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A Review: ROI based Image Compression of Medical Images

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Abstract: ***Diseases can be detected using medical imaging methods. One of the problems that physicians encounter with it to store the medical images. This storage occupy more area for storing images long time as there is need to keep the record of numerous patients. So there is need to compress the image to be resolved in a variety of medical images, including radiography, magnetic resonance (MR), mammography, and ultrasound images, X-Rays, Brain MRI, CT images and so on. So this long term rapid transmission is prohibitive without image compression, to reduce the size of files. To make the Medical Images more useful and process able, there is need to reduce the transmission time and storage space for the images. The image may become more visual too, by compressed as it will also help to reduce transmission errors as less data will be transmit, also reduce the cost. In vector quantization technique there is low PSNR values. Further, some methods provide high mean square errors. MAXSHIFT, SPIHT, and General scaling methods having low complexity but provide better results. As DCT (discrete cosines transform) method is widely used in image processing, especially for image compression. DCT algorithm works efficiently to compress the image; it applied on the image blocks. This proposed technique give best performance in terms of computation and speed of computation is high. Furthermore, resulting parameters (such as PSNR, MSE, and entropy) are calculated and compared with existing algorithm and observed that the proposed algorithm has better performance.***

Keywords: DCT, MAXSHIFT, SPIHT Brain MRI, PSNR, MSE.

I. INTRODUCTION

Early digital fax machines such as the Bartlane Cable Picture Transmission System preceded digital cameras and computers by decades. The first picture to be scanned, stored, and recreated in digital pixels was displayed on the Standards Eastern Automatic Computer (SEAC) at NIST [1]. The advancement of digital imagery continued in the early 1960s, alongside development of the space program and in medical research. Projects at the Jet Propulsion Laboratory, MIT, Bell Labs and the University of Maryland, among others, used digital images to advance satellite imagery, videophone technology, character recognition, medical imaging and photo enhancement [2].

Rapid advances in digital imaging began with the introduction of microprocessors in the early 1970s, alongside progress in related storage and display technologies. Advances in microprocessor technology paved the way for the development and marketing of charge-coupled devices (CCDs) for use in a wide range of image capture devices and gradually displaced the use of analogy film and tape in photography and videography towards the end of the 20th century. The computing power necessary to process digital image capture also allowed computer-generated digital images to achieve a level of refinement close to photorealism [3]. Images then could be processed in real time, for some dedicated problems such as television standards conversion.

As general-purpose computers became faster, with these fast computers and signal processors available in the 2000s, digital image processing has become the most common form of image processing and generally, is used because it is not only the most versatile method, but also the cheapest.

