REGION OF INTEREST BASED COMPRESSION OF MEDICAL IMAGE USING DISCRETE WAVELET TRANSFORM

Sudeepti Dayal and Neelesh Gupta

Rajiv Gandhi Proudhyogiki Vishwavidhyalaya, Bhopal, India

ABSTRACT

*Image abbreviation is utilized for reducing the size of a file without demeaning the quality of the image to an objectionable level. The depletion in file size permits more images to be deposited in a given number of spaces. It also minimizes the time necessary for images to be transferred. There are different ways of abbreviating image files. For the use of Internet, the two most common abbreviated graphic image formats are the **JPEG** formulation and the **GIF** formulation. The **JPEG** procedure is more often utilized or photographs, while the **GIF** method is commonly used for logos, symbols and icons but at the same time they are not preferred as they use only 256 colors. Other procedures for image compression include the utilization of **fractals** and **wavelets**. These procedures have not profited widespread acceptance for the utilization on the Internet. Abbreviating an image is remarkably not similar than the compressing raw binary data. General-purpose abbreviation techniques can be utilized to compress images, the obtained result is less than the optimal. This is because of the images have certain analytical properties, which can be exploited by encoders specifically designed only for them. Also, some of the finer details of the image can be renounced for the sake of storing a little more bandwidth or deposition space. In the paper, compression is done on medical image and the compression technique that is used to perform compression is discrete wavelet transform and discrete cosine transform which compresses the data efficiently without reducing the quality of an image.*

KEYWORDS

JPEG formulation, GIF formulation, fractals, wavelets, PNG arrangement, PSNR, MSE

1.INTRODUCTION

One of the important aspects of image deposition is its efficient and effective abbreviation. An image, 1024 pixel x 1024 pixel x 24 bit, without any abbreviation, would need 3 MB of deposition space and 7 minutes for transmission, by employing a high speed, 64 Kbit/s, ISDN line. If the image is compressed at a compression ratio of 10:1, the deposition requirement is reduced to 300 KB and the transmission time comes down to below 6 seconds. Seven 1 MB images can be compressed and transferred to a floppy disk in a very less time comparatively takes to transfer one of the original files. In a distributed environment, big image files still remain a major concern within systems. Compression is an important and beneficial technique of the solutions available for creating file sizes of manageable and transmittable dimensions. Increasing the bandwidth is another suitable method, but due to its cost sometimes makes less attractive or demanding solution.

At the existing state of technology, the only outcome is to compress multimedia data before its deposition and transmission, and de-compress it at the receiver terminal for play back. For example, with a compression ratio of 32:1, transmission time requirements, the space and bandwidth can be reduced by a factor of 32, with acceptable quality. A common characteristic

feature of most of the images is that the adjoining pixels are associated and therefore consists of redundant information. The foremost task then is found to be less correlated representation of the image.

Figure1.Stages of image compression

Image compression pinpoints the obstacle of reducing the amount of data needed to represent a digital image. The advantage of the reduction process is the elimination of redundant data. The compressed form of the image is decompressed at some future time, to rebuild the real image or an approximation to it.

Two fundamental elements of compression are:

Redundancy reduction- targets at eliminating duplication from the signal source.

Irrelevancy reduction-discards parts of the signal that are considered by the signal receiver, especially the Human Visual System (HVS).

1.1.Different Classes of compression Techniques

There are two forms of categorizing compression procedures are mentioned here.

Lossless vs. Lossy compression: Under this type of compression arrangement, the rebuilt image, after compression, is numerically similar to the real image. However lossless compression can only access a modest amount of compression. An image rebuilt following lossy compression [6] consisting degradation relative to the real. Often this is because of the compression arrangement completely discards redundant information. However, lossy patterns are capable of obtaining much higher compression. Under standard regarding conditions, no visible loss is recognized (visually lossless).

The information loss in lossy coding gets from quantization of the data. Quantization can be explained as the procedure of sorting the data into various bits and representing each bit with a value. The value selected to represent a bit is called the reconstruction value. Every item in a bit has the similar reconstruction value, which leads to the information loss (unless the quantization is so fine that every item gets its own bit).

