

**MEDICAL IMAGE PROCESSING FOR TELEMEDICINE APPLICATION**Kunal P. Ingole¹, Prof. Dr. M. H. Nerkar²^{1,2} *Electronics and Telecommunication Department, Government college of Engineering, Jalgaon*

Abstract — The main aim of this paper is to provide a better image or related data for medical interaction purposes. Medical images contain large amount of information that requires much storage space, large transmission bandwidths and long transmission times. Many classes of images contain spatial regions which are more important than other regions. For medical images, only a small portion of image might be diagnostically useful, but the cost of wrong interpretation is high. Hence Region Based Coding (RBC) technique is significant for image compression and transmission. Lossless compression schemes with secure transmission play a key role in telemedicine application that helps in accurate diagnosis and research. In this paper we propose a lossless scalable RBC for Digital Imaging and Communication in Medicine images based on Integer Wavelet Transform (IWT) and with distortion limiting compression technique for other regions in image. The main objective of this work is to reject the noisy background and reconstruct the image portions losslessly. The compressed image can be accessed and sent over telemedicine network using personal digital assistance (PDA) like mobile.

Keywords- Region based coding, Integer wavelet transform, SPIHT coding, Lossless compression, Telemedicine

I. INTRODUCTION

Large amount of image data is produced in the field of medical imaging in the form of Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Ultrasound Images, X-rays and many more recent techniques which can be stored in picture archiving and communication system (PACS) or hospital information system. A medium scale hospital with above facilities produces on an average 5 GB to 10 GB of data. So, it is really difficult for hospitals to manage the storing facilities for the same. Moreover, such high data demand for high end network especially for transmitting the images over the network such as in telemedicine. This is significant for telemedicine scenario due to limitations of transmission medium in Information and Communication Technology (ICT) especially for rural area. Image compression is useful in, reducing the storage and transmission bandwidth requirements of medical images. For e.g., an 8-bit grey scale image with 512×512 pixels requires more than 0.2 MB of storage. If the image is compressed by 8:1 compression without any perceptual distortion, the capacity of storage increases 8 times. Compression methods are classified into lossless and lossy methods. In the medical imaging scenario, lossy compression schemes are not generally used. This is due to possible loss of useful clinical information which may influence diagnosis. In addition to these reasons, there can be legal issues. Storage of medical images is generally problematic because of the requirement to preserve the best possible image quality which is usually interpreted as a need for lossless compression. 3D MRI contains multiple slices representing all information required about a body part.

Some of the most desirable properties of any compression method for 3D medical images include: (i) high lossless compression ratios, (ii) resolution scalability, which refers to the ability to decode the compressed image data at various resolutions, and (iii) quality scalability, which refers to the ability to decode the compressed image at various qualities or signal-to-noise ratios (SNR) up to lossless reconstruction. DICOM is the most comprehensive and accepted version of an imaging communications standard. DICOM format has a header which contains information about the image, imaging modality and information about the patient. The header also contains information about the type of media (CT, MRI, audio recording, etc.) and the image dimensions. Body of DICOM standard contains information objects such as medical reports, audio recordings and images. The coding– decoding algorithm must take care of other information in the DICOM file. Also, the algorithms should accept the input image in DICOM format at encoder end and produce DICOM file at decoder end.

II. LITERATURE REVIEW

Historically, telemedicine can be traced back to the mid to late 19th century with one of the first published accounts occurring in the early 20th century when electrocardiograph data were transmitted over telephone wires. Telemedicine, in its modern form, started in the 1960s in large part driven by the military and space technology sectors, as well as a few individuals using readily available commercial equipment. Examples of early technological milestones in telemedicine include the use of television to facilitate consultations between specialists at a psychiatric institute and general

practitioners at a state mental hospital, and the provision of expert medical advice from a major teaching hospital to an airport medical centre.

Recent advancements in, and increasing availability and utilization of, ICTs by the general population have been the biggest drivers of telemedicine over the past decade, rapidly creating new possibilities for health care service and delivery. This has been true for developing countries and underserved areas of industrialized nations. The replacement of analogue forms of communication with digital methods, combined with a rapid drop in the cost of ICTs, have sparked wide interest in the application of telemedicine among health-care providers, and have enabled health care organizations to envision and implement new and more efficient ways of providing care. The introduction and popularization of the Internet has further accelerated the pace of ICT advancements, thereby expanding the scope of telemedicine to encompass Web-based applications (e.g. e-mail, teleconsultations and conferences via the Internet) and multimedia approaches (e.g. digital imagery and video). These advancements have led to the creation of a rich tapestry of telemedicine applications that the world is coming to use.

