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# Performance Analysis of Image Compression Technique

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***Abstract:-*** **This paper addresses the area of image compression as it is applicable to various fields of image processing. On the basis of evaluating and analyzing the current image compression techniques. We Implemented and comparative study of SOM & JPEG2000 image coders using different techniques and measure the PSNR value of a compressed image that measures the quality of a picture by using various formulas like MSE. The objective of this paper is to provide a qualitative compression of DCT, WAVELET the original image.**

**Keywords: - Compression, ERROR METRIC, DCT, JPEG2000 Method, SOM, MSE, PSNR.**

## I. INTRODUCTION

With the continual expansion of multimedia and internet applications, the needs and the requirements of technologies used, grew and evolved. To address these needs and requirements in the specific area of still image compression, many efficient techniques with considerably different features have recently been developed for both lossy and lossless compression [1, 2]. IMAGE COMPRESSION is minimizing the size in bytes of a graphics file without degrade the quality of the image to an unacceptable level. It is a process intended to yield a compact representation of an image, reducing the image storage, reducing an image size allows more images to be stored in a given amount of memory space and also reduces the time over internet to download that image from web pages [4]. The objective of the image compression is to reduce the redundancy of the image and to store or transmit the data in an efficient form [3]. The three basic data redundancies are:-

- Coding redundancy
- Interpixel redundancies
- Psycho visual redundancies [4, 2].

There are some algorithms that perform this compression in different ways; Lossy Compression Algorithm & Lossless Compression Algorithm

**Lossy compression technique:-**

Lossy compression techniques include following schemes:

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

**TECHNIQUES AVAILABLE**

**1. Vector Quantization Scheme:-**

There are many ways to achieve the vector quantization process of image compression.

- **Kohenen's algorithm** is reliable and efficient way to achieve VQ and faster than other algorithm. It avoids the problem of dead unit. It realizes a mapping between the input and output. A vector is usually a block of pixel values. A given image is then partitioned into non overlapping blocks (vector) called image vectors.

**2. Entropy coding schemes:-**There are two most popular Entropy coding schemes are Huffman coding and Arithmetic coding.

- **Huffman coding algorithm** is an optimal compressed algorithm when only the frequency of individual letters are use t o compress the data.
- **Arithmetic coding algorithm** completely replaces an input symbol with a specific code. It takes a stream of input symbols and replaces it with a single floating point output number. The longer the message, the more bits are needed in the output number. The output from an arithmetic coding process is a single no less than 1 and greater than or equal to 0. In order to construct the output number, the symbols being encoded have a set probabilities assigned to them**2Lossless Compression Technique:-**
- Run Length Encoding
- Huffman Encoding

**ERROR METRIC:-**

Two error metric are used for various image compression techniques-

- MSE (Mean Square error):-MSE is a square error between the compressed and the original image.
- PSNR (Peak Signal to Noise Ratio):- PSNR of the peak error, if you find the higher the PSNR, the better the quality of the compressed or reconstructed image.

## II. IMAGE COMPRESSION STANDARD – JPEG 2000 AND SOM

What is JPEG2000? It was introduced in 2000, so it is called JPEG2000. The biggest advantage of it is flexibility. One can get compressed images scalable in nature. The compression technique can be truncated at any point in time, now the resolution and signal to noise ratio depend on the point they are truncated. In addition, it achieve variable compression rate due to its flexibility and adaptability. With JPEG, compression algorithm is applied before encoding while with JPEG2000 it is done in a single step.DCT is the algorithm name used to do processing of JPEG2000 format. From the research, it has been found that compression achieved by this method is 20% more as compared to JPEG. DCT algorithm works on a pixel value. It can vary from values 0 (black) to 256 (white) [6]. In DCT based compression, average and

 

difference of two adjacent pixels are taken. Then the value close to 0 is discarded. This is a method to reduce the number of bits. Because of its effectiveness in edge detection, it is used in medical images as well as in military images. Police department use it for finger print detection. DMV follows this algorithm for car plate detection and the preexisting PSNR value are 24.28 dB. A **self-organizing map** (**SOM**) or **self-organizing feature map** (**SOFM**) is a type of artificial neural network that is trained using unsupervised learning to produce a low-dimensional (typically two-dimensional), discretized representation of the input space of the training samples, called a **map**. Self-organizing maps are different from other artificial neural networks in the sense that they use a neighborhood function to preserve the topological properties of the input space

## III. EXPERIMENTAL WORK:-

### PROCESSING STEPS FOR DCT

Fig2 and Fig3 show the key process step of the DCT base mode of operation [1, 5]. It is a special case of single-component (gray scale) image compression.

