LOSSLESS MEDICAL IMAGE COMPRESSION USING REGION OF INTEREST

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Abstract:
Typically conducted on the small portion of an image in therapeutic field scanning, but because of its immense image size, it comes to high costs and less transmission speed. Gradually, it is incredibly difficult to reduce the scope of the image without data loss. In this case, we will reduce the size of the image by using certain compression techniques that have the potential to achieve higher reconstruction efficiency. Be that as it might a picture's existence plays a key role in the prescription. We have proposed optimized compression methods for this purpose. We perform region-based segmentation techniques as part of this technique by dividing the image into two regions, ROI and NONROI, which are monitored by applying compression techniques for LOSS and LOSSLESS. We can measure the compression ratio and discern the best suited wavelet technique by applying different wavelets for ROI and NONROI pictures. We will fulfill our prerequisites at that point i.e. picture with high speed of transmission, less cost and less size. Finally, compacted images should be transmitted through flexible administrations and web administrations. In this article, it assures assistance for the vulnerable community with regard to the cost-effectiveness of disease sufferers.
***Keywords**: Field scanning, ROI and NONROI*

I. INTRODUCTION

In the field of medical imaging, large quantities of image data are produced in the form of computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound images that can be stored in the Picture Archiving and Communication System (PACS) or in the hospital information system. On average 5 GB to 15 GB of data is produced by a medium-scale hospital with the above facilities. So for hospitals, it is very hard to handle the storage facilities for the same thing. In addition, the high data demand for high-end networks is extremely high, particularly for the transmission of images over the network, such as in telemedicine. Due to the limitations of the transmission medium in information and communication technology (ICT), this is critical for the telemedicine scenario, in particular for rural areas. In order to reduce the storage and transmission bandwidth requirements of medical images, image compression is beneficial. If the image without any perceptual distortion is compressed by 8:1 compression, the storage capacity increases 8 times. Compression techniques are divided into techniques that are lossless and lossy. Lossy compression systems are not commonly used in the medical imaging situation. This is due to the potential loss of important clinical evidence that could impact the diagnosis. In addition to these causes, legal problems will occur. Medical image storage is inherently problematic because of the need to retain the highest image quality possible, which is commonly translated as a need for lossless compression. 3D MRI requires several slices representing all the relevant details about a part of the body.

Some of the most desirable features of any 3D medical image compression process include: I high lossless compression ratios, (ii) scalability of resolution referring to the ability to decode the compressed image data at different resolutions, and (iii) scalability of quality referring to the ability to decode the compressed image at different qualities or signal-to-noise ratios (SNR) up to l The most thorough and approved version of an imaging communications protocol is DICOM. The DICOM format has a header containing image information, image modality, and patient information. The header also provides details about the media type (CT, MRI, audio recording, etc and the dimensions of the image. Material items such as medical records, audio recordings, and photographs are included in the DICOM standard body. Other information in the DICOM file must be taken care of by the coding-decoding algorithm.

Algorithms should also accept the DICOM format input image at the end of the encoder and generate the DICOM file at the end of the decoder. Image compression will reduce the size of a graphics file in bytes without reducing the image quality to an unacceptable level. This is because only the encoders specially built for them can leverage the statistical properties of the images well. Often, for the sake of a little more bandwidth or storage space, some of the inner information in the image may be sacred. In other words, in such places, lossy compression may be employed. Generally, a text file may be compressed to a certain degree without errors being introduced. This is called compression without loss. But mistakes are inevitable after that point. It is so critical for text and computer files that we use lossless compression because a single text or program file error changes the meaning of the text or causes the program not to run. There is often a minor image compression loss that is not apparent. Until the crucial point, there is no worry. It isn't conceivable beyond that! If there is loss tolerance or otherwise it has to be less the compression factor may be high. Thus, graphic images may have a high compression ratio compared to text or program files.

One of the main aspects of image storage is effective compression. For example, a 1024 x 1024 x 24 image would need 3 MB of storage memory and would need 7 minutes to transmit and use a high-speed ISDN (64 Kbit/s). But the memory needed for storage will be only 300 KB if the image is compressed at a ratio of 10:1 and the transmission time would drop below 6 seconds. We can pass compressed seven 1 MB files to a floppy in the time needed for sending an uncompressed file through the Applet alk network. Large files are often a significant setback in systems in every form of environment. This illustrates how badly we need compression for transmittable dimensions to be handled. We can also increase the bandwidth in addition to compression techniques, but this won't have effective outputs. To store and transmit such uncompressed data, the qualitative transformation from simple text to full motion video data and disk space, transmission bandwidth, and transmission time required.

