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RESEARCH ARTICLE

COMPARATIVE ANALYSIS OF IMAGE COMPRESSION USING WAVELET TRANSFORM.

Dhanashri Kansal1[1], Dr.Hemant Kumar Gupta[2] and Dr. Rahul Srivastava[3].

1. M.Tech. Scholar Jaipur, Department of Electronics and Communication Engineering.
2. Professor, Department of Electronics and Communication Engineering, Arya College of Engineering & IT, Kukas, Jaipur.
3. Professor, Department of Electronics and Communication Engineering, Arya College, Kukas, Jaipur.

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Abstract

Recent advances in networking and digital media technologies have created a large number of networked multimedia applications. Uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. Despite rapid progress in mass-storage density, processor speeds, and digital communication system performance, demand for data storage capacity and data-transmission bandwidth continues to outstrip the capabilities of available technologies. The recent growth of data intensive multimedia-based web applications has not only sustained the need for more efficient ways to encode signals and images but have made compression of such signals central to storage and communication technology. Data compression which can be lossy or lossless is required to decrease the storage requirement and better data transfer rate. One of the best image compression techniques is using wavelet transform. It is comparatively new and has many advantages over others. Wavelet transform uses a large variety of wavelets for decomposition of images. The state of the art coding techniques like EZW, SPIHT (set partitioning in hierarchical trees) and EBCOT(embedded block coding with optimized truncation)use the wavelet transform as basic and common step for their own further technical advantages. The wavelet transform results therefore have the importance which is dependent on the type of wavelet used. In our project, we have used HAAR wavelets to perform the transform of different test image and the results have been discussed and analyzed. The analysis has been carried out in terms of PSNR (peak signal to noise ratio) obtained and time taken for decomposition and reconstruction.

Introduction:-

In the last decade, there has been a lot of technological transformation in the way we communicate. This transformation includes the ever present, ever growing internet, the explosive development in mobile communication and ever increasing importance of video communication. Data Compression is one of the technologies for each of the aspect of this multimedia revolution. Cellular phones would not be able to provide

Corresponding Author:- Dhanashri Kansal.
Address:- M.Tech. Scholar Jaipur, Department of Electronics and Communication Engineering.

communication with increasing clarity without data compression. Data compression is art and science of representing information in compact form. Despite rapid progress in mass-storage density, processor speeds, and digital communication system performance, demand for data storage capacity and data-transmission bandwidth continues to outstrip the capabilities of available technologies. In a distributed environment large image files remain a major bottleneck within systems. Image Compression is an important component of the solutions available for creating image file sizes of manageable and transmittable dimensions. Platform portability and performance are important in the selection of the compression/decompression technique to be employed.

Compression Techniques:-

Almost all data compression systems can be viewed as comprising four successive stages of data processing arranged as a processing pipeline (though some stages will often be combined with a neighboring stage, performed "off-line," or otherwise made rudimentary).

The four stages are

1. Preliminary pre-processing steps.
2. Organization by context.
3. Probability estimation.
4. Length-reducing code.

The ubiquitous compression pipeline (A-B-C-D) is what is of interest. With (A) we mean various pre-processing steps that may be appropriate before the final compression engine.Lossy compression often follows the same pattern as lossless, but with one or more quantization steps somewhere in (A). Sometimes clever designers may defer the loss until suggested by statistics detected in (C); an example of this would be modern zero tree image coding. (B) Organization by context often means data reordering, for which a simple but good example is JPEG's "Zigzag" ordering. The purpose of this step is to improve the estimates found by the next step. (C) A probability estimate (or its heuristic equivalent) is formed for each token to be encoded. Often the estimation formula will depend on context found by (B) with separate 'bins' of state variables maintained for each conditioned class. (D) Finally, based on its estimated probability, each compressed file token is represented as bits in the compressed file. Ideally, a 12.5%-probable token should be encoded with three bits, but details become complicated

Wavelet Compression Technique:-

Wavelets are functions thatare localized in both time and frequency and are used toefficiently represent data. The effectiveness of a wavelet is in its ability to make agood approximation of signals or data, but each wavelet hasa wide range of properties.Transformation of the Wavelet ischaracterized by excellent energy compaction and decor relationproperties. Wavelets are also tolerant withrespect to color intensity shifts, and can capture bothtexture and shape information effectively. Thegenerated image’s signature is constructed in thewavelet domain.

