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An Efficient and Secure Fractal Image and Video Compression

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ABSTRACT: The image compression is to decrease the size of graphical file without disturbing its quality. Depending on the compression ratio the reconstructed image has to be exactly same as the original or some unspecified loss may be cause. Image and Video compression is a fundamental technology in multimedia and digital communication fields. Ideally, an image compression technique removes redundant and dissimilar information, and efficiently encodes what remains. It is necessary to throw away both on redundant information and related information to achieve the compression. The existing image compression algorithm is based on the relationship between adjacent pixels and therefore the compression ratio is not high. But the correlation not only exists in adjacent pixels within a local region, but also in unlike regions and local regions with global regions. The fractal scheme is based on the self-similarities that are built in many real world images for the reason of encoding an image as a collection of transformations. The combined DCT and Fractal Image Compression approach is used to perform the video compression with scalability vector. The experimental result of proposed scheme shows the effectiveness in compressing the color images and videos. Also, a comparative analysis is performed to prove that the system is competent to compress the images in terms of PSNR, SSIM and UIQI measurements.

KEYWORDS: Image compression, Discrete Cosine Transform, Fractal Image Compression, Peak Signal to Noise Ratio (PSNR), Universal Image Quality Index (UIQI) and Structural Similarity Index (SSIM).

I. INTRODUCTION

Image processing is a quickly developing field with universal use in the area of mobile technology. A rising number of products like cellular phones, smart phones, laptop computers and cameras used in transmit and receive videos and images by means of moveable wireless devices. The requirement of efficient techniques that can store and transmit visual information has been increased by the growing use of color images as well as video in the continuous growth of multimedia application. Image compression can reduce the size in bytes of a graphics file without spoiling the quality of an image away from acceptable limits. It also, reduces the time taken to send images via the Internet or downloaded from web pages. Fractal compression scheme is proposed to meet both the efficiency of the reconstructed image as well as video quality necessities. This scheme is based on the fact that the affine comparison between two image blocks is equivalent to the Discrete Cosine Transform(DCT). It operates by splitting image into differing frequency parts[3]. Fractal image compression comes under the type of lossy compression among the two types in Image Compression methods. The main aim is to divide the image into segments by using typical image processing techniques such as color partition, edging, spectrum and quality analysis. Then each segment in the given image is looked up in a library of fractals. Image compression methods can also be divided as two different types one is symmetrical and another is asymmetrical.

Fractal image compression is the asymmetrical methods. Fractal algorithm can be used to deal with both encoding and decoding methods and here Fractal encoding is mainly used to convert bitmap images to fractal codes. Two important benefits are immediately observed by converting conventional bitmap images to fractal data. The first is the capacity to modify the division of fractal images. The second benefit is that there will be particular size of the data for each and every image and this size of data in a given input image will be used to store the fractal codes which are smaller than the size of original data in an image. Then the process of matching fractal is done with the fractal codes. This process will not look for exact matches, but it will look for 'best fit' matches based on the compression

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parameters[2]. The process of Fractal Video Compression is similar as Fractal Image Compression. The main difference between them is that, the video compression takes advantage of the similarity between consecutive frames and hence it obtain higher compression rates, if compared with image compression. In proposed method, the color image can be compressed using DCT and to avoid compression on similar blocks of the image, Fractal image compression is used. The self similarity of the image blocks can be calculated using an Euclidean distance. Then powerfully encode the image using Huffman encoding. The rest of the paper is organized as follows: Section II describes some of the literature survey of different compression techniques and briefs about the fractal image compression process. The proposed methodology is described in section III. Experimental results and analysis of the proposed methodology are discussed in section IV. Finally, concluding explanation provided in section V.

II. RELATED WORK

The technique of Genetic Algorithm (GA) is useful for Fractal Image Compression (FIC) to decrease the search complexity of similarity between range block and domain block. The image compression techniques in the spatial domain is Fractal Image Compression but the main limitation of FIC is that it has a more computational time due to global search. In order to recover the computational time and also the appropriate quality of the decoded image, Genetic algorithm is developed. The Genetic Algorithm is a superior method than the acceptable exhaustive search method[7].