Telemedicine is a confluence of Communication Technology, Information Technology, Biomedical Engineering and Medical Science. The Telemedicine system consists of customized hardware and software at both the Patient and Specialist doctor ends with some of the Diagnostic Equipments like ECG, X-ray and pathology Microscope/Camera provided at the patient end. They are connected through a Very Small Aperture Terminal (VSAT) system and controlled by the Network Hub Station of ISRO. Through a Telemedicine system consisting of simple computer with communication systems, the medical images and other information pertaining to the patients can be sent to the specialist doctors, either in advance or on a real time basis through the satellite link in the form of Digital Data Packets. These packets are received at the specialist centre, the images and other information is reconstructed so that the specialist doctor can study the data, perform diagnosis, interact with the patient and suggest the appropriate treatment during a Video Conference with the patient end. Telemedicine facility thus enables the specialist doctor and the patient separated by thousands of kilometers to see visually and talk to each other. This enables the specialist doctor to assess the physical and psychological state of the patient and suggest treatment. This remote tele-consultation and treatment is much more valuable in case of post operation (Post Surgery) follow up since the patient is not required to travel unnecessarily and hence saving money and time. In this way, the systematic application of Information and Communication Technologies to the practice of healthcare rapidly expands the outreach of the healthcare system.

The literature reports that while telemedicine offers great opportunities in general, it could be even more beneficial for underserved and developing countries where access to basic care is of primary concern. One of the biggest opportunities telemedicine presents is increased access to health care. Providing populations in these underserved countries with the means to access health care has the potential to help meet previously unmet needs and positively impact health services. Telemedicine applications have successfully improved the quality and accessibility of medical care by allowing distant providers to evaluate, diagnose, treat, and provide follow-up care to patients in less-economically developed countries. They can provide efficient means for accessing tertiary care advice in underserved areas. By increasing the accessibility of medical care telemedicine can enable patients to seek treatment earlier and adhere better to their prescribed treatments, and improve the quality of life for patients with chronic conditions.

Telemedicine has been advocated in situations where the health professional on duty has little or no access to expert help; it is able to offer remote physician access to otherwise unavailable specialist opinion, providing reassurance to both doctors and patients. Telemedicine programmes have been shown to directly and indirectly decrease the number of referrals to off-site facilities and reduce the need for patient transfers. Remote care and diagnosis via telemedicine in less-economically developed countries thus benefits both patients and the health care system by reducing the distance travelled for specialist care and the related expenses, time, and stress. Furthermore, telemedicine programmes have the potential to motivate rural practitioners to remain in rural practice through augmentation of professional support and opportunities for continuing professional development.

Telemedicine networks in developing countries could also offer secondary benefits. Telecommunication technologies, such as those used in telemedicine initiatives, have shown to be effective tools for connecting remote sites. By opening up new channels for communication telemedicine connects rural and remote sites with health-care professionals around the world, overcoming geographical barriers and attempting to reverse 'brain drain' or flight of human capital. This can lead to increased communication between health service facilities, and facilitate cross-site and inter-country collaboration and networking. Such collaborations can support health-care providers in remote locations through distance learning and training.

Telemedicine also provides opportunities for learning and professional development by enabling the provision and dissemination of general information and the remote training of health-care professionals. As Zbar and colleagues asserted, "Telemedicine creates a university without borders that fosters academic growth and independence because the

local participating surgeons have direct access to experts in the developed world.” For example referred specialists have reported value in terms of medical education through the provision of consultation. It is important to note that such partnerships provide mutual benefits. For example, health-care providers in developed nations are provided with an opportunity to learn to treat neglected diseases, which they very seldom see in person. The knowledge sharing that occurs as a result of inter-site collaboration may be formal or informal and has shown to aid health-care professionals in overcoming the professional isolation that they often face in remote areas, and to improve their skills and the services they offer. A telemedicine program to support maternal and neonatal health in Mongolia exemplifies many of these points.