Predictive vs. Transform coding: In predictive coding, information transferred or available is utilized to predict later values, and the difference between them is to be coded. Since this can take place in the image or spatial domain, it is comparatively simple and easier to execute and is readily adapted to local image. Differential Pulse Code Modulation (DPCM) is one of the significant examples of predictive coding. On the other hand, first transforms the image from its spatial domain representation to a different kind of representation by utilizing some well-known transform and then codes the transformed values (coefficients). This procedure offers greater data compression as compared to that of predictive procedures, although at the expenditure of greater computation.

1.2. Image Compression Process

It contains three closely connected elements: (a) Entropy Encoder (b) Quantizer, and (c) Source Encoder. Compression is proficient by applying a linear transform to de-correlate the image data, quantizing the proceeding transform coefficients, and entropy coding are form of the quantized values.

Figure2. Compression process

Source Encoder (or Linear Transformer):

Throughout the years, a variation of linear transforms have been developed which includes Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform and several other alternatives, each have its own merits and demerits. The source encoder eliminates the redundancy in the binary sequence at the receiver side.

Quantizer:

A quantizer rounds off or reduces the number of bits required to store the transformed coefficients by reducing the exactness of those values. Since this is a form of many-to-one mapping, it is a lossy process and is an important source of compression in an encoder. Quantization that can be operated on each individual coefficient is known as Scalar Quantization (SQ). Quantization that can be operated on a group of coefficients together is known as Vector Quantization (VQ). Both the types, uniform as well as non-uniform quantities can be utilized depending on the problem at hand.

Objective:

One goal is to compile an introduction to the subject low complexity low memory image abbreviation.

Another goal is to evaluate the performance of video encoder with respect to PSNR, computation time, Compression ratio. These elements are chosen as they have the largest impact on execution effort.

Entropy Encoder:

An entropy encoder later on abbreviates the quantized values lossless to give better overall compression. It utilizes a model to precisely evaluate the possibilities for each quantized value and introduces a detail code depend on these assumptions such that the total output code stream is smaller than the input stream. The most frequently utilized entropy encoders are the arithmetic encoder and the Huffman encoder, for fast execution response, simple run-length encoding (RLE) has satisfied very effective and efficient too.

To get the best possible compression, it is note worthy that an accurately designed entropy encoder and quantizer is absolutely mandatory along with optimum signal transformation.

2. Medical Imaging

With the fast growing technology in image compression some researchers extracted some advantageous and fruitful methods of storing medical images digitally [2]. They realized that number of digital data can be stored further in the computer by compressing the original data or an image so that no essential information is lost and the size gets reduced without affecting the quality of an image. They further subdivided an image into two categories namely:

1. ROI (Region of interest)
2. Non-ROI

Medical Imaging is the technique of generating visual illustrations of the body for the medial analysis. Medical imaging uses various techniques such as MRI (magnetic resonance imaging), CT scan (computed tomography), X-ray, radiography, ultrasonography, endoscopy, electrocardiography and many more. These techniques are used to provide the area needs to diagnose.

2.1. Region of interest

All the information in a medical image is not equally important. ROI describes the affected part of an image and which is to be analyzed. This region is compressed so that reduced size of an image can be achieved with no information being lost. The ROI region is compressed using DWT (discrete wavelet transforms).

2.2. Non Region of interest

In the process of compression, the non ROI region is compressed so that if there is any loss in information also it does not leads to any issue. Non ROI corresponds to the background data which is less important. The non region of interest region is compressed using discrete cosine transform (DCT) [7].

3. PROPOSED METHOD

In the proposed work, an image is taken and is segmented into region of interest (ROI) and non region of interest. Since the image before segmentation was in RGB (red, blue, green) format, it first converts to gray and then to binary. The segmentation is done by applying seeded region growing process. Separate algorithm is applied to ROI and non ROI part. Discrete cosine

transform is applied to the non ROI and discrete wavelet transform is applied to the ROI. The resultant image is reconstructed back to recover the original signal. The image thus obtained is the compressed image. For the compression we prefer to compress region of interest efficiently without affecting the quality of the image. Hence, below are the results showing the compression using wavelet transform based on three parameters, mean square error, peak signal to noise ratio and compression ratio. More the PSNR and compression ratio better will be the quality of an image.