The research done by William Robson Schwartz's this method is based on robust feature descriptors to speed up the encoding time. The classification search approach is based on a quad-tree technique. For each level of the quad-tree decomposition, domain blocks are group mutually and only those belonging to the closest of that group to a given range block are considered as candidates to a match. The use of strong features provides more characteristic and typical information for regions of the image. When the regions are better represented, the search for analogous parts of the image can be reduced to main focus only on the most similar matching region, which gives to decrease the computational time. It reduces the encoding time while keeping high compression rates and rebuilding quality[5].

The combined DWT-DCT approach to perform Video compression based of Frame Redundancy[4] is about the up-down sampling based approach. It is used to achieve the video compression with scalability vector. The DWT will achieve the adaptive filtering and DCT will use these weighted values as DCT coefficient. The DCT and DWT approach will give the high degree of compression ratio. It will gives the compression approach to decrease the media size and develop the DCT and fractal image compression techniques[3]. DCT is used to compress the color image while the repetitive compression of similar blocks. Similar blocks are found by using the Euclidean distance measure. Video compression is improved based on frame similarity and the correlation. In this method the given image is encoded by means of Huffman encoding technique.

Absolute Pearson's correlation coefficient (APCC) is based similarity between two blocks in FIC is equivalent to absolute value of APCC on the among them. First, all blocks in the range and domain pools are selected and classified using an APCC-based block classification method to enhance the matching possibility. Second, by sorting the domain blocks with respect to APCCs between these domain blocks and a specific block in each class, the identical domain block for a range block can be searched in the elected domain set in which these APCCs are closer to APCC between the range block and the preset block. It speed up the encoding process in FIC though preserving the reconstructed image quality well[1].

Vijaya-Prakash and Gurumurthy have proposed a technique namely as A novel VLSI architecture for digital image compression using DCTQ to increase the data compression technique. To performing image compression a new DCT and Quantization (DCTQ) architecture have been designed. Compression of image data might be achieved by utilizing the DCT which is a kind of image transform and performing quantization of the DCT data coefficients[6].

III. PROPOSED SYSTEM

The Proposed System consist of two modules, one is the Compression and other is the Decompression. Videos consist of number of frames , and each frame is nothing but the image. Compression of individual video frames is performed by a few applications of two-dimensional DCT. Compression of video streams is the most ordinary application of multidimensional DCT. The proposed system use DCT to compress the image as well as video. The first

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stage of the proposed system is to convert the video into the number of frames and each frame is nothing but the block image which will be the input to image compression, Then the coefficients of a DCT are linearly quantized by dividing into a predetermined quantization step. The Proposed System is describe in details are as follows:

a) Quantization:

The Quantization process minimizes the number of bits required to characterize a quantity by minimizing number of possible values of the quantity. A range of values are compressed to a single quantum value to complete quantization. The stream becomes more compressible as the number of discrete symbols in a specific stream is reduced.

b) Zig-Zag Scaning:

The entire quantized coefficients are rearranged in a zig-zag style, after the coefficients of DCT are quantized. Most of the high frequency coefficients (lower right side corner) be converted into zeros after quantization. A zig-zag scan of the matrix giving long strings of zeros is used to exploit the number of zeros. The current coder acts as filter and passes only the string of non-zero coefficients. A list of non-zero tokens for each block proceed by their count will be obtained at the end of this process[3].

c) Factral Image Compression:

The property of self-similarity of fractal items is used by fractal compression and fractal encoding. Some of the blocks obtain by dividing the colour image into several 8*8 blocks are similar. So, the Concept of fractal image compression is used to avoid performing repetitive compression on the same block. It is used to encode the quantized image blocks. Similar blocks in a input image are identified using FIC. The corresponding domain blocks for each range block in an image are defined. The Euclidean distance measure is used to calculate the similarity between image.

