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Compression and Analysis of Image using High Resolution Grid and Rice Encoding

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ABSTRACT
In this paper we have discussed compression and analysis of image using high resolution grid and SPIHT encoding technique. Firstly the original image is converted in to low resolution (less size) image, then quantization and SPIHT encoding, techniques are applied to compress the image. To restore the original image, the compressed image is decompressed (dequantized & decoded) and interpolation techniques using high resolution grid (tukey window and PG algorithm) are applied to achieve high resolution decompressed image. The PSNR of the high resolution decompressed image is high compared to PSNR of low resolution original image. At last we found the compression ratio is directly proportional to PSNR.

Keywords
SPIHT, ROI Compression, MIC, Peak Signal to Noise Ratio (PSNR), Compression Ratio (CR), Tukey-wind, PG algorithm (Papoulis-Gerchberg method).

1. INTRODUCTION
Image compression is the process of identifying and removing redundant data from images and then encodes it with a lossless or lossy encoder in such a way that the information is represented with less number of bits than the original image. Uncompressed high resolution images take lot of memory. For example, a single small 4″ × 4″ size colour picture, scanned at 300 dots per inch (dpi) with 24 bits/pixel of true colour, will produce a file containing more than 4 megabytes of data. This picture requires more than one minute for transmission by a typical transmission line (64k bit/second ISDN). Therefore large image files remain a major bottleneck in a distributed environment. This problem is generally overcome by various image compression techniques like JPEG compression. From the discussion it is clear that an image compression is essentially a quantization technique. Therefore at the receiver when the image is represented, there will be information loss which affects the overall resolution and clarity of the images. This is a major problem in medical images. With increasing number of medical image acquisition every day, storage, transmission and information preservation in such images has become a huge challenge. In this work we addressed this issue by proposing a novel technique for medical image compression and by showing the efficiency of the same.

Medical images are very sensitive to losses as the details are critical in terms of diagnosis and medical observation. Hence conventional image compression techniques are avoided in medical images. Medical Images need compression in such a way that medically relevant information (called ROI or region of interest) suffers minimum loss.

A variable bit stream coding is adopted for ROI image compression. A ROI coding is simply an image compression technique where different parts of the images are encoded at different rates, therefore having different compression ratio and PSNR. In a medical image, the area of the image over which the information is present is called ROI. In medical image compression scheme, a ROI can be determined by manual outlining or by segmentation technique. So the approach is to divide an image into regions and then apply encoding with different rates over transformed data of those images. So while encoding ROI part, quantization will consider more distinct levels where as non ROI part should be encoded by considering lesser number of quantization level.

The basis of any image compression is quantizing the values of the images and encoding the quantized values with the help of an encoding technique like entropy coding, Huffman coding, zero tree coding, SPIHT and so on. Quantization requires image values to be unique and need to remove the sparse information. Therefore representing the image in the transformed domain is important as against spatial domain as the significance of the pixels in spatial domain are not known and therefore assigning them bits is difficult. Most widely used transformation for the image is wavelet transform.

A better choice is to first scale down the image resolution to an acceptable level (say 256x256), Apply compression and store or transmits. At the decoder, the image must be uncompressed and then should be mapped to a high resolution plane (1024x1024) using interpolation technique using Papoulis-Gerchberg method.

2. PAPER OBJECTIVE
This project is designed to achieve a high resolution image with low memory occupancy from a high resolution image with low memory occupancy, without loss in the image quality. In other words, the input image for this project is a high resolution image. The high resolution image is compressed using the SPIHT Coding. Now the compressed image is converted into a high resolution image by creating a high resolution grid and projecting this compressed image onto the high resolution grid. By using SPIHT Coding is that the image is compressed with minimum loss in quality.

3. SCOPE OF PROJECT
There are many methods of lossless compression which are discussed in the forth coming sections. By using this project both colour and gray scale images can be processed and their respective high quality high resolution images can be obtained. In terms of efficiency, this project is much superior to other methods of image compression and retrieval in the sense that this project produces effective PSNR and Normalized Cross Correlation (NCC). In this project, care is taken to register the input image without any loss. But as there is no integration mechanism involved for frame by frame storage, only steady images can be compressed and their high resolution outputs can be produced. By introducing an

integration mechanism of frame by frame storage of the processed input images, we can extend the same concept of first compressing and retrieving the same on a higher resolution to even video images. If the same concept of first compressing and retrieving on a high resolution is applied to video images, we can save large memory spaces, due to which the videos can be downloaded as uploaded very fastly. Apart from fast access of the large video file, less storage memory is required so that many such files can be stored in a low memory space.

