferred as it consumes more energy and more time for image transfer. Lossless compression techniques use following compression encoding.

- Run length encoding
- Huffman encoding
- LZW coding
- Area coding

b) Lossy Compression

Lossy compression techniques refer to the loss of information when data is compressed. As of this distortion, must higher compression ratios are possible as compared to the lossless compression in reconstruction of the image. 'Lossy' compression sacrifices exact reproduction of data for better compression. It both removes redundancy and creates an approximation of the original.

It causes in superior compression ratios to the detriment of mutilation in recreation. The benefit of lossy over lossless is high compression ratio, less process time and low energy requirements in case of power constrained applications. The following are the coding techniques used in lossless compression of images.

- Transformation coding
- Vector quantization
- Fractal coding
- Block Truncation Coding
- Sub band coding

II. SPACES DISTORTION IN IMAGE COMPRESSION

The Rate-Distortion theory comes under the umbrella of source coding or compression and it is concerned with the task to find the best trade-off between the quality of the reconstruction (distortion D) and the loss of information (bit rate cost R). In other words, RD theory seeks for the fewer number of bits possible to achieve a given reproduction quality. Initially, the YCbCr color space was considered for use as a standard color space, but this idea was abandoned. However, the YCbCr color space was used as the default color space for much of the experimental research carried out by the JPEG committee.There has been a limited amount of research on how the use of other color spaces affects the compressibility of color images. Although, given the drastic differences among the various ways of representing color, it seems unlikely that there would be no differences among the color spaces. In fact, the XYZ and YCbCr color spaces have been shown to be better than the RGB color space for image compression.The various color spaces currently available can be divided into three different categories. These divisions are device color spaces, linear transforms of device color spaces, and non-linear transforms of device color spaces.

Techniques of Image Compression

a) Predictive Coding

In predictive coding the image data is not compressed in the manner described in Fig. 1. Instead, one predicts the image pixels and computes a prediction error. The prediction error is actually the information that is quantized and encoded. In general, predictive coding is similar to DPCM systems, which were commonly used before computer technology made transform coding affordable.The actual pixel is predicted somehow from information conveyed through the past (already processed) pixels and only the prediction error is quantized and encoded. The decoder applies the same prediction step as the encoder. Given the predicted value, the decoder simply integrates the error to the predicted value in order to produce the reconstructed pixel. A feedback loop is required at the encoder side to synchronize encoder and decoder. However, predictive systems are often used for “lossless” compression, i.e. the data is not quantized and, hence, there is no need for the feedback loop. There are several methods for adaptive or non-adaptive prediction.

b) Discrete Wavelet Transformation (DWT)

Wavelet functions have a finite interval of spread and their respective average value is zero for all cases. Any function can be transform to wavelet function using the wavelet transformation (t). The essential capacity otherwise called infant wavelets are gotten from single model wavelet called the mother wavelet. In the image compression process, first the image is ordered into squares of 32*32. After categorization the blocks are passed through filters such as scaling filter and wavelet filter. Scaling filter is a low pass filter and wavelet filter is high pass filter.

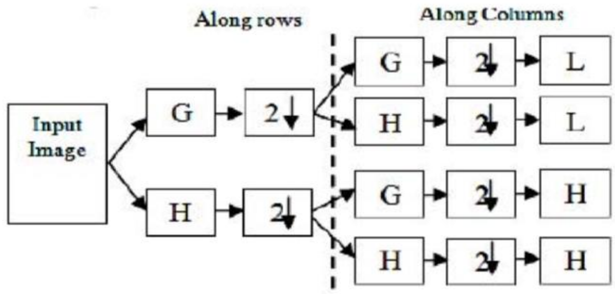

Figure 2.1 Block Diagram for Forward DWT.

c) Discrete Cosine Transform (DCT)

DCT is commonly used compression and transformation technique for images. This is an orthogonal algorithm with basic features which makes it special. These features are: algorithm for computation, good energy compaction, correlation reduction properties and image independent basic functions. DCT is very closely related to DFT because both are real valued transformations.

The remarkable development in the field of information technology and the diversity of multimedia applications in recent years imply the development of more efficient image compression techniques to enhance the capacity of data transmission and storage. Based on the fact that Curvelets transform provide a sparse decomposition of images, which means representing the most relevant information (geometric structures in this case) with coefficients of large amplitudes. Author reported to use a non-uniform logarithmic quantization, able to quantify the high amplitudes coefficients more accurately in order to promote, in this step, the coefficients which carry the directional information of the image.

III. LITERATURE SURVEY

SR. NO.	*TITLE*	*YEAR*	*APPROACH*
1	Cross-Space Distortion Directed Color Image Compression [1]	2018	Author reported a novel compression scheme for color images through defining a cross-space distortion so as to reduce as much as possible the distortion in the RGB space in this examination work
2	Task-Based JPEG 2000 Image Compression: An Information-Theoretic Approach [2]	2018	In this research work author reported a method to produces a JPEG 2000 compliant compressed codestream, which can be decoded by any JPEG 2000 compliant decoder
3	Rate-distortion based sparse coding	2015	In this work, author reported a novel image set

	for image set compression [3]		compression approach based on sparse coding with an ordered dictionary learned from perceptually informative signals.
4	Image compression based on the transform domain downward conversion [4]	2015	In this examination work, author focus on the design of a new block-based image compression by using proposed transform domain downward conversion (TDDC).
5	Efficient VLSI architecture of visual distortion sensitivity based spatially adaptive quantization for image compression [5]	2013	This work presents new and efficient very large scale integration (VLSI) architecture for the implementation of VDSSAQ.
6	JPEG image compression using quantization table optimization based on perceptual image quality assessment [6]	2011	Author considers the use of perceptual image quality assessment for quantization table (QT) optimization for JPEG compression in this work
7	A fast lossless compression algorithm for Arabic textual images [7]	2011	In this research, a novel algorithm for compressing textual images is presented by author. The algorithm comprises of two parts: (i) a fixed-to-variable codebook; and (ii) row and column reduction coding scheme, RCRC.

IV. PROBLEM IDENTIFICATION

An image can be defined as a matrix of pixel or intensity values. Image compression is used to reduce the redundancy and randomness present in the image because to increase the storing capacity and efficiency level of the images. Therefore it is essential to compress the images by storing only the required information needed to reconstruct the image. To compress any image, redundancy must be removed. Sometimes images having large areas of same color will have large redundancies and similarly images that have frequent and large changes in color will be less redundant and harder to compress.

V. IMAGE COMPRESSION PERFORMANCE METRICS

The performance of a compression technique can be assessed in a number of ways the amount of compression, the comparative difficulty of the technique, memory constraint for implementation, time required for the compression on a machine, and the distortion rate in the reconstructed image. The following are the performance metrics to evaluate the compression techniques.

a. Image Quality

b. Compression ratio

c. Speed of compression

- Computational complexity
- Memory resources.

d. Power consumption

VI. CONCLUSION

Image compression is basic for beneficial transmission and capacity of pictures. Colossal request of wireless communication and media getting to the sight and sound information through Internet is growing viciously Image compression is a capacity of information compression Images are a fundamental advanced archive now days; image join distinctive information e.g. human bodies in restorative pictures that are used for various reason like medicinal security and unmistakable plans. Compression of pictures is utilized in a few applications like ID data and transmission framework. a novel compression plot for color pictures are infer in the connection for the distortion space. To figure with them in an exceedingly couple of utilizations they must be packed a ton of or less looking on the point of the machine. Respect to centrality of pictures information lossless or lossy compression is favored.

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