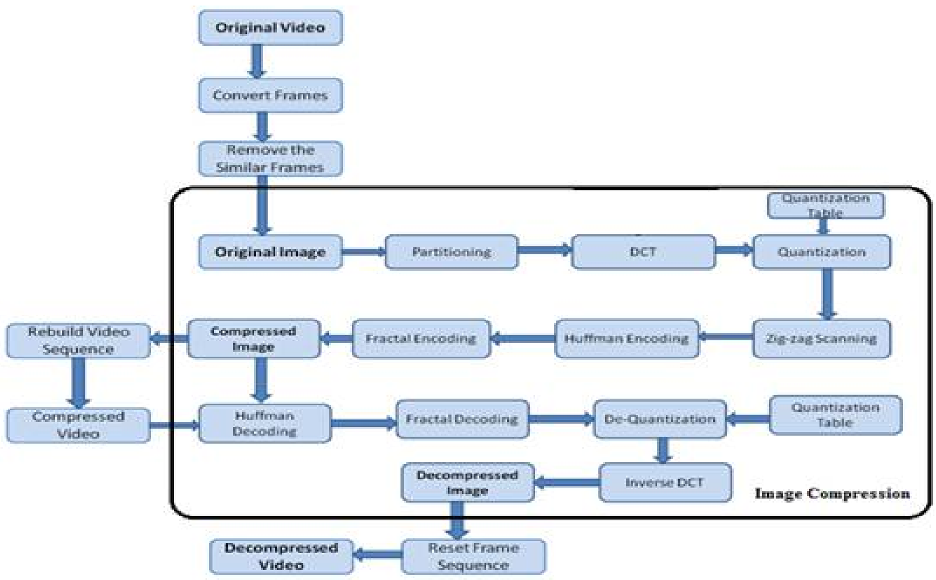

Figure 1. System Architecture of Image and Video Compression using DCT and FIC.

d) Entropy Encoder:

The quantized values are additional compressed by a lossless entropy encoder to give a better overall compression. For each quantized value , an output code stream that is lesser than the input stream is produced by using a model to accurately determine the probabilities. Huffman Encoder and Arithmetic Encoder are the most usually used entropy encoders. Entropy encoding is a lossless data compression technique. The proposed system is using Huffman Encoder[3].

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e) Decompression Process:

The decompression process is quite simple. It first decode the fractal parameters and repeatedly transform an arbitrary image by fractals. A DCT domain fractal estimate of the original image is produced by this process. To get the decompressed image by decoding the Huffman code and de-quantizing it. Finally, it gets the decompressed image by transforming the addition of the fractal approximation and the decompressed image by inverse 2D DCT.

IV. EXPERIMENTAL RESULTS

The proposed method is compared with the known image compression standard such as DCT with JPEG Compression with particular image qualities. The proposed method give better result than DCT with JPEG. There are few blocking artifacts in the decompressed image of the proposed method, but the blocking artifacts come out only when increase the threshold value. At lower threshold value the image quality is fine when compared to JPEG. The test image used in experiments include: Lena, Barbara, Baboon and Peppers. The Quality of the reconstructed image was determined by measuring the PSNR, SSIM and UIQI values and compression efficiency of the proposed system in terms of compression ratio.

A) PSNR

The Peak Signal to Noise Ratio (PSNR) is the ratio between a signal's maximum power to the PSNR based on the Mean Square Error (MSE) is used as a quality measure.

PSNR		
Image	Existing JPEG System	Proposed Fractal System
lenna	27.672	34.59
Baboon	30.032	37.54
Barbara	26.984	33.73
Peppers	27.04	33.8
Img(133)	25.928	32.41
Img(127)	27.432	34.29

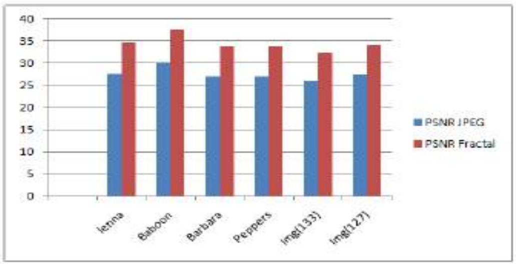

Fig2.PSNR comparison between the Existing JPEG and Proposed System of Image

PSNR		
Image	Existing System	Fractal System
Newstar	23.580479	29.475601
quetzal	49.987	63.275
snowflake	47.34	59.178
swirlique	26.30419	32.880234
Composite	51.5845	65.5495

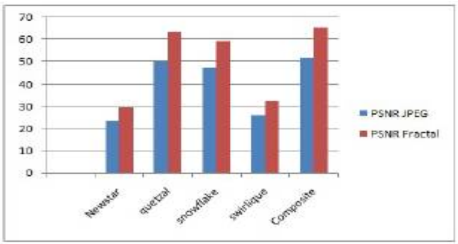

Fig3. The PSNR comparison between the Existing JPEG and Proposed System of Video

B) UIQI

Universal Image Quality Index is the one of the many techniques to measure the image quality. The UIQI is calculated by modelling any image distortion as a combination of three factors: loss of correlation, luminance distortion, and contrast distortion. The universal image quality index for each block can be calculated for the UIQI measurement.