4. TECHNICAL APPROACH

The coding of this project is done using Matlab Software. The high resolution input image is compressed to a low resolution image using SPIHT Codes. The compressed low resolution image is to be scaled. In other words, a scaling factor is selected and a new high resolution grid is created which is scaling factor times the dimensions of the low resolution grid. After the high resolution grid is created, now we should determine the new pixel values of each pixel in the high resolution grid. This is done by interpolation i.e. the known values are assigned directly and the unknown values of the pixels are determined by knowing the shift and rotate angles whose relations are explained in the coming sections and applying these shift and rotate angles to the known pixel values. Finally, all the pixel values of the high resolution grid are determined and stored to achieve the high resolution image with superior image quality and low memory occupancy.

5. PROPOSED WORK

Scale down or resize the image

- ✓ Apply SPIHT or Quad tree encoding to the sub images or sub band images.
- ✓ Store number of levels of decomposition in the encoded data.
- ✓ Decode data using SPIHT decoding
- ✓ Apply Inverse transform

Use Projection technique to scale up the low resolution image to high resolution one.

6. Image Projection and Interpolation

Figure describes the two steps graphically. On the left hand side four low-res images are shown (pixel values at integer pixel only). Motion estimation is used to estimate the pixel positions of the three images with respect to the 1st image. Note that these pixel positions would not be at integer values, but can take any real value. Once this information is calculated accurately, it is possible to project this information on a desired high-resolution grid.

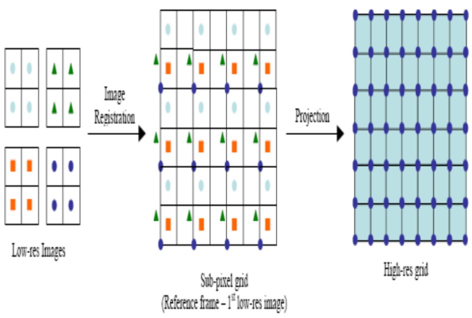

Fig.1 Simple representation of image projection from low resolution image to high resolution image

Before delving into the solution, lets first try to understand what are we trying to achieve. Let's say we start with a high-resolution image. Then we down sample it (without low-pass filtering). So, we have aliasing in the down sampled images. Now, in real-life we will be given these down-sampled images with aliasing and our goal is to create an HR image from them. So, basically as shown in the figure below, it boils down to finding the lost high-freq components and fixing the aliased low-freq values in the HR image. The Papoulis-Gerchberg algorithm (discussed in more detail below) along with POCS is used to solve this problem. It concentrates mainly on fixing the low-freq components, but it turns out that this algorithm also gives us some high-freq components depending on the information in the LR images.

The two steps used to solve this problem are shown below. The detail of each step is given in the following sections.

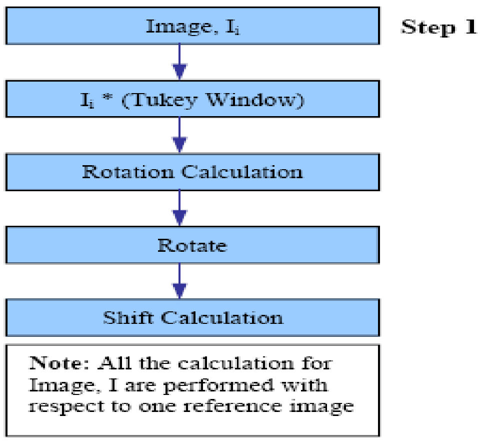

Fig.2 various operations done on the image before applying P-G Algorithm in step 1

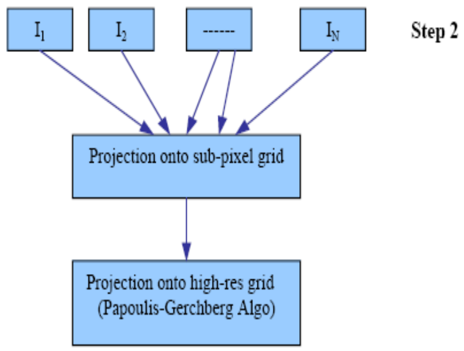

Fig.3 various operations done on the image after step 1.