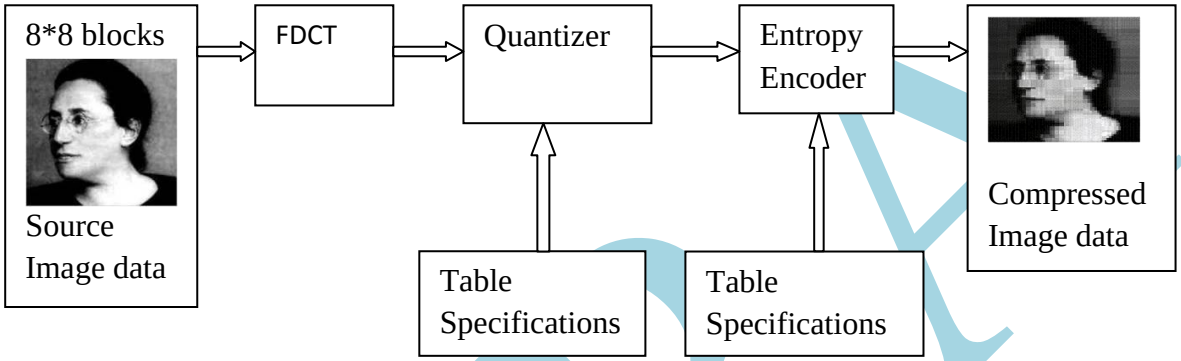


Fig1. DCT-Based Encoder Processing Steps

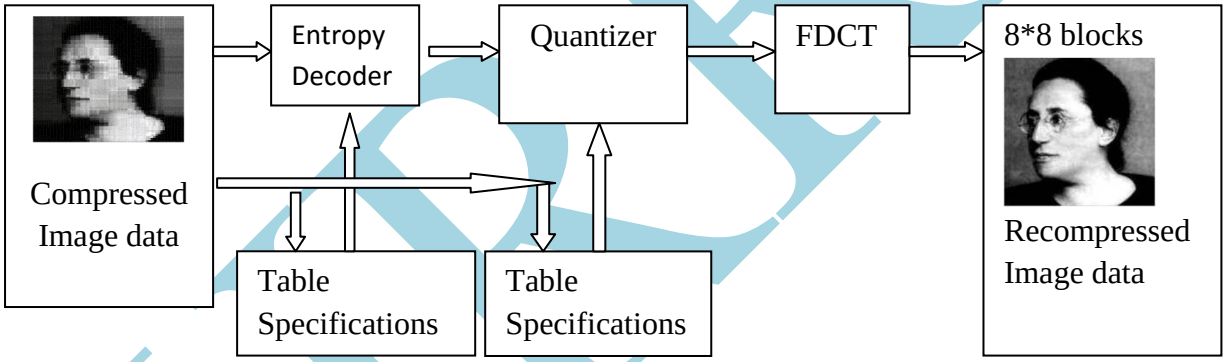


Fig2. DCT- Based Decoder Processing Steps

Basic Block Diagram of Image Compression using JPEG 2000 standard can be represented as:

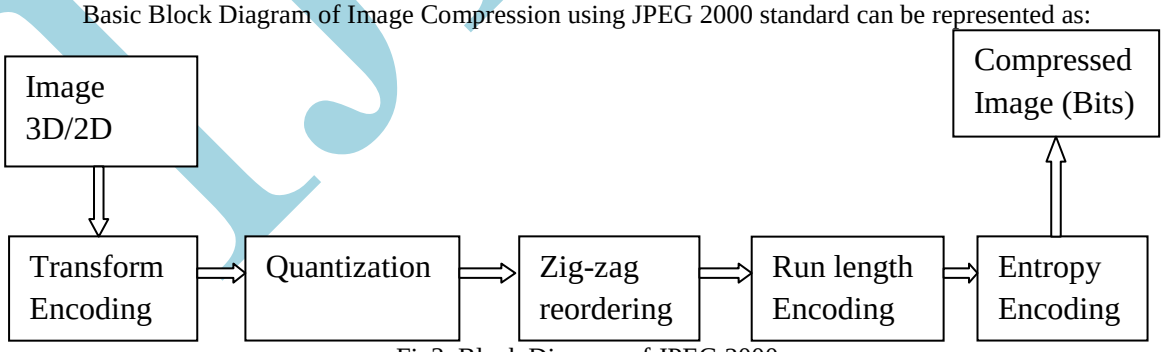


Fig3. Block Diagram of JPEG 2000

JPEG 2000 PROCESS

The Process of JPEG 2000 Standard is:

- The Image is broken into 8x8 Blocks of Pixels.
- Working from Left to Right, Top to Bottom, the DCT is applied to each Block.
- Each Block is compressed through Quantization.

$$C_{ij} = round(D_{ij} / Q_{ij})$$

- The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.
- When desired, the image is reconstructed through Decompression, a process that uses the Inverse discrete Cosine Transformation (IDCT).