II. LITERATURE SURVEY

Deepak.S.Thomas, M.Moorthi and R.Muthalagu (2014) in their paper, "Medical Image Compression Based on Automated Roi Selection for Telemedicine Application" present solutions for efficient region based image compression for increasing the compression ratio with less mean square error at minimum processing time based on Fast discrete curvelet transform with adaptive arithmetic coding. They said this project heavily utilized for compressing medical images to transmit for telemedicine application. To minimize the information loss, arithmetic entropy coding was used effectively. It will be enhanced by combining speck coding for compressing the secondary region and this hybrid approach was increased the CR and reduce the information loss. They analyzed the performance through determining the image quality after decompression, compression ratio, correlation and execution time [23]. Rushabh R. Shah and Dr. Priyanka Sharma (2014) in their paper "Performance Analysis Of Region Of Interest Based Compression Method For Medical Images" told about DICOM images. They did work on ROI based compression. They proposed haar wavelet technique on medical MRI brain image by detecting ROI and non-ROI parts of the image. Within this technique they calculated MSE, PSNR, Average difference, Structural contend and minimum difference [11]. Neha S. Korde, and Dr. A. A. Gurjar, (2014) in their paper "Wavelet Based Medical Image Compression For Telemedicine Application", presented the compression technique on medical MRI and CT images. Firstly, they converted the image into gray level. After that filter the input images then segmented the image to detect ROI part and background part. In last, they used discrete cosine transform and integer wavelet compression method, and revealed that mean square error reduces using wavelet compression method. They also discussed the various types of wavelet method [24]. Gaurav Vijayvargiya, Dr. Sanjay Silakari, and Dr.Rajeev Pandey (2013) in their paper "A Survey: Various Techniques of Image Compression" addresses various types of image compression techniques. They presendet the survey of various existing research papers and analyzed which compression method is best. After study of all techniques they found that lossless image compression techniques are most effective more than the lossy compression techniques [18]. B. Brindha, G. Raghuraman (2013) in the paper, "Region Based Lossless Compression for Digital Images in Telemedicine Application" proposes a very efficient and low complexity compression method for Digital Imaging and Communications in Medicine (DICOM) images. Main advantages of Region based coding technique is exploited in their paper. ROI part of the image is identified by manually in and combined with effect of Integer Wavelet Transform (IWT) which is useful to reconstruct the original image, reversibly with desired quality. The overall compression process helps to reach a satisfactory level for image transmission in limited bandwidth over a telemedicine application using Discrete Cosine Transform (DCT) method [5]. Lavanya. M, M. SureshKumar (2013) in the paper "Intelligent Compression Of Medical Images Based On Multi ROI" proposed a technique of lossy and lossless compression over multiple region of interest to obtain high compression ratio and good quality in primary region and edges are detected [26]. Dr. Monisha Sharma, Mr. Chandrashekhar K., and Lalak Chauhan, (2013) in their paper "An Efficient Medical Image Compression by SPIHT and EZW Based on ROI and NROI Using Wavelet Decomposition" proposed SPIHT and EZW wavelet algorithms to compress the medical CT and MRI images. After dividing the image into two parts i.e. ROI and non-ROI, lossless technique is applied on marked ROI area and wavelet method is applied on non-ROI area. Then calculated PSNR, MSE and CR factor,s from which CT images achieved 70-92% compression ratio [27]. T. M. P. Rajkumar and Mrityunjaya V Latte (2011) in the paper, "ROI Based Encoding of Medical Images: An Effective Scheme Using Lifting Wavelets and SPIHT for Telemedicine" proposed renowned wavelet based image encoding scheme SPIHT is used by the proposed encoding scheme. The ROI coding commences with the selection of ROI and its corresponding resolution by the user. The diverse ROIs are encoded with diverse resolution (bpp) by applying lifting wavelet transform and SPIHT. Their experimental results illustrate that using lifting wavelet transform and SPIHT, the proposed ROI encoding scheme provides high compression ratio and quality ROI [33]. Arash Ashtari Nakhaie and Shahriar B. Shokouhi (2011) in their paper "No Reference Medical Image Quality Measurement Based on Spread Spectrum and Discrete Wavelet Transform Using Roi Processing" proposed ROI processing method. They implemented DCT technique on non-ROI part. For ROI part, they worked on No-Reference quality measurement method for compression to owing the limitation of full-reference method. As in full-reference method, there is need for large information at comparison point but

No-reference method measure the quality of the image. Hence this paper presented the watermarking method using spread spectrum and discrete wavelet transforms [34]. M. Firoozbakht, M. Martini, H. Amin, and SD. Qanadli (2010) in their paper "Compression of digital medical images based on multiple regions of interest" implemented a context-based and regions of interest (ROI) based approach to compress the medical images in particular vascular images, where contrast sensitivity and high spatial resolution is required in areas such as stenosis. The vascular image is divided into: the primary region of interest (PROI), the secondary region of interests (SROI) and the background. The PROI may be a stenosis of vessel and it is recognized manually by the radiologist. The SROI is divided into other regions among which the most important level is represented by vessels. The other levels are the other part of the body and the last level is the background region. The SROI is detected automatically by a region growing algorithm. The PROI is considered as a seed for region growing. Then, they compared the result with jpeg2000 images [36].