Figure3. Flow Chart of the proposed algorithm

3.1.Multiple-Level Decomposition

The multiple level decomposition procedure can be recapitulate, with successive approximations being decomposed, so that one signal is broken down into various less resolution elements. This is known as the wavelet [19] decomposition tree and is depicted below.

Figure4.Multi level decomposition

3.2.Wavelet Reconstruction

The reconstruction of the image is carried out by applying the inverse discrete wavelet transform (IDWT) [13]. The values obtained are first up sampled and then passed to the filters. This is represented as shown in Fig. 4

Figure5. Wavelet reconstruction

The wavelet analysis consists of filtering and down sampling, whereas the wavelet rebuilt process consists of up sampling and filtering. Up sampling is the process of lengthening a signal element by inserting zeros between samples as shown in Fig. 4.

Figure6. Reconstruction using up sampling

3.3.Reconstructing Approximation and details

It is possible to rebuild the real signal from the coefficients of the accuracy and details. The procedure yields a rebuilt precision which has the similar length as that of the real signal and which is a real precision of it.

4.SEEDED REGION GROWING PROCESS

Region growing process [1] locates the input image data into sets of linked pixels, known as regions, as per requirement of authorized categories which generally checks the properties of local groups of pixels.

Steps for this process are described below:

- Image is divided into 16×16 blocks. Initial seed points are calculated as follows.
- Threshold T is calculated for each block.
- Repeat the first two Steps till T converges.
- Sort pixels into a group of two X1 and X2, where X1 has pixels whose intensity is greater than T and X2 has pixels whose intensity is less than T (threshold).
- Calculate Mean and Standard Deviation of X1 and X2.
- Re evaluate T.
- Measure total variance (TV) and mean variance (MV).
- Measure Seed Threshold, $TS = TV + MV$
- Determine pixels with 'threshold seed < threshold' and select them as starting candidate seed points.
- After choosing seed points, calculate their intensity difference i.e., between seed point and its neighbourhood pixels.
- Check the adjacent pixels and add them to the region if they are similar to that seed point.
- Continue to repeat the last two steps until no more pixels are to be added.

5.Simulation Results

Figure7.segmentation of an image

Figure8. DCT compression applied to non-ROI and it's Reconstruction

Figure9. DWT compression applied to ROI and its Reconstruction

Figure10.Compressed image

Figure11.Graph showing results of compression ratio and PSNR

6.CALCULATIONS

In the proposed methodology we are improving the quality of an image with the help of the parameters such as mean square error [MSE], peak signal to noise ratio [PSNR], compression ratio.

Mathematically these parameters are represented as:-

1.Peak signal to noise ratio (PSNR)

Psnr is the parameter for calculating the quality of a compressed image.

$$PSNR = 10 \log \left[\frac{I^2}{MSE} \right]$$

Where I= intensity of the image pixel level. For 5 bit per pixel,

$$I^5 - 1 = 31$$

2.Compression ratio

$$\text{Compression ratio} = \frac{\text{Number of bits required for an original image}}{\text{Number of bits required for compressed image}}$$

Parameter	ROI
Compression Ratio	4.3234
PSNR	51.3964
MSE	0.26

Table1. Results of compression by DWT applied on Region of interest scaled on the above parameters.

7.CONCLUSIONS

In the paper, an image is segmented into ROI and no ROI. Region of interest (ROI) represents the area which is to be examined. Therefore while compressing an image, especially ROI image it should be marked that the quality of the image does not diminish. Two algorithms, discrete cosine transform and discrete wavelet transform are implemented on non ROI and ROI respectively. On combining the results of both algorithms, we finally get compressed image which has good PSNR and compression ratio.

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