II. COMPRESSION FRAMEWORK AND PERFORMANCE EVALUATION

The goal of image compression is to eliminate or at least reduce the redundancy present in the representation of the original image. There is usually a quantity of similarity between nearby pixels in real world images that can be taken advantage of to get a more economical representation. The compression ratio, i.e. the ratio of the size of the original image to the size of the compressed one in bytes, is typically calculated with the so-called compression ratio (CR). For example, if an image is converted to a 1 bpp representation with a (contrast) resolution of 8bits/pixel (8 bpp), the compression ratio would be 8:1. Two types of average number of bits per pixel (bpp) are referred to as bit schemes:

LOSSLESS

These methods (also referred to as reversible) minimize the inter-pixel association to the point that it is possible to recreate the original picture precisely from its compressed form. This class of methods is commonly recognized in the radiology community, as it means that the compression/expansion process will not be followed by data loss. However, while the compression ratio that can be achieved depends on the modality, lossless techniques are unable to provide compression ratios greater than 2:1 to 4:1.

LOSSY

The compression obtained by lossless schemes is often insufficient to manage the amount of image data involved. Lossy schemes (also referred to as irreversible) may therefore be used to achieve a more compact representation of the image at the expense of some data losses, which, however do not lead to an equivalent amount of loss of information. In other words, while the original image cannot be completely restored, for the purposes of the particular mission, the deterioration that it has experienced is not evident to a human observer. Compression ratios achieved from 4:1 to 100:1 or even greater across lossy compression range.

III. ROI BASED DICOM IMAGE COMPRESSION

It needs a huge amount of data for storage and requires large transmission bandwidth if we consider any medical image, so we have to compress medical image.

A single image or series of pictures may be a medical image for compression. Geometrically, the diagnostic information provided by hospitals has increased. Some of the medical images suggest that a compression technique is required, resulting in greater reductions in data and thus transmission speed. In medical cases, a technique of lossy compression that preserves the diagnostic data is required. ROI-based coding has also recently been shown to be a good strategy for compression of medical images, especially in telemedicine applications. The regions of interest (ROI) are those regions that in any given picture can be given more significance.

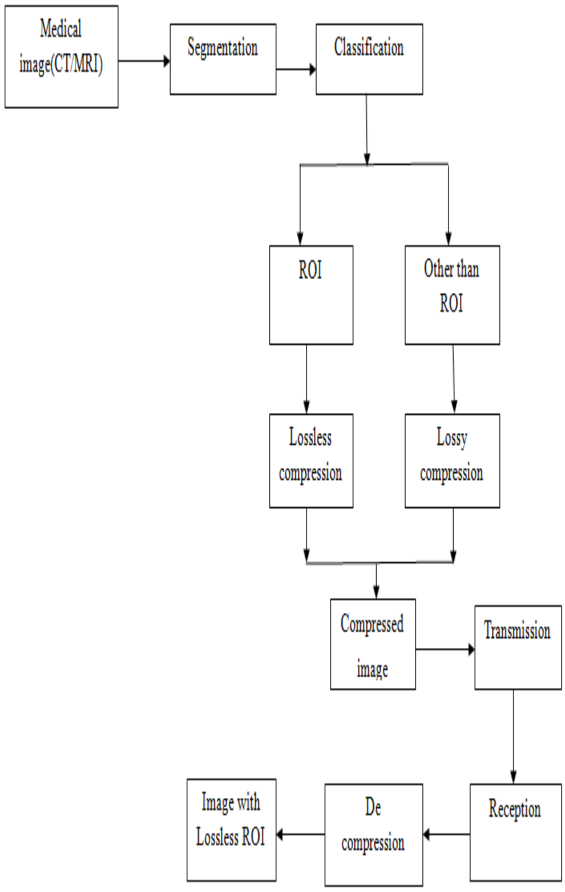


Figure 1: ROI based DICOM image compression

If quality loss is affordable, then for general images, several compression schemes generate high compression rates. Medicine does not however, afford any deficiency in diagnostically relevant regions (ROI). Therefore an approach that brings a high compression rate that retains good ROI quality is required. Since medical images are not of similar meaning in all areas. As with brain MRI, the part of the image containing the tumor is inspected instead of scanning the entire image. This results in high reconstruction quality in a limited time over user-specified spatial regions. For a medical image compression device, Lossless compression, Progressive transmission and region of interest (ROI) are required criteria.