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UIQI		
Image	Existing JPEG System	Proposed Fractal System
lenna	0.12991999	0.16239999
Baboon	0.17712	0.2214
Barbara	0.116160005	0.1452
Peppers	0.1172	0.14649999
Img(133)	0.09503999	0.1188
Img(127)	0.12504	0.15630001

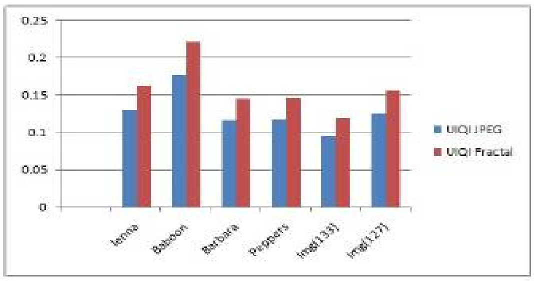

Fig4.UIQI comparison comparison between the Existing JPEG and Proposed System of Image

UIQI		
Image	Existing System	Fractal System
Newstar	0.048070397	0.060087994
quetzal	0.1632	0.20663
snowflake	0.0999	0.1246
swirlique	0.10253713	0.12817143
Composite	0.199	0.252

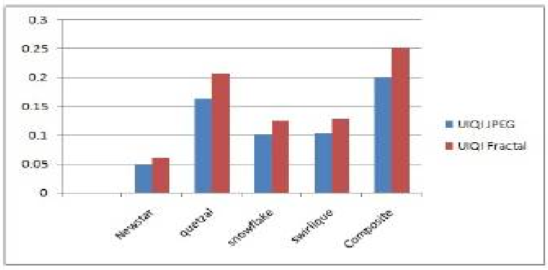

Fig5. The UIQI comparison between the Existing JPEG and Proposed System of Video

C) SSIM

One of the many techniques to measure the quality similarity between two images is called Structural Similarity (SSIM) index. The SSIM index is measure the image quality based on an initial uncompressed or distortion-free image as reference. It is the similarity measure that of pixel intensities that have been normalized for luminance and contrast.

SSIM		
Image	Existing System	Proposed System
lenna	0.1446129	0.18076612
Baboon	0.18942098	0.23677623
Barbara	0.13153383	0.16441728
Peppers	0.13255483	0.16569355
Img(133)	0.11147146	0.13933933
Img(127)	0.13996527	0.17495659

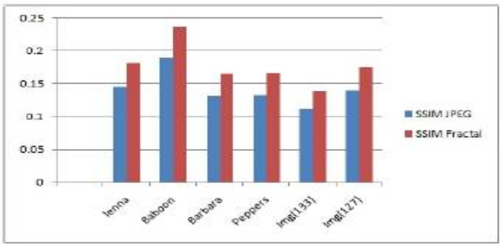

Fig6.SSIM comparison between the Existing JPEG and Proposed System of Image

SSIM		
Image	Existing System	Fractal System
Newstar	0.06684926	0.083561584
quetzal	0.1969	0.2492
snowflake	0.137	0.1713
swirlique	0.11858757	0.14823444
Composite	0.241	0.2924

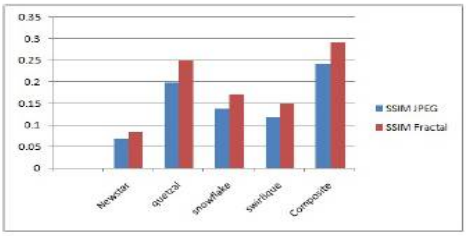

Fig7.SSIM comparison between the Existing JPEG and Proposed System of Video

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V. CONCLUSION AND FUTURE WORK

An efficient and secure fractal image and video compression can be used efficiently to compress images and video using DCT. Generally, the DCT based compression technique produce some blocking artefacts. Here, the artefacts can be removed by utilizing the fractal image compression method. Also, the self similarities between the analogous blocks can find by using the Euclidean distance measure. So, this eliminates the continual compression of analogous blocks. From the experimental results, the proposed system is efficient in compressing the images. Also, the proposed system technique successfully compress the images and video with high PSNR value, SSIM index and the UIQI value.

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