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Comparative Analysis of Compression Techniques: A Survey

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Abstract - ***In today world, social and network computing are having a great demand and for data and file's fast transformation, less space occupation with easy access, there is need for compression methods. The compressed images can be easily transferred to nearby stations for further processing and are refined with provided approaches. There are various methods for compressing images and data. Thus, this paper discusses various lossy compression techniques. All these techniques compress and decompress data with some loss of data. Various lossy compression techniques are transform coding, Fractal compression, vector compression, block truncation and chroma sub-sampling. Out of these techniques transform coding and fractal compression are efficient approaches and are mostly used due to its efficiency in providing compressed refined images.***

Key Words: compression, lossy, lossless, transformation, TC, FC, VC, BT, CS, encoding, decoding.

1. INTRODUCTION

Finite number of elements having particular location and value makes a Digital image, These elements are known as image pixels. Digital images require a very large number of bits, this causes problem for digital image transformation and storage [16]. The 2-D images which are represented in numerical form are digital images. Digital image refers to raster image or a bitmapped image. Raster image contains finite set of pixels. Row and columns of pixels represent a digital image [2][3]. Pixels are stored in computer as raster images .various techniques and data input devices are used to generate raster images. Compression term used for reducing quantity of data which represents a file. Compression is needed to reduce the storage space needed to store that image and reduced time for transmission. Compression decreases costs for storage hardware and network bandwidth. Image compression is basically used to remove three types of redundancies like:-

- **Coding redundancy:-**which is present when less than the smallest length code words are used.
- **Inter pixel redundancy**:-which is due to correlation between pixels.
- **Psycho visual redundancy:-**which is results from data that is ignored by human visual system.

The compressed file firstly needs to convert into its original form and then used. For this decompression is performed on compressed file on receiver side. Decompression is a process of reconverting data which is compressed by compression process into its original form.

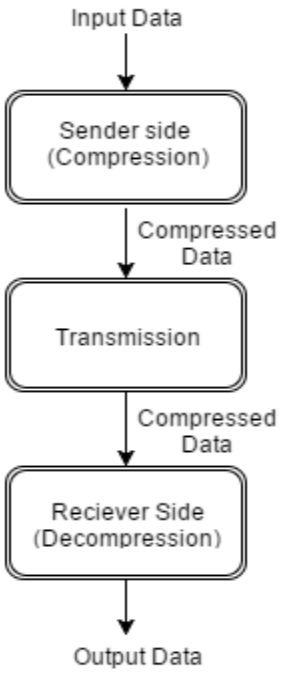


Fig-1: Compression and Decompression process diagram

1.1 How Images Are Transform

Multiple bands of data that are acquired from single or more than one image at different time are manipulated using image transformation process. Image transformation is used to generate new image using single or more than one image according to properties and features of interest; better than the original input images. Commonly arithmetic operations are performed on image data for transformation. Image subtraction is used to describe those changes that occurred between collected images on different days. The goal of transformation is to get a new representation of the picture; this new representation can be more convenient for a

particular application or can ease the abstraction of particular property of the picture [4][5]. Following is an expression for image transformation:-

$$im[x,y] \xrightarrow{T} IM[u,v]$$

- im is the original image.
- IM is the transformed image.
- x,y (or u,v) represents the spatial coordinates of a pixel.

Three types of transformation are:-

- **Point to Point transformation:** The output value at specific coordinate id dependent only on one input value but not necessarily at the same coordinates.
- **Local to Point transformation:** The output value at specific coordinate id dependent on the input value in the neighborhood of the same coordinate.
- **Global to Point transformation:** The output value at specific coordinate id dependent on all the values in the input image.

