Oscillation Concept for Image Compression

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Abstract— **In biomedical image analysis image compression has immense importance as time consumption is very high to process out the Original biomedical image. it becomes necessary to compress the image to reduce processing time required to retrieve target components from biomedical images. In order to compress image different techniques are used. All those techniques are classified in to lossy compression And Lossless compression techniques. Amongst these methods lossy compression schemes are not used due to possible loss of useful clinical information and as operations like enhancement may lead to further degradations in the lossy compression. While lossless schemes avoids above mentioned drawbacks of lossy compression technique. But no lossless compression algorithm can efficiently compress all possible data. For this reason, multiple algorithms exist that are designed either with a specific type of input data in mind or with specific assumptions about what kinds of redundancy the uncompressed data are likely to contain.**

In order to balance the advantages of lossy as well as lossless compression technique paper is proposing Oscillation concept for medical image compression.

***Keywords*—Oscillation algorithm; Compression ratio; Principle component.**

I. INTRODUCTION

Medical image compression has an important role in hospitals as they are moving towards filmless imaging and go completely digital. To reduce the file size for storage requirement purpose Picture Archiving and Communication Systems (PACS) is used. Which maintain relevant diagnostic information [5]. Medical imaging produces the great challenge of compression algorithms. The special care has to be taken while compressing the data to avoid diagnostic errors and yet have high compression rates for reduced storage and transmission time [4]. This paper outlines the new approach to biomedical image compression using oscillation concept. It introduces the theory of oscillations in images. Proposed theory states that in every image it has variations in pixels with respective to x and y axis of an image. These variations are nothing but oscillations at image. Appropriate oscillations can be utilized for image compression. In this paper we are applying this oscillation theory to a biomedical image. This method supposed to show effective compression ratio.

2. Compression technique

The one of the application of data compression is an image compression which encodes the original image. For the compression of an image innovative lossy compression technique for biomedical image compression providing high compression ratio is introduced in this paper.

2.1 The objectives of an image compression are :

a. To reduce the redundancy of an image.

b. To store or transmit data in an efficient manner. c. To find out oscillations in a biomedical image.

d. To extract principle component of biomedical image using oscillations.

e. To achieve maximum compression ratio of biomedical image.

2.2 Principle components Analysis (PCA):

Principal component analysis (PCA) belongs important features as ,

a. Linear transforms based statistical techniques.

b. Powerful tool for pattern recognition and data analysis which is normally used in an image and signal processing as a technique for data compression [4].

2.3 Picture Archiving and Communication System(PACS):

Now a days modern hospitals are having PACS and it plays vital role in image compression. It enables presentation, processing, communication, storage of medical images and corresponding data. Digital medical images tend to occupy enormous amount of storage space. There are large amount of digital images in modern hospitals, so the volume of medical images reaches to hundreds of petabytes and is still increasing. Due to the increased demand for digital medical images, image compression is introduced for medical imaging. It relaxes requirements like storage and network of a PACS, and reduces the overall cost of the system [5].

2.4 Lossy Compression Techniques

Lossy compression leads to loss of some information. If an image reconstructed by using lossy compression scheme it contains losses as compare to the baseband signal or original information. It happens due to the compression scheme which completely removes redundancy from the information. However, lossy techniques are capable for achieving much higher compression. The compressed image is same as to the original uncompressed image but not just like the previous, as in the process of compression some concerning information of the image has been lost. Lossy compression technique provides a higher compression ratio than lossless. The performance analysis of a lossy compression scheme include important considerations like Compression ratio (CR), Signal to noise ratio(SNR) and Speed of encoding & decoding.

II. LITERATURE REVIEW

In paper "Performance superiority of hybrid dkt-dct wavelet compared to dkt, dct individual transforms and their wavelets in image compression" by H.B. Kekre and Tanuja Sarode, they propose simple and novel image compression method

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using transforms. Discrete cosine Transform (DCT) and Discrete Kekre Transform (DKT) are applied on image individually. Wavelet transform of DCT and DKT is generated using Kekre's algorithm of wavelet generation. Wavelet transform gives better energy compaction than individual transform. It is reflected in reconstructed image quality of wavelet transforms. Further hybridization of two transform is used and hybrid wavelet transform using DKT and DCT is generated and applied on images. It combines properties of both, Kekre transform and DCT. Hybrid wavelet transform gives lesser error than wavelet transform and individual orthogonal transform. This paper proposes superiority of DKT-DCT hybrid wavelet transform over respective wavelet transforms and individual orthogonal transform.[1]