### ADVANTAGES OF DCT OVER OTHER TRANSFORM

- DCT energy compaction is better than the other transforms.

 

- Because of availability of fast algorithms it is computationally simple.

SOM PROCESS

The process of SOM is:

- The Image is broken into blocks of Pixels.
- DWT is applied on original image.
- Quantization is applied on DWT image.

The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space. When desired; the image is reconstructed through decompression, a process that uses the Inverse discrete Wavelet Transform (IDWT).

Basic Block Diagram of Image Compression using Self Organized Feature Maps can be represented as:

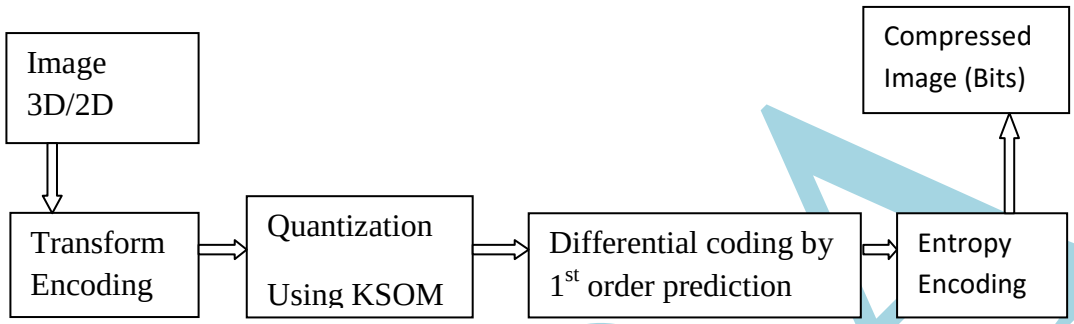


Fig.4: Block Diagram of SOM

The first step is same as the JPEG 2000 process in which the Transform Encoding such as DCT or DFT or Wavelet transform is applied on the input image. The Quantization using KSOM is applied which is done by using Vector Quantization. Then, differential coding is done by using 1st Predictor and Entropy Encoding method is applied to get the desired compressed image in the form of bits. At Last, the performance analysis of image compression using these algorithms is done by calculating PSNR values.

The peak signal-to-noise ratio (PSNR) is the ratio between a signal's maximum power and the power of the signal's noise. The PSNR is used to measure the quality of reconstructed images that have been compressed. Each picture element (pixel) has a color value that can change when an image is compressed and then uncompressed. Signals can have a wide dynamic range, so PSNR is usually expressed in decibels, which is a logarithmic scale.

## IV. RESULT

The image is first broken into 8x8 blocks and then the Discrete Cosine Transform and wavelet encoding used on each 8x8 blocks of an image. After the DCT, Uniform Quantization method is to be applied. Then, Zigzag Reordering can be done to convert the matrix obtained from the quantization technique to 1 D vector form and Run Length Encoding is to be applied on 1 D array to shorten the length of an array. At last, the Entropy encoding (Huffman Encoding) is applied to obtain the final compressed image in the form of bits. The image is reconstructed through decompression, a process that uses the Inverse discrete Cosine Transformation (IDCT).

Fig5. Original image

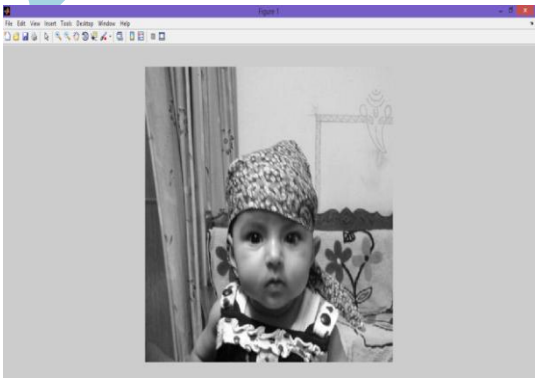

Fig6. Grayscale Image

 