2. METHODS OF COMPRESSION

There are various methods of compression**.** These method are lossy compression and lossless compression [18]. Following diagram shows methods of compression:

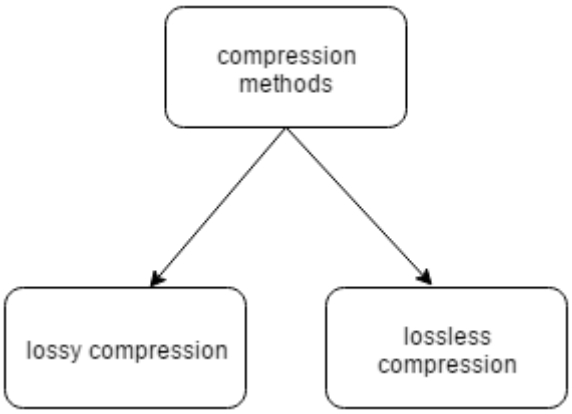


Fig-2: Methods of compression [11][18]

2.1 Lossy Compression

Lossy compression decreases a document by forever wiping out certain data, particularly excess data. At the point when the record is uncompressed, just a part of the first data is still there (in spite of the fact that the client may not see it). Lossy pressure is by and large utilized for video and sound, where a specific measure of data misfortune won't be distinguished by most clients. The JPEG picture record, usually utilized for photos and other complex pictures [1][13]. Utilizing Following diagram shows lossy image compression flow .

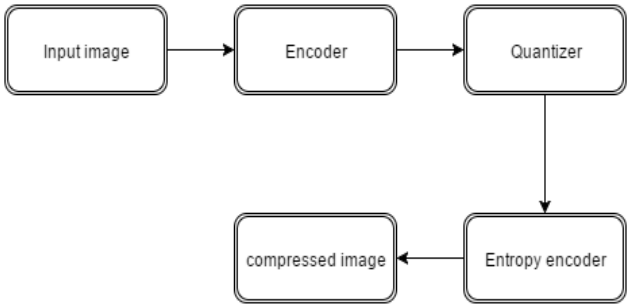


Fig-3: Lossy compression

2.2. Lossless compression

With lossless compression, each and every piece of information that was initially in the record stays after the document is uncompressed. The greater part of the data is totally restored. This is for the most part the system of decision for content or spreadsheet records, where losing words or monetary information could represent an issue [6].

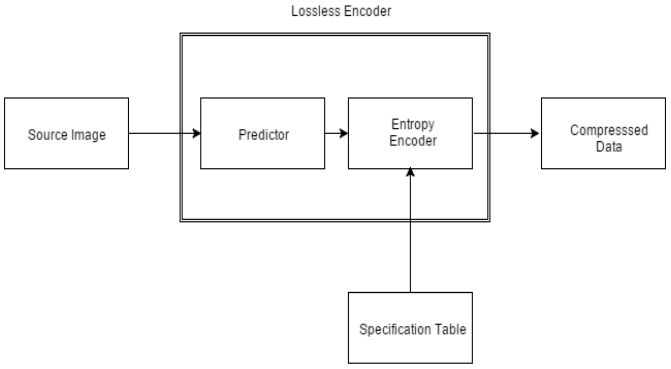


Fig-4: Lossless Compression

3. TECHNIQUES OF LOSSY COMPRESSION

There are various compression techniques for lossy compression [7]. Following are some lossy image compression techniques:

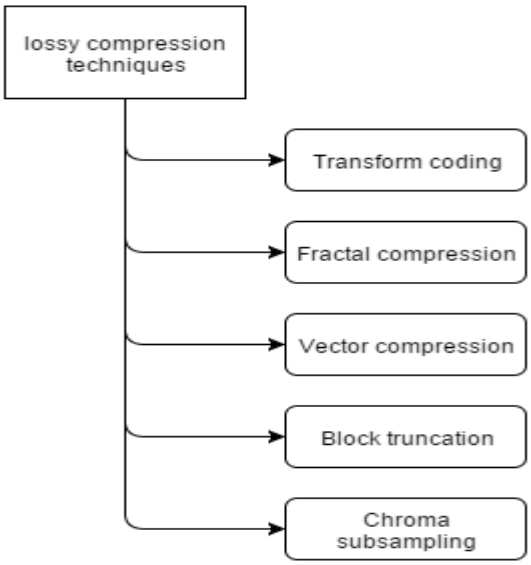
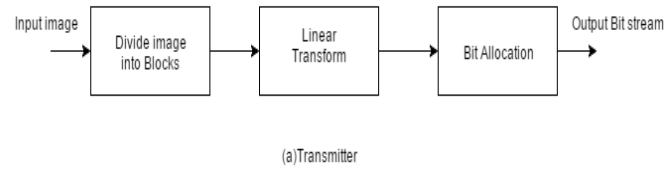