In our proposed technique, we need to distinguish both ROI and non-ROI components for ROI-based image compression and apply compression methods accordingly. Let us consider a medical image in Figure 1, either CT or MRI, and the image will be divided into both ROI and non-ROI sections by applying segmentation technique.

IV. REGION OF INTEREST

Those regions of a picture that are taken more into account compared to other regions are referred to as regions of interest, i.e. ROI. ROI. It is a general observation that all regions do not exhibit equal value to the inspection point of view in any real picture or medical image. In view of this fact, attention is paid only to selected parts of the image. For example, in Figure 1, the tumor-containing area of a brain MRI image is examined instead of scanning the whole image, since there is real information here.

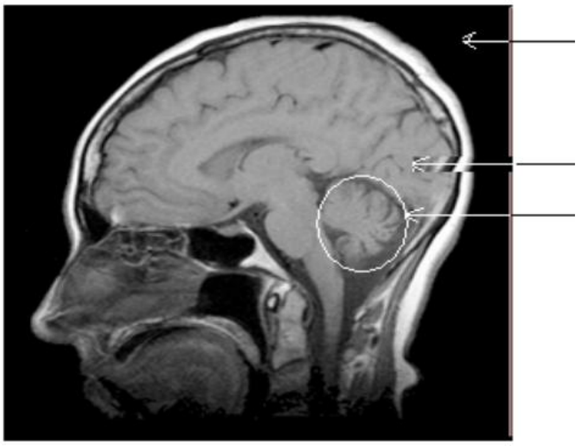


Figure 2: Different parts of a medical image

The Region of Interest (ROI) definition is significant in medical diagnosis because of the limitation and hampering of medical images due to techniques of lossy and lossless compression. The lossless compression techniques' compression ratio results in 25 percent of the original size, while the compression ratio for the lossy encoder is much higher, but both of these compressions cause data loss. The essential part of the medical picture may be crowded by this lack of details. To get rid of this problem, a better compression technique is required which by taking care of the important part (ROI) of the medical images, provides a better compression ratio.

By using Integer Wavelet Transform, we can apply lossless compression to the ROI region and use the SPIHT algorithm to apply lossless compression to the non-ROI portion. After that the two images that will be the compressed image will be merged. It will transmit the compressed image via the transmission channel. The image will be retrieved from the receiver and the original image will be extracted by decompression. The image with lossless ROI is the output image.

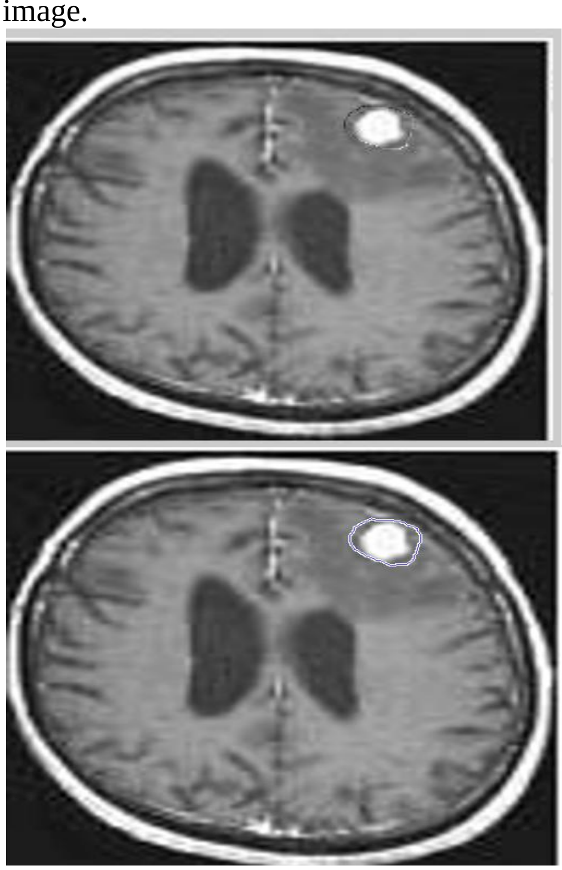


Figure 3: **original image**

PROCEDURE FOR SEGMENTATION ALGORITHM

Step 1:- Read an image.

