Implications of JP2K coding standard for MRI image based on a feature of Region of Interest in Telemedicine

Muhammad Iqbal Bhatti [1], Pervez Akhtar [2], Tariq Javid Ali[3], Muhammad Abdul Muqeet[4]
[1]Associate Professor, Sir Syed University of Engineering and Technology
[2]Associate Professor, PNEC, National University of Sciences and Technology
[3]PhD Student, PNEC, National University of Sciences and Technology
[4]BMED Student, Sir Syed University of Engineering and Technology
E-mail: [1]mibhatti@ssuet.edu.pk, [4]amuqeet@ssuet.edu.pk
[2]pervez@pnec.edu.pk, [3]tariqjavid@pnec.edu.pk,

***Abstract* - In Telemedicine use of region of interest (ROI) coding with MAXSHIFT method is one of the innovative functionalities supported by JP2K. It enables medical images such as MRI images with ROI to be compressed losslessly, conversely Non-ROI with some loss of information but recognizable to achieve a higher compression level subsequently lower transmission time coded vigorously to bear up required network medium. Using a developed model, results of reconstructed images are presented tabularly and graphically at different bit rates in conformation.**

Keyword: ROI, JP2K, MRI

INTRODUCTION

The objectives of telemedicine are to improve access and to enhance overall quality of care at affordable cost. Improved access and cost savings could be achieved by allowing a doctor to remotely examine patients or to consult with a specialist. This reduces or eliminates the time and expense of travel necessary to bring the patient to the doctor or the doctor to the patient [1]. Quality of care is improved by providing the diagnostically important images [2].

Rigorous research in diagnostic imaging and image compression in telemedicine is gaining prominence all over the world, particularly in developing countries [3]. Engineers are developing technologies and tools, enabling the medical practitioners to provide efficient treatment. From the elaborate medical information, the doctor prefers to focus on certain selected region(s) of interest. Also the doctors are more comfortable with image– processing and analysis solutions that offer subjective analysis of medical images more than depending on the objective engineering results alone. Technology assisted, integrated diagnostic methods are of high relevance in this context [4].

CONCEPTS

In medical context, the regionally lossless schemes have to be studied more closely. They can be any of the following based on different types of end user/observer or context.

- "Visually lossless" (non-clinical human observer)
- "Diagnostically lossless" (clinical-observers) significant degrees of inter-observer and intra-observer variations may be there.
- "Quantifiably lossless" (mostly non-human observer/computer assisted detection), may be information consideration our method is proposed [4]

A. Coding Scheme

Most of the commonly used methods use baseline JP2K algorithm[5] that involves the Discrete wavelet transform on tiles[6], Maxshift method for ROI[5] , quantization levels and entropy coding[7].

Also in medical situations during compression phase, lossy schemes are not preferred. To avoid the chance of loosing any diagnostically significant 32x32 codeblock size is selected with considering ROI size is ¼ of original image and used maxshift method in which the background coefficients are scaled down rather than scaling up the ROI coefficients. Lossless schemes prove costly with less compression efficiencies and are ineffective in certain application environments [3]. Regionally lossless schemes [5] prove as a valuable/meaningful solution between the completely lossless or lossy ones.