Fig-5 Techniques Of Lossy Compression

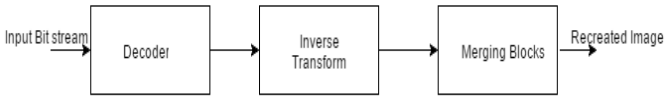
3.1. Transform Coding (TC)

In this technique number of coefficients produced is equal to the number of pixels in input image. Fourier, Karhonen-loeve, Walsh Hadamard, lapped orthogonal, descrete cosine transform are some transform which are apply on input image [10]. In this mathematical operations are used to convert pixels of input images into transform coefficients. These coefficients are used for further processing. This technique is beneficial for natural and real life images.

Steps 1: Provide input image to transmitter.
Steps 2: Transmitter first of all divide the whole image into NxN pixel blocks.
Steps 3: Discrete cosine transform is used to read pixels of each block. pixels are read by DCT from left to right and top to bottom [1][2].
Steps 4: Bits are allocated to these pixels blocks.
Steps 5: Receiver takes bit stream as input and decode it..
Steps 6: Reverse discrete cosine transform is performed on decoded data.



(a)Transmitter



(b)Reciever

Fig-6: Transform coding

3.2. Fractal Compression (FC)

Similar forms and patterns occurring in different sizes makes a structure called as a fractal [8]. Take an example of floor which is made up of either wood, tiles or concrete but having repeating patterns in its texture. if we compare all parts of floor then we find various mathematical equations, these equations are known as fractal code. This fractal code describes the fractal properties or features of pattern. Image can be regenerated by using these fractal equations. This is a technique which generates fractal code for parts of image that looks same. The code is used to recreate image.

Step1: Do segmentation of the image, and assign labels to all pixels.
Step2: Divide image into 8x8 blocks which are called 'R' blocks that does not contain any over lapping.
Step3: Divide image into such blocks that contain overlapping known as 'D' blocks.
Step4: Change 'D' blocks size to 'R' block's size.
Step5: Calculate variance of all D blocks and sort them.
Step6: Take one 'R' block and after calculating its variance match it with threshold.
Step7: In which space 'R' block locate, find nearest variance 'D' block.
Step8: Define a searching a window.
Step9: Find best match of 'D' block after affine transformation and grey migration.
Step10: If matching error between 'D' and 'R' block is large than threshold then divide 'R' block into Parts & repeat above process.
Step 11: same process is followed for all blocks.

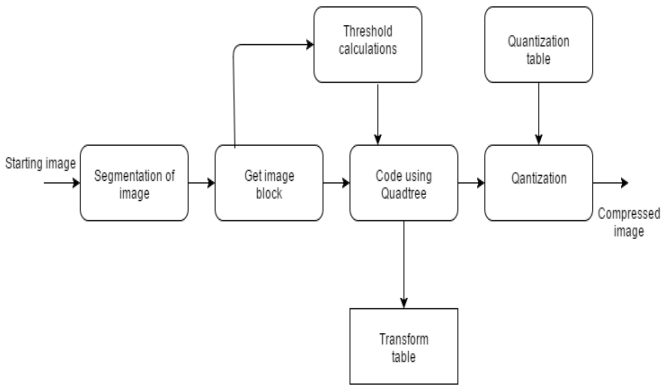


Fig-7: Fractal Compression

3.3. Vector Compression (VC)

In vector compression at encoder side or sender side , encoder do mapping process mean to say
match for codeword for an input image in code book, and then transmit the index to decoder or at
receiver side . then decoder also match for the codeword of that index and produce the image as
output [9].

Step1: Takes as input an image.
Step2: Encoder match for codeword from codebook.
Step3: Encoder transmit the index of that code word to decoder.
Step4: Decoder find the code word for that index and reconstruct image.