III. PROPOSED METHOD

A. Block Diagram

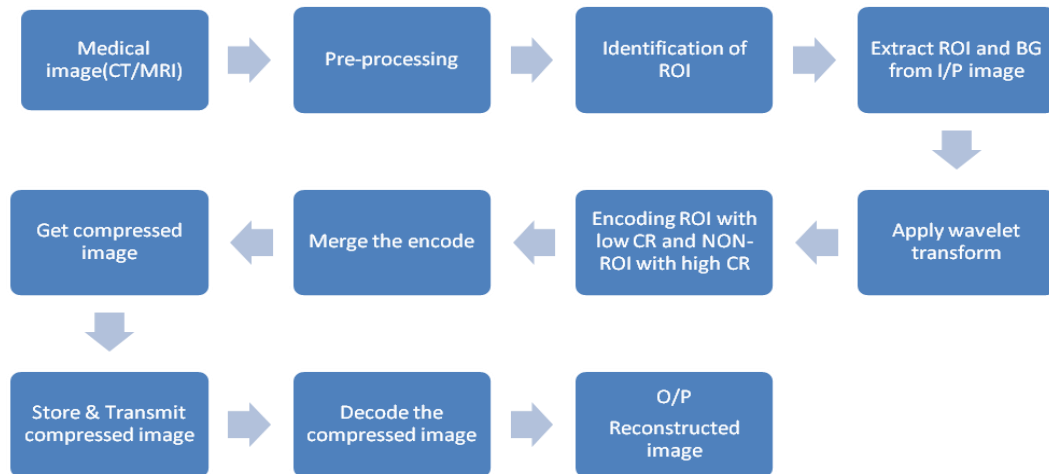


Fig.1 Block Diagram

The above fig 1 shows the block diagram of the proposed method. Initially the input image is fed to the system, the input image may be a highly non stationary one, hence we convert the size of the input image to 256 x 256. In gray scale coding even if the input image is a color image it will be converted into gray scale image using RGB converter. After the input image is taken, in the Pre-processing step each and every neighborhood pixel of an input image should have a new brightness value corresponding to the output image. Such pre-processing operations are also known as filtration. Types are enhancement (image enhancement for shape detection), image restoration (aim to stem degradation using knowledge about its nature of an image; i.e. relative motion of camera image and object, wrong lens focus etc.), image compression. After getting pre-processed image identification of region of interest part is to be done by the observer. After identifying the ROI image we can easily separate ROI and NON-ROI by marking particular ROI region and then we apply wavelet transform on both the images i.e. ROI & NON-ROI, Then we encode the ROI with low CR and NON-ROI with high CR so that we don't get any loss in our ROI image and after merging both the image finally we get our compressed image.

A CT or MRI image contains three parts, ROI (the diagnostically important part), Non-ROI image part, and the background (part other than image contents) as shown in figure 2. The ROI would be selected by expert radiologists. Depending on the selected part ROI-mask is generated in such a way that the foreground is totally included and the pixel values in the background are made zero. The background regions though they appear to be black in color, they do not have zero grey level values.

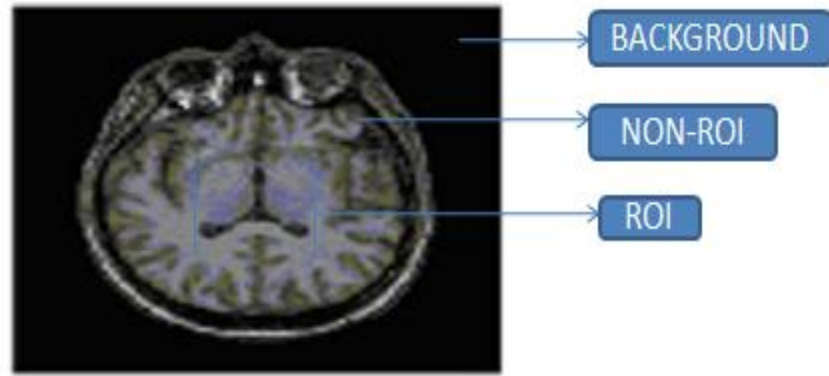


Fig.2 Different parts of medical image

B. Wavelet Transform Image

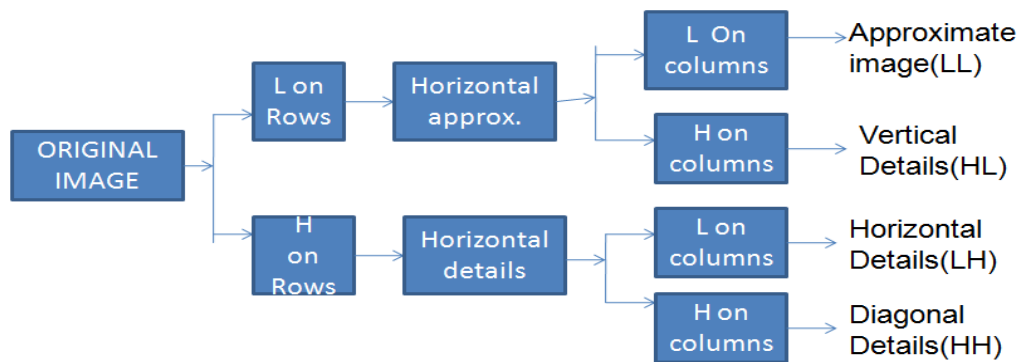


Fig.3 Generation of wavelet transform image

Wavelet transform are more appropriate for non-stationary signals. Process of generation of 2D wavelet transform image is shown in above figure 3. A wavelet transform image gives us four different components of the same image. So that if these component values are small then that can be deleted and we get compressed image. Wavelets are the functions that are concentrated in time as well as frequency around a certain point. Heisenberg's uncertainty principle state that we can have either high freq. resolution & poor temporal resolution and vice versa. so wavelet transform is designed in such a way that we get good freq. resolution at low freq. components and high temporal resolution at high freq. components. Figure 4 and figure 5 below shows a generated wavelet transform images.