7. RESULTS & OBSERVATION

Experiments are performed on various images capture from mobile phones and digital camera and compare PSNR of low resolution image and high resolution image. In my technique first I convert original image in to low resolution then quantization and SPIHT encoding will be done after then decoding of image will be done at receiver side I done eleven iteration for decompression of image to original image but at this stage image is in low resolution and has low PSNR so I done something new to increase the PSNR value at this stage so I use tukey window and pg algorithm to increase PSNR value.

To prove my concept I perform operation on three image as shown in table

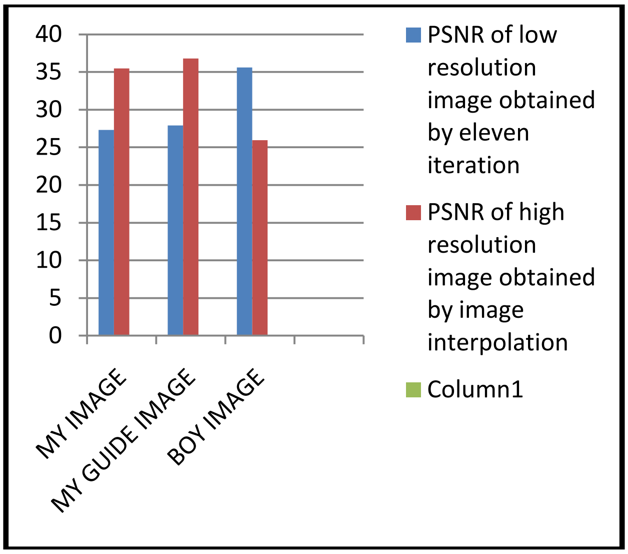

Fig.4 Graph construct in accordance with result analysis table

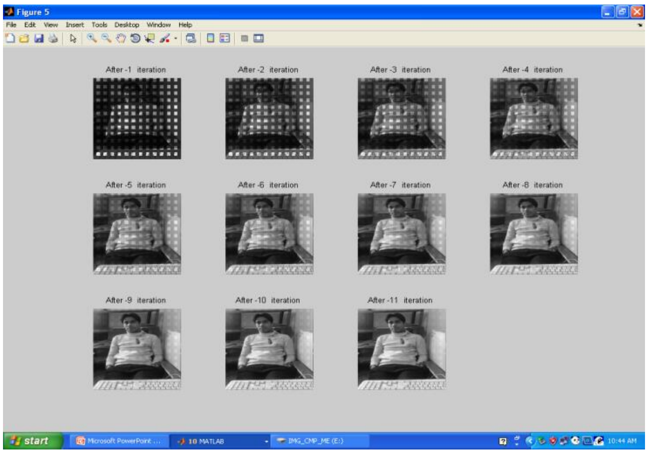

Fig.5 My image Decompressed Low Resolution image after 11 iteration

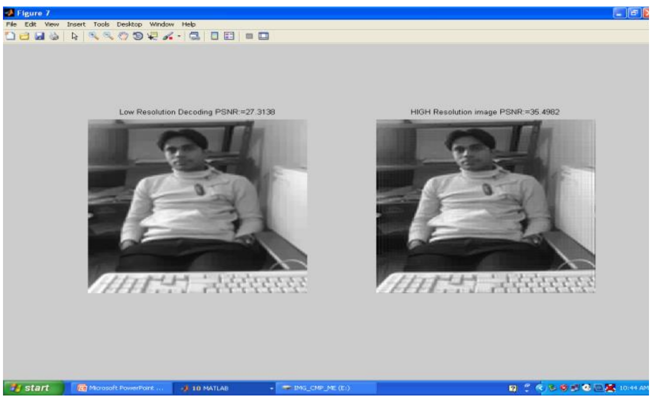

Fig. 6 Comparison between low resolution and high resolution image in terms of PSNR of my image

TABLE I

Name of the image	**PSNR of high resolution decompressed image obtained by image interpolation (db)**	**PSNR of low resolution decompressed image obtained by eleven iteration (db)**
My image	35.4982	27.3138
My guide image	36.8207	27.9361
Boy image	35.6154	25.9674