Step 2:-Apply imfreehand functionto the image .

Step 3:- CreateMask to the image.

Step 4:- Apply roifilt2 function to the image.

Step 5:- Finally divide the image into ROI region and NONROI region.

Step 6:- By using wcompress function compress the NONROI region.

Step 7:- And by using the lift wave function compress the ROI region.
Step 8:- Finally by adding those ROI and NONROI we got the compressed image.

In this paper, segmentation is used to distinguish ROI and NON ROI pieces. There are so many masking techniques for this function, such as sobel, laplacian, log, average, disk, and gaussan. We use the laplacian mask for image segmentation in our paper. The method consists essentially of defining a discrete second-order derivative formulation and then constructing a filter mask based on that formulation. We are generally interested in isotropic filters, the response of which is independent of the position of the discontinuities in the picture to which the filter is applied.

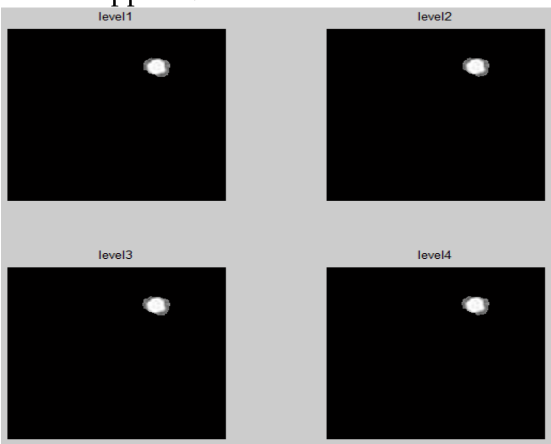


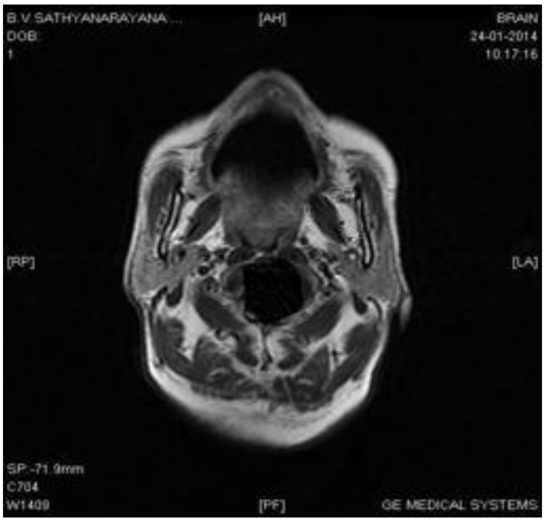
Figure 4: **compressed ROI part**

We use masking techniques for the separation of ROI and NON ROI materials. There are various techniques of masking, such as laplacian, sobel, log transformation, and gradient. In our paper, we choose laplacianmask. This technique essentially consists of defining a discrete second-order derivative formulation and then constructing a filter mask based on the formulation. Isotropic filters are of interest, the response of which is independent of the position of the discontinuities in the picture to which the filter is applied.

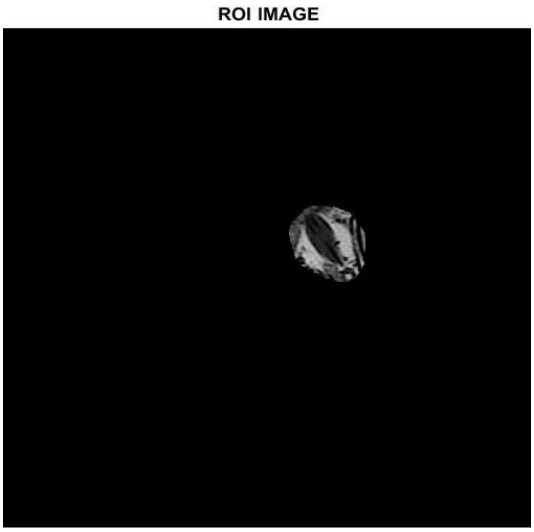
We get separate ROI and NON ROI components after segmentation. We use the wcompress method for compression of the NON ROI portion. The maximum number of loops for computation in this step is 32. We use the lift wave process for ROI component compression. We use hair wavelet transformation in this.

After applying SPIHT and integer wavelet transform we get this compressed image as shown in Figure 5.