The parameter values used for construction and the resulting wavelet filter coefficients are kept secret. A problem with constructed parametric wavelet filters is that the high-pass/ low-pass sub-band property is partially lost.Image compression is a fast paced and dynamically changing field with many different varieties of compression methods available. Images contain large amount of data hidden in them, which is highly correlated. A common characteristic of most images is that the neighbouring pixels are correlated and therefore contain redundant information.

In wavelet image compression, parts of an image is described with reference to other parts of the same image and by doing so, the redundancy of piecewise self-similarity is exploited. There are a number of problems to be solved in image compression to make the process viable and more efficient. A lot of work has been done in the area of wavelet based lossy image compression. However, very little work has been done in lossless image compression using wavelets to improve image quality.

A picture can say more than a thousand words. However, storing an image can cost more than a million words. This is not always a problem because now computers are capable enough to handle large amounts of data. However, it is often desirable to use the limited resources more efficiently. For instance, digital cameras often have a totally unsatisfactory amount of memory and the internet can be very slow. In these cases, the importance of the compression of image is greatly felt. The rapid increase in the range and use of electronic imaging justifies attention for systematic design of an image compression system and for providing the image quality needed in different applications. Wavelet can be effectively used for this purpose. A low complex 2D image compression method using

Haar wavelets as the basis functions along with the quality measurement of the compressed images have been implemented here.

Computational Strategies:-
A typical lossy image compression system is shown in Fig. 1. five stages of compression and decompression are shown in Fig.2 Compression is achieved by applying a linear transform in order to de-correlate the image data, quantizing the resulting transform coefficients and entropy coding the quantized values.

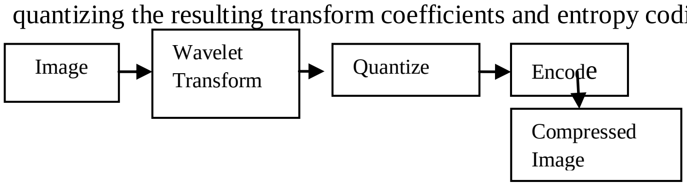

Fig. 1:- Compression of an image.

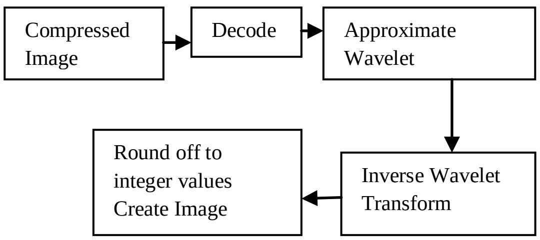

Fig.2:-Decompression of an image.

Transformation:-
The discrete wavelet transform cuts the image into blocks of 64 pixels (8 × 8) and processes each block independently, shifting and simplifying the colors so that there is less information to encode.

Quantization:-
The values in each block are then divided by a quantization coefficient. This is the compression step where information loss occurs. Pixels are changed only in relation to the other pixels within their block.

Encoding:-
The reduced coefficients are then encoded, usually with Huffman coding (entropy encoding that finds the optimal system of encoding based on the relative frequency of each character) with high compression ratio.
The purpose served by Wavelet transform is that it produces a large number of values having zero, or near zero magnitudes.

Result And Analysis:-

After compression of various test image signals the following results comes out. The table with test images, PSNR and MSE values given below.

Table 1:-Test Images with MSE and PSNR value.