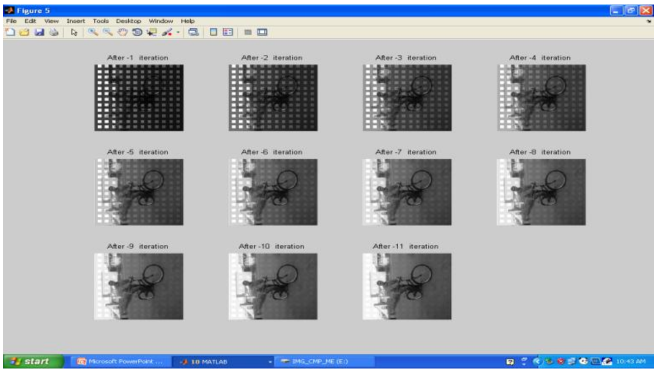

Fig.7 My guide Decompressed Low Resolution image after 11 iteration

Fig.8 Comparison between low resolution and high resolution image in terms of PSNR of my guide image

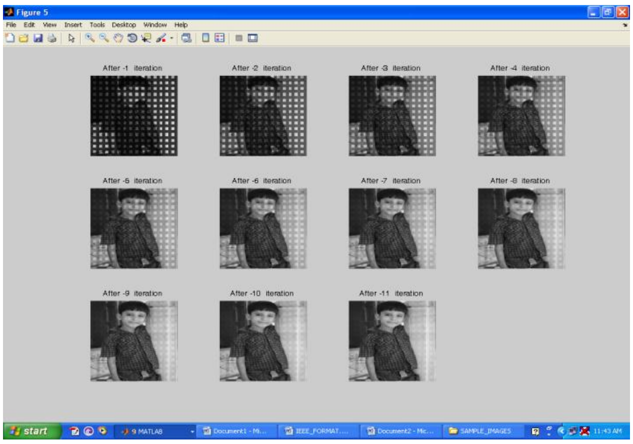

Fig.9 Boy image Decompressed Low Resolution image after 11 iteration

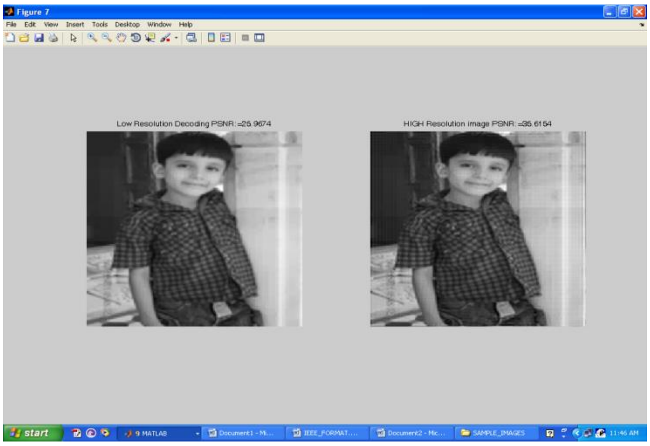

Fig.10 Comparison between low resolution and high resolution image in terms of PSNR of boy image

8. CONCLUSION & FUTURE SCOPE

There have been several techniques for image compression like the most widely adopted JPEG, SPIHT and so on. But the emergence of medical imaging and explode of images in this field has resurfaced the need to tailor made medical image compression techniques that can attain very high compression ratio, without compromising the medical information stored in the images. In this work we developed a two level compression technique. In the first level the image is compressed by rescaling the image to lower resolution, followed by transforming the image with lifting integer wavelets and encoded using SPIHT. At the decoder side, the decompressed image is scaled back to the original resolution using Papoulis-Gerchberg method of image interpolation. Results show a significant performance improvement over JPEG compression. But there are certain performance issues that need to be addressed. Use of the proposed technique introduces redundant colours in the edge of ROI and non ROI region when the compression ratio is high (Such redundancy may lead to misleading diagnosis of the image in automated image processing technique. A future work of the proposed technique will be to remove the extra shade, that appears in the boundary of ROI part. This could be attained using either fuzzy based techniques or by adopting image inpainting techniques.

9. ACKNOWLEDGMENT

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