V. SIMULATION RESULTS:

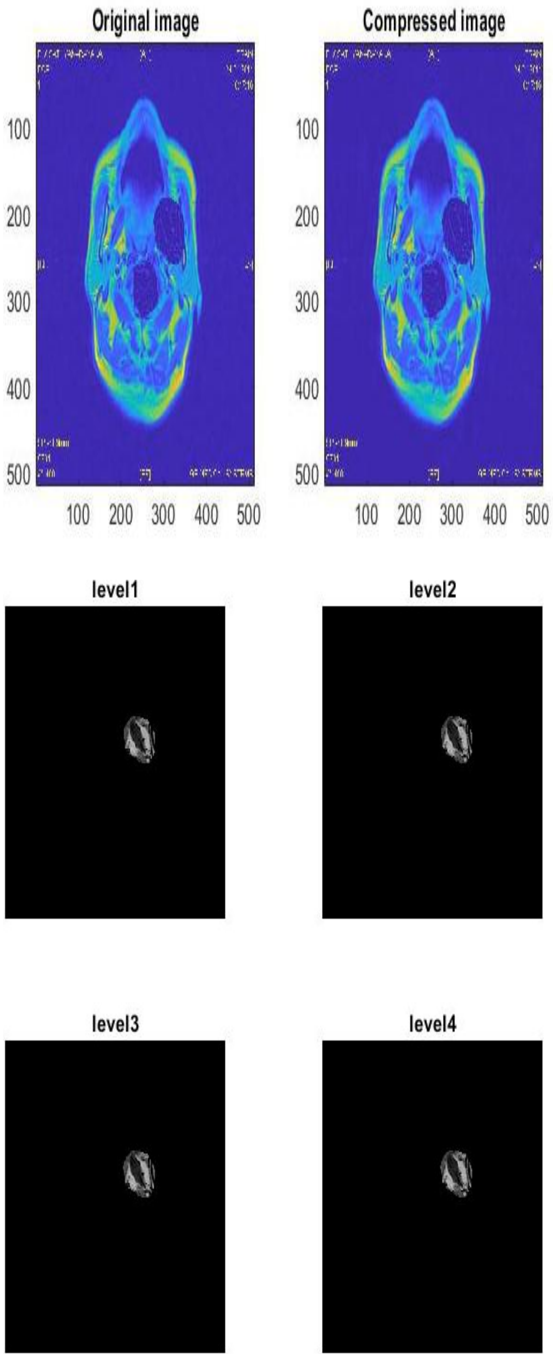


Input image



ROI image

e



Different Levels

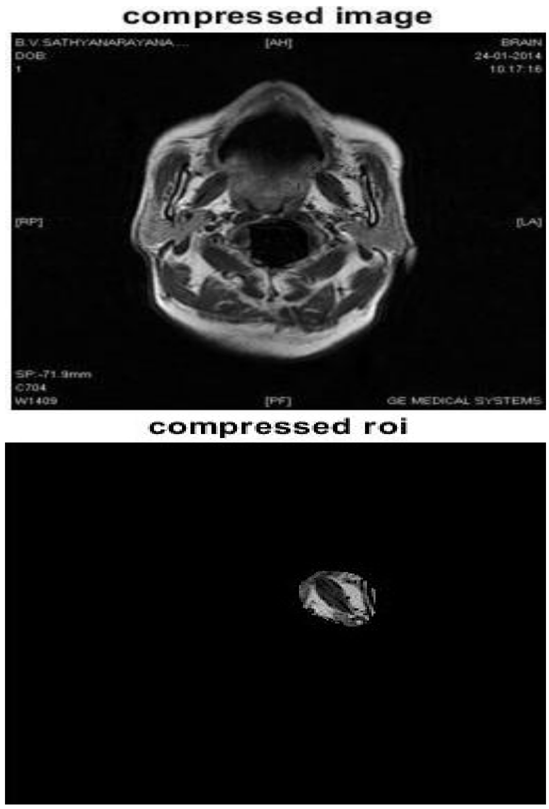


Figure 5: Compressed Image

VI. CONCLUSION

Every image contains some redundant information, which needs to be identified by the user to obtain compression. The floating-point representation of the DWT gives small error in the system. The IWT is recommended for critical medical application because of its perfect reconstruction property. ROI-based compression is providing better results as compared with lossless methods, along with preservation of diagnostically important information. We have concluded that ROI based image compression is the best one. By this analysis we make sure that the compressed image will be helpful in telemedicine. After this compression we can send the medical image through mobile.

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