Volume 4, Issue 9, September 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Review on Image Compression

Priya Kapoor
M.Tech Research Scholar, GIMET, Amritsar, India

Sunaina Kumara
M.Tech Research Scholar, India

Gurpreet Kaur
GIMET, Amritsar, India

Abstract: Image compression attempts to condense the number of bits obligatory to digitally symbolize an image while maintaining its apparent visual excellence Image compression is a procedure that is very vastly used for the integral and resourceful convey of data. It not only reduces the dimension of realistic file to be transferred but at the equivalent time reduces the storage space requirements, cost of the data transferred, and the time required for the transfer. It makes the diffusion progression faster, provides superior bandwidth and security beside illegitimate use of data. Image compression involve two types lossy image compression and lossless image compression. In lossy image compression there is no loss of data. However lossless image compression is used to retain original multimedia object.

***Keywords**:Lossy compression,lossless compression*

I. INTRODUCTION

Images may be appeal a thousand terminology, but they usually engage much additional liberty in a hard disk, or bandwidth in a diffusion system, than their recognizable foil. Image compression may be lossy or lossless. Lossless compression is ideal for archival purposes and repeatedly for medical imaging, methodological drawings, clip art, or caricatures. This is because lossy compression methods, principally when worn at squat bit rates, commence compression artifacts. Lossy methods are particularly suitable for expected images such as photographs in applications where negligible thrashing of commitment is tolerable to accomplish a generous lessening in bit rate. The lossy compression that produces unnoticeable differences may be called visually lossless. Image compression is a procedure that deals with tumbling the quantity of data mandatory to symbolize a digital image by removing the superfluous data. It is been used to curtail the size in bytes of a graphics file exclusive of corrupting the excellence of the image to an undesirable intensity. The lessening in file dimension allows supplementary images to be stored in a specified quantity of diskette or recollection space. It also reduces the instant mandatory for images to be sent over the Internet or downloaded from Web pages .

A typical lossy image compression system which consists of three closely connected components namely

(a) SourceEncoder
(b) Quantizer,
(c) Entropy Encoder.

Compression is accomplished by applying a linear transform to decorrelate the image data, quantizing the resulting transform coefficients, and entropy coding the quantized values.

A. Source Encoder (or Linear Transformer)

Over the years, a variety of linear transforms have beendeveloped which include Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) [1], Discrete Wavelet Transform(DWT)[13] and many more, each with its own advantages and Disadvantages

B. Quantizer

A quantizer simply reduces the number of bits needed to store the transformed coefficients by reducing the precision of those values. Since this is a many-to-one mapping, it is a lossy process and is the main source of compression in an encoder.

Quantization can be performed on each individual coefficient, which is known as Scalar Quantization (SQ). Quantization can also be performed on a group of coefficients together, and this is known as Vector Quantization (VQ). Both uniform and non uniform quantizers can be used depending on the problem at hand.

C. Entropy Encoder

It uses a model to accurately determine the probabilities for each quantized value and produces an appropriate code based on these probabilities so that the resultant output code stream will be smaller than the input stream. The most commonly used entropy encoders are the Huffman encoder and the arithmetic encoder, although for applications requiring fast execution, simple run-length encoding (RLE) has proven very effective.

II. RELATED WORK

The fundamental initiative behind image compression is to diminish the quantity of bits obligatory to digitally symbolize an image while maintaining its superficial visual eminence. The concert of this method is compared with the obtainable jpeg compression technique over a spacious number of images, screening good agreements. The scheme behind this method is that is using surrounded encoding algorithm is encoder can conclude encoding at any point. The encoder accept the input from quantize which eliminate their applicable information and encoder dispense minimum code to most numerous information in regulate to process it easily. Image compression technique reduces insignificance and redundancy of the image an regulate to be able to accumulate broadcast in efficient form .it is functional development to accumulate a lot of space and resource while distribution The main endeavor is to accomplish elevated compression quotient and lowest dreadful circumstances in excellence.

III. IMAGE COMPRESSION TECHNIQUES

The image compression techniques are generally confidential into two categories depending on whether an precise imitation of the innovative image could be reconstructed or not using the condensed image. These are:

3.1. Lossless technique
3.2.Lossy technique

3.1 Lossless compression

It is a category of statistics compression algorithms that allows the renovation of the precise innovative from the condensed statistics. Lossless compression reduces a file's dimension with no defeat of superiority. This is one of the suitable methods for tumbling file sizes that can be functional to mutually image and audio files. Lossless compression principally tends to rephrase the statistics of the innovative file in a extra competent manner. nevertheless, because no excellence is lost, the consequential files are normally much superior than image and audio files condensed with lossy compression. unlikely to produce a file smaller than half of the original sizeFollowing techniques are included in lossless compression:

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

A. Run Length Encoding: Run-length encoding (RLE) is a very effortless appearance of data compression in which runs of data are stored as a particular data worth and calculations lightly than as the innovative dash. This is most functional on statistics that contains many such runs: for example, simple striking images such as icons, line drawings, and animations. It is not useful with files that don't have many runs as it could greatly increase the file size. Run-length Encoding, or RLE is a technique worn to diminish the extent of a repeating sequence of lettering. This repeating sequence is called a run, normally RLE encodes a scamper of cipher into two bytes , a reckoning and a symbol. RLE can compress any type of data regardless of its information content, but the content of data to be compressed affects the compression ratio. Consider a character run of 15 'P' characters which normally would require 15 bytes to store :

PPPPPPPPPPPPPPP is stored as 15P

With RLE, this would only require two bytes to store, the count (15) is stored as the first byte and the symbol (P) as the second byte.

B. Huffman encoding: Huffman coding is an entropy programming algorithm used for lossless data solidity. The Huffman code refers to exploit of a incompatible duration code table for encoding a source representation where the inconsistent length code chart has been constructed in a meticulous way based on the anticipated prospect of incident for each promising value of the source symbol. Huffman coding is based on the incidence of incidence of a data item . It is based on the attitude to use a subordinate quantity of bits to encode the statistics that occurs more recurrently .Codes are stored in a Code manuscript which are constructed for each image or a set of images.

Huffman algorithms have two ranges static as well as adaptive. Static Huffman algorithm is a procedure that encodes the statistics in two passes. In first pass it requires to evaluate the regularity of each symbol and in the second pass it constructs the Huffman tree. Adaptive Huffman algorithm is extended on Huffman algorithm that constructs the Huffman tree in one pass but take more space than Static Huffman algorithm.

C. LZW coding: If any statistics file on a computer is viewed, disposition by disposition, one would perceive that there are many frequent patterns. LZW is a statistics solidity method that takes benefit of this duplication. The innovative description of the method was created by Lempel and Ziv in 1978 (LZ78) and was auxiliary experienced by Welch in 1984. approximating any adaptive/dynamic compression method, the inspiration is to first start with an original model, secondly read statistics portion by portion and lastly revise the model and encode the statistics as one go along. LZW is a "phrase book"-based compression algorithm, this means that instead of tabularizing temperament counts and building trees, as done in case of Huffman encoding, LZW encodes statistics by referencing a phrase book. Thus, to encode a substring, only a single code number, analogous to that substring's catalog in the phrase book ,needs to be printed to the output file. It normally performs superlative for documentation with recurring substrings.

D. Area coding: In area coding procedure unique codeword's are used to categorize huge areas of adjacent 1's or 0's. In this method the entire image is alienated into blocks of size m*n pixels, which are confidential as block having only white pixels, chunk having only black pixels or chunk with varied intensity. The most recurrent happening grouping is then assigned the 1-bit codeword 0, and the remaining other two categories are assigned with 2-bit codes 10 and 11. The code assign to the assorted concentration grouping is used as a prefix, which is followed by the mn-bit pattern of the chunk. Compression is achieved because the mn bits that are usually used to characterize each invariable area are replaced by a 1-bit or 2-bit secret word .When principally white text credentials are being compressed, a vaguely simpler approach called white block skipping is mature to cipher the solid white areas as 0 and all other blocks including the concrete black blocks are coded as 1 followed by the bit blueprint of the block. This approach takes improvement of the projected structural patterns of the image to be compress.

3.2 lossy compression technique

In lossy compression technique there is some lost of data. But still we can recognize the information

Types of lossy compression

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

A. Transformation coding

Transform field coding is been used to transform the pixels in the inventive image into regularity field coefficients called convert coefficients. These coefficients have numerous pleasing properties. Transform coding techniques uses a reversible, linear mathematical alter to plot the pixel values onto a position of coefficients, which are then quantized and encoded. The key aspect following the success of transform-based coding schemes depends on many of the consequential coefficients for most expected images which have small magnitudes and can be quantized without causing significant deformation in the decoded image.

B. Vector quantization

A vector is typically distinct as a chunk of pixel morals. The basic scheme behind the procedure is to enlarge a vocabulary of fixed-size vectors, called policy vectors. Vector quantization, also called "block quantization" or "pattern matching quantization" is a technique frequently used in lossy statistics compression. It works by encoding morals from a multidimensional vector liberty into a restricted set of ethics from a disconnected subspace of lower element. A lower-space vector requires fewer storage spaces, so the data is compressed

C. Block truncation coding

Block truncation coding (BTC) is a straightforward and swift lossy compression technique planned for digitized gray scale images. It was initially introduced by Delp and Mitchell. The solution behind BTC is to execute instant preserving (MP) quantization for blocks of pixels so that the superiority of the image will continue adequate and at the same time the storage space stipulate also remains decreased