In the paper "Image Compression Using the Discrete Cosine Transform" by *Andrew B. Watson* The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components. It is widely used in image compression. Here we develop some simple functions to compute the DCT and to compress images.These functions illustrate the power of *Mathematica* in the prototyping of image processing algorithms. In this article, they developed some simple functions to compute the DCT and show how it is used for image compression. they used these functions in our laboratory to explore methods of optimizing image compression for the human viewer, using information about the human visual system . The goal of this paper is to illustrate the use of *Mathematica* in image processing and to provide the reader with the basic tools for further exploration of this subject.[2]

In the paper "Query based Image Retrieval using Kekre's, DCT and Hybrid wavelet Transform over 1st and 2nd Moment" by H. B. Kekre and Kavita Sonawane. In this paper, they describe the novel techniques to retrieve similar images from large volume of databases based on contents. Feature extraction strategy of the proposed system is based on transform domain. Three different techniques are used to extract the image features using three transforms namely Kekre's transform, Discrete Cosine transform and Hybrid wavelet transform which is constructed using combination of DCT and Kekre's Transform. Experimental results obtained using these three approaches for 100 queries using database of
1000 bmp images. Results are obtained in two levels. Level 1 gives results for R, G and B plane separately, Level 2 combines these results by taking combination of three planes based on three different criteria. [3]

In the paper "Robust watermarking technique using hybrid wavelet transform generated from kekre transform and discrete cosine transform" by Dr. H. B. Kekre, Dr. Tanuja Sarode, Shachi Natu. This paper presents a novel image watermarking technique using Kekre's algorithm to generate hybrid wavelet transform DKT_DCT from Kekre transform and Discrete Cosine Transform. In the proposed technique, 256x256 hybrid transform is generated using 16x16 Kekre transform and 16x16 DCT whereas, 128x128 hybrid wavelet transform is generated using 32x32 Kekre transform and 4x4
DCT matrix. Generated DKT_DCT transform is applied to host and watermark in three different ways: column wise, row wise and full transform. Performances of these three ways of applying transform are compared against various image processing attacks namely image cropping, image compression, adding noise and image resizing attacks. Column DKT_DCT transform is most robust for compression and resizing attack whereas row DKT_DCT wavelet transform is most robust for cropping, JPEG compression attack and binary distributed run length noise attack for increased run length. Column and row DKT_DCT transform show exceptionally better performance than full DKT_DCT wavelet transform. Also column DKT_DCT transform is observed to be better than column DCT wavelet transform for above mentioned attacks and row DKT_DCT wavelet is better than row DCT wavelet for binary distributed run length noise attack showing the strength of hybrid wavelet transform over wavelet transform generated from same component orthogonal transform matrices.[4]

In the paper "Digital Image Compression using Hybrid Transform with Kekre Transform and Other Orthogonal Transforms" by H.B. Kekre, Tanuja Sarode, Prachi Natu, they presents image compression technique using hybrid transform. Concept of hybrid wavelet transform can be extended to generate hybrid transform. In hybrid wavelet transform first few rows represent global features of an image and remaining rows represent local features of an image. In Hybrid wavelet matrix rows contributing to global characteristics can be varied. In the limiting case by taking kronecker product of to orthogonal component transforms, hybrid transform is generated where all rows of transform matrix represent global features and no local features are present. This hybrid transform matrix is then applied on color image. High frequency contents of transformed image are eliminated and only low frequency contents are retained to get compressed image. RMSE is calculated at different compression ratios to check the performance of hybrid transforms. Various orthogonal transforms like DCT,Walsh, Slant, Hartley, Real- DFT and DST are combined with Kekre transform to generate hybrid transforms. DKT-DCT gives better image quality and lower RMSE than other pairs formed with DKT. Component size 32-8 i.e.32x32(Kekre Transform) and 8x8 (DCT) gives best results than other possible size combinations like 8-32,16-16 and 64-4.
[5]

In the paper"Jpeg Image Compression Using Discrete Cosine Transform - A Survey" by A.M.Raid, W.M.Khedr, M. A. El- dosuky and Wesam Ahmed,they compute the number of bits per image resulting from typical sampling rates and quantization methods, they find that Image compression is needed. Therefore development of efficient techniques for image compression has become necessary .This paper is a survey for lossy image compression using Discrete Cosine Transform, it covers JPEG compression algorithm which is used for full-colour still image applications and describes all the components of it.. This survey paper has been focused on the Fast and efficient lossy coding algorithms JPEG for image Compression/Decompression using Discrete Cosine transform. [6]