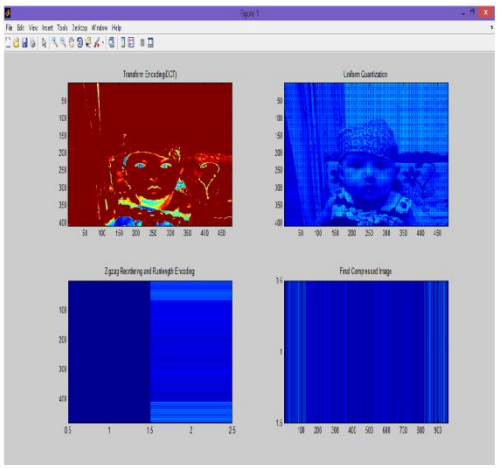

Fig7. Image Compression using JPEG 2000

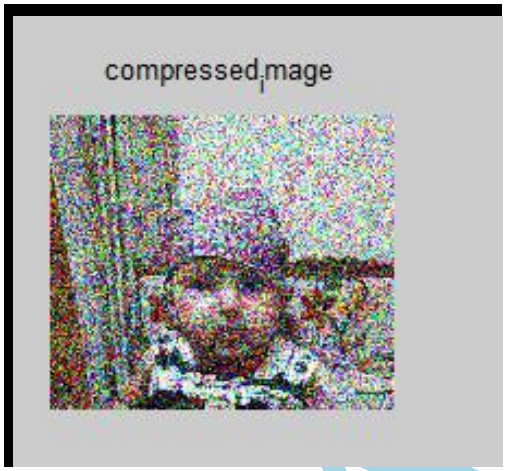


Fig8. Image Compression using SOM

**PEAK-SIGNAL-TO-NOISE RATIO:-**

The performance analysis of image compression using JPEG2000 method is to be done by calculating PSNR value and typical value for the PSNR in lossy image is between 20 and 50 d B where higher is better. The PSNR is often used as a quality measurement between the original and a compressed image. The higher the PSNR better the quality of the compressed or reconstructed image.

Processing steps of PSNR:-

1. Define the bel and decibel. The bel is defined mathematically as

$$LB = \log\left(\frac{p_1}{p_0}\right)$$

Where P1 and P0 are two quantizes that are in the same units of measurement. The decibel is 0.1 bel, so the decibel value LdB is

$$L_{dB} = 10\log_{10}\left(\frac{p_1}{p_0}\right)$$

2. Define the mean squared error (MSE) between two monochromatic images, where one image is considered to be an approximation of the other. The MSE can be described as the mean of the square of the differences in the pixel values between the corresponding pixels of the two images.
3. Express MSE mathematically from the description in Step 1. We therefore have

$$MSE = 1/mn\left[\sum I(i,j) - K(i,j)\text{^}2\right]$$

Where I and K are matrices that represent the images being compare. The two summations are performed for the dimensions "i" and "j." Therefore I (i,j) represents the value of pixel (i,j) of image I.

4. Determine the maximum possible value of the pixels in image I. typically, this may be given as (2^n) - 1 where n is the number of bits that represent the pixel. Thus, an 8-bit pixel would have a maximum value of (2^8) - 1 = 255. Let the maximum value for pixels in image I be MAX.
5. Express the PSNR in decibels. From Step 1, we have the decibel value $L_{dB}$ as

$$L_{dB} = 10\log_{10}\left(\frac{p_1}{p_0}\right)$$

Now let

P1 = MAX^2 and P0 = MSE. We have

$$PSNR = 10\log_{10}(MAX\text{^}2/MSE) = 10\log_{10}(MAX/(MSE)^$$

$$= 20\log_{10}(MAX/(MSE)\text{^}(1/2))$$

Therefore

$$PSNR = 20\log_{10}(MAX/(MSE)\text{^}(1/2))$$

So, the PSNR is calculated by using the formula

$$PSNR = 10.\log_{10}\left(\frac{MAX_1^2}{MSE}\right)$$

$$= 20.\log_{10}\left(\frac{MAX_1}{\sqrt{MSE}}\right)$$

And Mean Square Error, MSE can be calculated as

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left[I(i,j) - K(i,j)\right]^2$$

When the two images are identical, the MSE will be zero. For this value the PSNR is undefined. Where, $MAX_I$, is the maximum possible pixel value of the image. When the pixels are represented using 8 bits per sample, this is 255.

| S.NO | TECHNIQUE | PSNRvalue(dB) |
|---|---|---|
| 1 | DCT Based JPEG 2000 | 24.78 |
| 2 | Wavelet based Self organized maps | 30.80 |

Fig9. Peak-signal-to-noise Ratio

 

## V. CONCLUSION

The implementation of image compression using SOM can be done with the help of a codebook which can be generated and makes easier for the user to compress the images of high resolution. With the help of codebook we can store the images of different resolutions and compress them according to the requirements. The performance analysis of image compression using these both techniques is to be done by calculating PSNR values and typical values for the PSNR in lossy image and video compression are between 30 and 50 dB where higher is better.

The PSNR block computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher PSNR value becomes better quality of the compressed or reconstructed image.

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