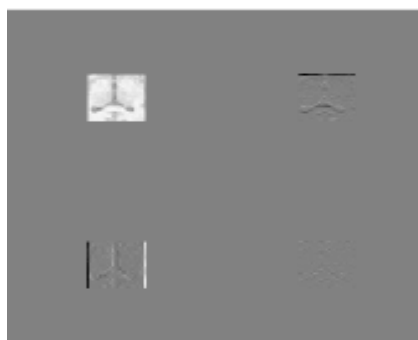


Fig 4. WT of ROI

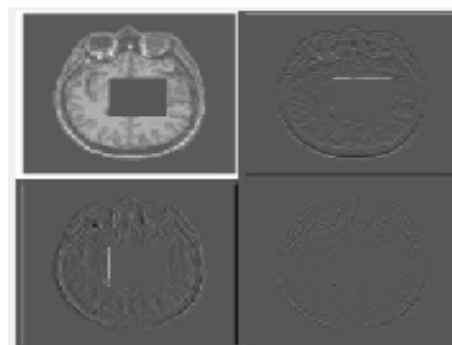


Fig.5 WT of NON-ROI

IV. EXPERIMENTAL RESULTS

Experimental result shows original image, ROI image , NON-ROI image & output generated wavelet transform images of both ROI, NON-ROI and O/P compressed image. So the output compressed image is much reduced in size as compared to input image.

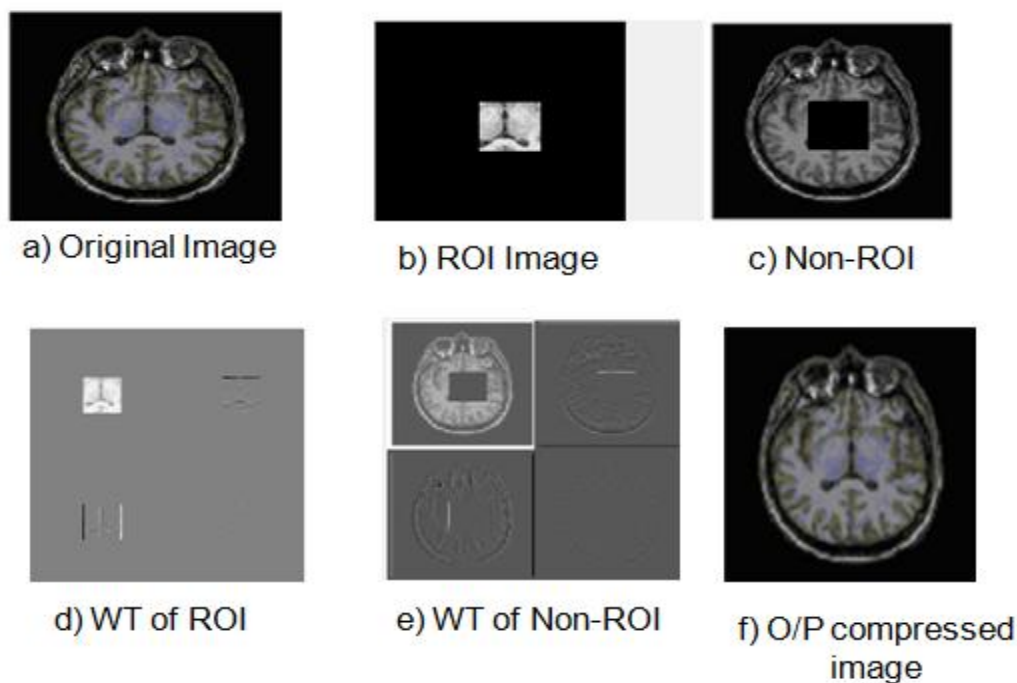


Table 1

Sr. No.	Parameters	Original image	O/P image
1	PSNR	28.50	39.30
2	MSE	58	40.22
3	CR	74.50	82.50

As shown above we have got good PSNR and minimum Mean square error for our output image, so if we compare our regenerated image with DCT compressed image then we will get much difference in PSNR and MSE and it will be observed clearly that our WT image is much better and accurate.

V. CONCLUSION

In this paper the focus is on getting better compressed output image so that we can save our storage space and also the image can be easily shared. So that we require less bandwidth for transmission of these type of compressed image and hence processing speed will increase. The floating point representation of the WT gives small error in the system. The WT is recommended for critical medical application because of its perfect reconstruction property. Hence this is current area of interest in telemedicine. So the wavelet transform gives better compressed image.

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