IV. VARIOUS TYPES OF REDUNDANCY

Three Redundancy is the difference between the shortest way one could convey a piece of information (i.e., the information content itself) and the data used to represent it. In the previous example, the first "l" is highly redundant while the second "l" is not

There are basic types of redundancy in images:

1. Redundancy
2. Interpixel Redundancy
3. Coding Visual Redundancy

A. Coding redundancy

Pixels have to be encoded in images. Like all things in a computer, we have to assign some arbitrary set of bits for different possible values. Sometimes, some values are more probable than others. As such, they are more expected and thus have less information content. Others are less probable (less expected) and thus have more information content. The key to reduce coding redundancy is to assign bits according to the information content. The more information, the more bits; the less information, the fewer bits. If we try to eliminate coding redundancy in textual information, we can measure the frequency with which each letter occurs. If it occurs more frequently, encode it with as few bits as possible. If it doesn't occur much at all, use more bits. Thus, we might encode "E" with a few bits and "X" or "Q" with lots of them. Who cares if "X" takes 12, 20, or even 50 bits--it doesn't occur that often anyway. Likewise, we can use such variable-length coding for pixels or other information for images. For example, if an image is 50 and 50 black pixels? Why not use one bit to signal if the pixel is black or not, and then follow the non-black ones by the actual grey-level value (8 bits). This would use one bit for half the image and nine bits for the other half. This would use 4.5 bits per pixel instead of eight. The best known and most efficient method for variable-length encoding is Huffman coding. Pure

Huffman coding is computationally expensive and requires measuring the full statistics of the data. Typically, a modified form is used that is based on presumed frequency distributions and not-quite-perfect encoding.

B. Interpixel Redundancy

If you were to scan across a row of a binary image and read off the values, and if the values were "white", "white", "white", "white", "white", what would you guess the next one to be? While either "black" or "white" are possible, you'd probably guess that the next one is white. This makes sense for images because they usually have regions of constant or similar values. This is called *interpixel redundancy*. In order to reduce the interpixel redundancies in an image, the 2-D pixel array normally used for human viewing and interpretation must be transformed into a more efficient format. For example, the differences between adjacent pixels can be used to represent an image. Transformations of this type are referred to as mapping. They are called reversible if the original image elements can be reconstructed from the transformed data set.A common characteristic of most images is that the neighboring pixels are correlated and therefore contain redundant information. The foremost task then is to find less correlated representation of the image. Two fundamental components of compression are redundancy and irrelevancy reduction. Redundancy reduction aims at removing duplication from the signal source (image/video). Irrelevancy reduction omits parts of the signal that will not be noticed by the signal receiver, namely the Human Visual System (HVS). In general, three types of redundancy can be identified:

- Spatial Redundancy or correlation between neighboring pixel values.
- Spectral Redundancy or correlation between different color planes or spectral bands.
- Temporal Redundancy or correlation between adjacent frames in a sequence of images (in video applications).

B. Visual Redundancy

The third way of reducing redundancy is to realize that our senses aren't equally sensitive to all things. In this sense, information content relates to the ability of our visual systems to tell the difference. Examples of this include

- Our greater sensitivity to changes in intensity than to changes in hue.
- Our greater sensitivity to low-frequency changes than to high-frequency ones.

By transforming our image into spaces that correspond to these properties, we can then better reduce the number of bits we devote to them. For example, by transforming to YIQ color spaces, we separate intensity from color and can correctly apportion the bits. Likewise, by transforming to frequency-based spaces (such the frequency domains of the Fourier Transform or DCT), we can distribute our precious bits according to spatial frequency. Psychological redundancy is fundamentally different from the redundancies discussed earlier. Unlike coding and interpixel redundancy, psychologically redundancy is associated with real or quantifiable visual information. Its elimination is possible only because the information itself is not essential for normal visual processing. Since the elimination of psycho visually redundant data results in a loss of quantitative information, it is commonly referred to as quantization. This terminology is consistent with normal usage of the word, which generally means the mapping of a broad range of input values to a limited number of output values. As it is an irreversible operation (visual information is loss).

V. WHY WE NEED COMPRESSION

The examples given in the Table I clearly illustrate the need for sufficient storage space, large transmission bandwidth, and

long transmission time for image, audio, and video data. At the present state of technology, the only solution is to compress multimedia data before its storage and transmission, and decompress it at the receiver for play back. For example, with a compression ratio of 32:1, the space, bandwidth, and transmission time requirements can be reduced by a factor of 32, with acceptable quality.

VI. CONCLUSION

- This review work has focused on image compression and its techniques.
- This survey shows that the various techniques are used for the compression of image and in near future we will used DCT based techniques for compression of image..
- DCT based techniques can preserve the maximum information while doing the compression. So the resultant images will not much blurred or not lost their information after compression.

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