III. SYSTEM DEVELOPEMENT

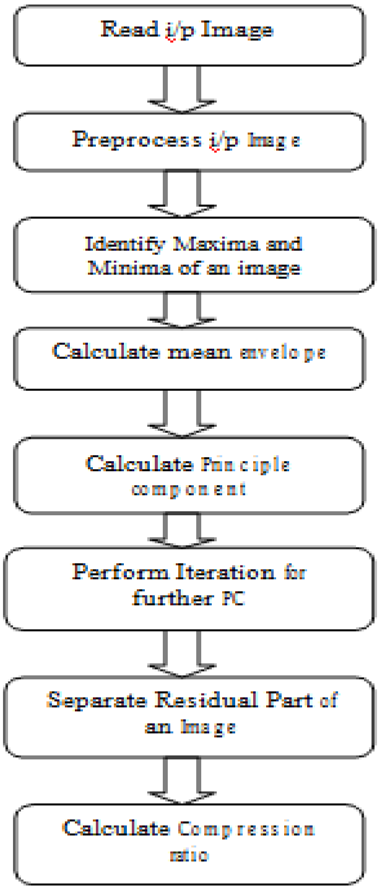

Fig.1 System flow of proposed system

3.1 Pre-processing of an image:
Pre-processing of an image includes resizing of an image. The basic condition for any image processing algorithm is that images must be of same size for processing purpose. Hence in order to process out any image with respective algorithm we resize the image. The size can be fixed like (256*256) or (512*512) [1].

3.2 De-noising of an image:
It's necessary to have quality images without any noise to get accurate result. Due to the noisy image your algorithm may lead towards inaccurate result. So it becomes necessary to de-noise an image. So, de-noising becomes essential. To de-noising an image different methods and algorithms are used. Removing the noise while preserving edges is the main property of a good image de-noising model. Basically, linear models have been used. To de-noise the image we can use median filter. For smoothening of an image Median filter is one of the famous method [2].

3.3 Identify local maxima and minima in an input image:
To found the maxima and minima of an input image. For continuous function we have maximum or minimum value in an interval and these values are not absolute maximum or minimum of the function. So, we sometimes call them as local maxima or local minima [7,8].

3.4 Deduce an upper and a lower envelope by interpolation:
By interpolating between maxima ending up with some envelope called it emax(t) and minima ending up with some envelop called emin(t).

3.5 Calculating the mean envelope:
After deducting an upper and a lower envelope by interpolation and calculating maxima and minima ending up we can get mean envelope.

$$m(t) = (emax(t) + emin(t))/2 \quad \text{eq. 1}$$

3.6 Extracting the principle components:
After compression of an image we are bringing out the principle components.

$$p(t) = x(t) – m(t) \quad \text{eq. 2}$$

3.7 Compression ratio can be calculated by taking ratio of principle component file size versus original file size. there are three compression ratio for three principle components .

By calculating the 1st principle component we can continue the iterations till we get better quality. The total number of iterations are proportional to compression ratio of biomedical image. In this paper we have calculated principle components till three iterations.
up to third component it shows good quality of an image. but beyond that though compression ratio goes on increasing although the quality of an image gets degraded. hence iterations are done till third principle component only.

Oscillation based principle component extraction algorithm : The proposed methodology suggests that every image can be considered as non-stationary with respect to x-axis & y-axis
by considering variations in pixel values. This concept provides attempt to analyze frequency information evolving with time and identifying the amount of variation due to oscillation at different scales and locations with respect to time in a target biomedical image. By focusing on principle oscillations in a input image we can achieve principle part of the same target image. Doing number of iterations over extracted part, methodology can extract more principle part from image. The process of oscillation detection and extraction should be continued till image gives good quality of principle component [7].
The proposed methodology proves that it gives quality extraction with extraction of principle component. It provides better level of compression. It can be seen from results that with increasing iteration level umber of principle components can be achieved. the principle component with ascending order shows increase in compression ratio. but to find mid of compression ratio and image quality principle component up to third iteration gives better results.

IV. Results

Image	File Size in Kb	Compression ratio(%)
Original Image	31.4	N.A
PC 1	12.8	40.70
PC 2	7.8	24.78
PC 3	5.17	16.43

The proposed algorithm shows maximum compression ratio. With the more number of iteration of principle extraction it can achieve highest compression ratio as compared to other compression techniques. But iterations have to be limited up to the extent where we get good quality of compressed image. Hence we have calculated up to the 3 iterations where we are getting good quality of compressed image.

V. CONCLUSION

Oscillation based Principle component extraction for biomedical image compression can achieve maximum compression ratio with good quality. It provides flexibility to end user to use any principle component according to his/her requirement and application. Increasing count of principle component with iteration gives more compression ratio. but to have media between compression ratio and quality of an image it becomes necessary to restrict iteration of an algorithm.

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