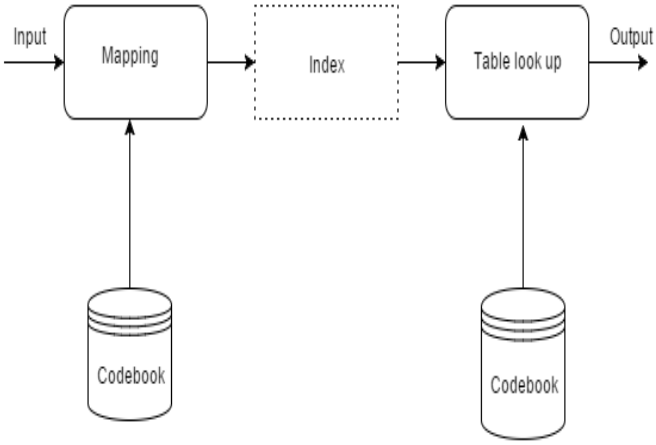


Fig-8: Vector Compression

3.4. Block Truncation (BT)

According to block truncation technique of image compression the input image is divided into NxN blocks of pixels which are non overlapping. Then for each block of pixels threshold and reconstruction value is calculated. Threshold is the mean of all pixel values in the block; For each block, bitmap is generated by comparing threshold value with pixel value. Reconstruction value is the average of all values in the original block [14][17].

Step1: Take an image as input.
Step2: Divide the image into blocks.
Step3: Calculate threshold and reconstruction value for each block.
Step4: Create bitmap of the each block by comparing all pixels of block with threshold. If Value is greater than or equal to threshold then replace it with binary digit 1 if less than threshold then replace with 0 binary digit.
Step5: Encode and transmit the bitmap values to decoder.

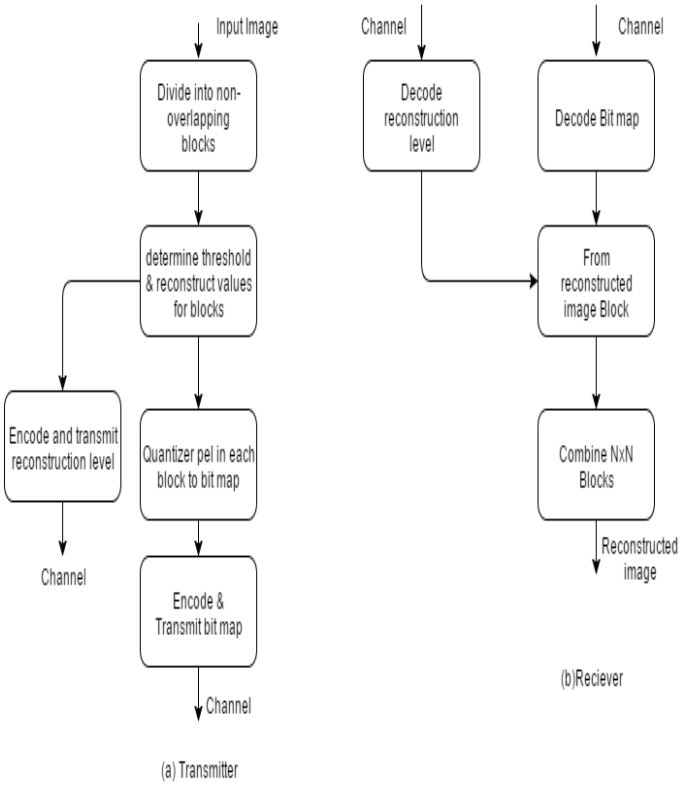


Fig-9 Block Truncation

3.5. Chroma Sub-Sampling(CS)

Most of the time 2x2 chroma sub-sampling is performed by graphics programs, in which whole image is divided into 2x2 pixel blocks. Each block stores only the average colour information. In video encoding techniques, this technique is used. This is basically used to handle low resolution and intensity information. In this technique two conversions are done firstly red/green/blue are represented to an intensity plus color representation, and then reverse process is followed to display picture [15].

4. Conclusion

In this paper we have reviewed and studied various lossy compression techniques . Out of these lossy compression techniques mostly used are transform coding and fractal compression because these can be further modified with any of the interpolation techniques such as linear bi-linear or nearest . These compression techniques provides a method to compress the images in order that the data, pixels did not get distorted or blurred, and upon applying the inverses of these compression we get a refines image. The refinement in the compressed images is done using inverse transformation and quantization methods.

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