B. Transmission Hierarchy

Recent acceptance and deployment of picture archiving

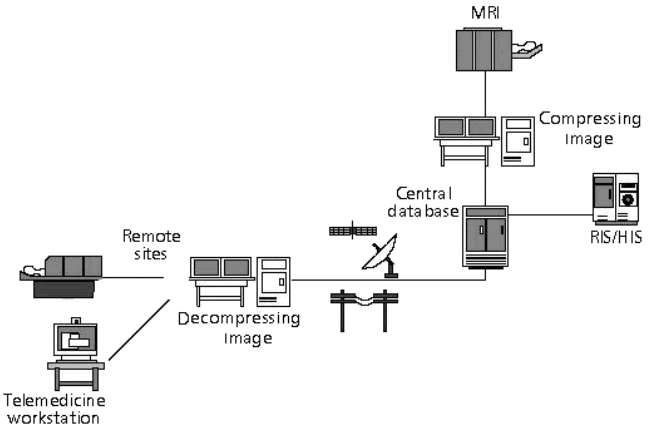

Fig 1. Transmission Hierarchy

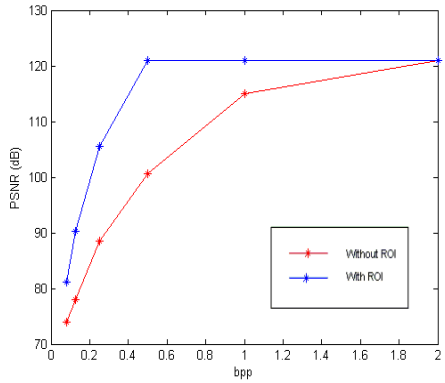

Fig. 2 Objective measurement

and communications system (PACS) [8] in hospitals and the availability of DICOM medical images via PACS is and important building block of telemedicine. Fig.3 illustrates the extension of a PACS to remote sites using telemedicine.

EXPERIMENTAL RESULTS

MRI images are taken from a famous national health care institution. We utilize Irfanview [9] for image format conversion, MATLAB 7 [10] for mathematical treatment and graphs, JJ2000 [12] for image compression, and MS Excel [11] for organizing data.

The performance evaluation of JP2K compression standard using MAXSHIFT method is an individual application on one of the MRI image among 6 other images obtained from the same modality.

A. Subjective Measurement

The evaluation of the reconstructed images was based upon mixed criteria including: Mean Opinion Score (MOS) [13] for which image quality assessment was carried out by visually. The ranking was done on an integer scale based on MPQM model [13] from 1 to 5, i.e. 1 (bad), 2 (poor), 3 (fair), 4 (good) and 5 (excellent). An image is ranked as acceptable if it maintains satisfactory diagnostic value (i.e. MOS > 3.99).

B Objective Measurement

When the reconstructed images to be encoded contain a ROI and PSNR is calculated for the ROI alone and over whole image (for the ROI and the background). Experiment was completed using version 5.0 of JJ2000 [12].

The effect of JP2K coding on MRI image for lossless compression ratio is presented in fig. 2. Compression is performed by means of the JP2K compression standard.

The images, at first, are compressed and decompressed at 0.08 bpp up to 2.0 bpp at 1/128quantization levels.

C Discussion

The MRI image (Fig 3-1) is initially obtained from MRI scan modality and archived in a DICOM imaging database which is later converted in PGM format through Irfanview for JJ2000 software. The image then passed through various stages of the algorithm as described in [5] and finally we get a JP2K compressed image ready for storage or transmission. The reconstructed image then followed a similar pattern in reverse when a compressed image is received or accessed from archival.

The superiority of the ROI coding scheme, based on the MAXSHIFT method, over without ROI, can be subjectively and objectively judged in fig 2 and fig 3. Achieving a compression ratio of 1:16 (in fig. 3-2) subjectively got MOS>4.5 and objectively in fig 2 gained up to 21dB (PSNR), however on the compression ratio of 1:32 subjectively got MOS>4 and objectively in fig 2 gained up to 19dB (PSNR) but inadaptable because it is shows non linear graph and background of image is unrecognizable shown in fig. 3-3.

CONCLUSION

Our results proved that 1:16 compression ratio on 1/128 quantization level gain is 21dB appropriate for the MRI image to be reconstructed in lossless settings reducing transmission sixteen times, proving the out performance of the JP2K standard being applied.

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Fig. 3-1 Original MRI image


Fig.3-2 Compressed at 1/128 quantization level achieving 1:16 ratio


Fig. 3-3 Compressed achieving 1:32 ratio with ROI

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