S.No.	Test Image Name	MSE	PSNR
1	Mandrille	255	24.099397501897442
2	LenaTest3	251.4810	24.160835909394947
3	Barbara	254.9991	24.099413094414587
4	House	254.8972	24.101149411484780
5	Jetplane	254.9991	24.099413094414587
6	Lake	254.8637	24.101719584331633
7	Livingroom	252.1995	24.147426051319137
8	Peppers_gray	249.9550	24.186180988133790
9	Pirate	255	24.099397501897442
10	Walkbridge	254.2280	24.112565290804790

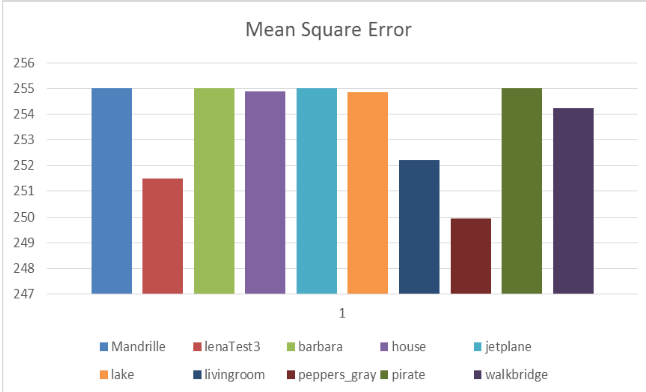

Fig 3:- Plot for different MSE value with Image test cases.

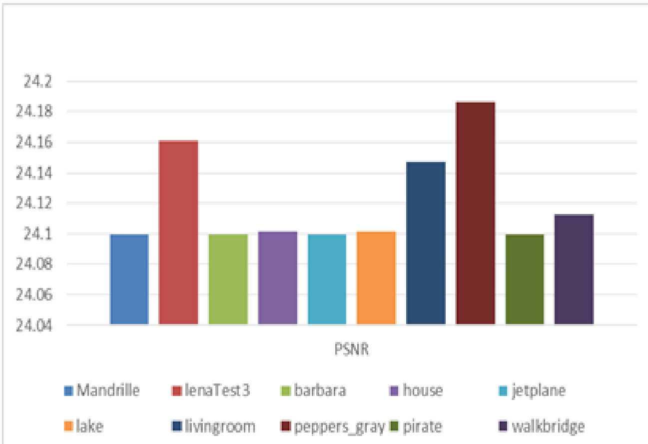

Fig 4:- Plot of PSNR with Different Image Test Cases.

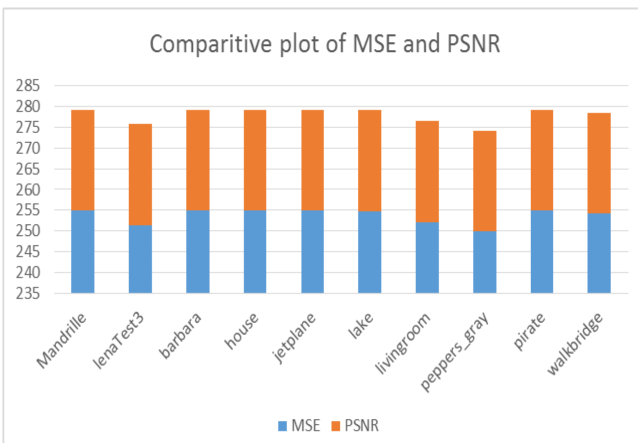

Fig 5:- Comparative Plot for MSE and PSNR

Conclusion and Future Work:-

In this paper, the work carried out with a modified digital signature scheme for image authentication. Content-dependent structural image features and wavelet filter parameterization are incorporated into the traditional crypto signature scheme to enhance the system robustness and security. The analysis and the experimental results confirm that the proposed scheme can achieve good robustness against transmission errors and some acceptable manipulation operations.This dissertation includes the development of computationally efficient and effective algorithm for lossy image compression using wavelet techniques. The promising results obtained concerning reconstructed image quality as well as preservation of significant image details, while on the other hand achieving high compression rates. Some of the applications require a fast image compression technique but most of the existing technique requires considerable execution time and memory requirement. Results show the reduction in encoding time without degradation in image quality compared to existing methods. While comparing the developed method with proposed method memory requirement and execution time is also decreased.

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