2.1 Problem Formulation

Medical imaging is one of the best techniques for monitoring the person's health condition which is used widely nowadays. Also some of diseases can be detected using medical imaging methods. One of the problems that physicians encounter with it to store the medical images. This storage occupy more area for storing images long time as there is need to keep the record of numerous patients. So there is need to compress the image to be resolved in a variety of medical images, including radiography, magnetic resonance (MR), mammography, and ultrasound images, X-Rays, Brain MRI, CT images and so on.

The rapid and reliable digital transmission and storage of medical and biomedical images would be tremendous boon to the practice of medicine. Patients in urban areas or even in rural areas could have convenient access to second opinions. Patients readmitted in hospitals could have earlier imaging studies instantly available. Rather than waiting for others to finish hard copy films, medical and surgical teams collaborating on patient care could have simultaneous access to imaging studies on monitors throughout the hospitals. So this long term rapid transmission is prohibitive without image compression, to reduce the size of files.

For any type of fracture, there is need for X-Rays. It is very common and most people fracture their bone at least once in their lifetime. The most common symptoms are: swelling around the injured area, loss of function in the injured area, bruising around the injured area, deformity of a limb. There are many types of fractures: simple, stress, impacted, compound, complete and incomplete. Bone fractures can be detected by taking an Xray in defected area. An x-ray is a non-invasive medical test that helps physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body. X-rays are the oldest and most frequently used form of medical imaging. A bone x-ray makes images of any bone in the body, including the hand, wrist, arm, foot, ankle, knee, leg or spine.

To compress the size of medical images is also useful in helping radiologist or surgeons to examine the previous data of their patient; in order to detect pathologic or abnormal regions, and planning suitable treatment, magnetic resonance images are used.

To make the Medical Images more useful and process able, there is need to reduce the transmission time and storage space for the images. The image may become more visual too, by compressed as it will also help to reduce transmission errors as less data will be transmit, also reduce the cost. Majority of the traditional methods lacks in terms of low compression ratio with lossless technique, some methods having problem of lost data when lossy compression technique is used. In vector quantization technique there is low PSNR values. Further, some methods provide high mean square errors. MAXSHIFT, SPIHT, and General scaling methods having low complexity but provide better results.

As DCT (discrete cosines transform) method is widely used in image processing, especially for image compression. DCT transforms the image or signal from spatial domain to frequency domain. DCT algorithm works efficiently to compress the

image; it applied on the image blocks. If the blocks are too large then local features are no longer exploited, but if the blocks are too small then the images are not effectively correlated. So the size of the blocks is important as they determine the effectiveness of the transform over the image. Despite the advantages, DCT also suffer from some problems such as it does not use for transformation in JPEG2000 standard. It performs well only on moderate bit rates. The DCT is associated with blocking artifact since the JPEG standard suffers heavily from this at higher compressions. However the DCT is protected against blocking artifact. Ringing is a major problem in DCT. This ringing effect increases, when larger blocks are used, but larger blocks are better in compression terms, so a trade off is usually established. DCT does not perform efficiently for binary images (fax or pictures of fingerprints) characterized by large periods of constant amplitude (low spatial frequencies), followed by brief periods of sharp transitions. DCT function is fixed, cannot be adapted to source data.

But still there is not a single algorithm giving optimized values on above factors. This proposed work will deal with the investigation and implementation of traditional compression algorithm of Images of Medical domain, as a preliminary step and then will propose a compressed algorithm, which will overcome the above adaptive problems being faced by traditional algorithms.

2.2 Objectives

1. To study the region growing algorithm on MRI medical images.
2. To study different image compression methods for medical images.
3. To propose a technique for image compression in medical images.
4. Compare the proposed technique with other state of the art methodologies of image compression.
5. To generate a quantitative analysis of the above compression.

III. METHODOLOGY

Data Flow for Proposed Algorithm

The working of the proposed algorithm is shown in the following fig as:

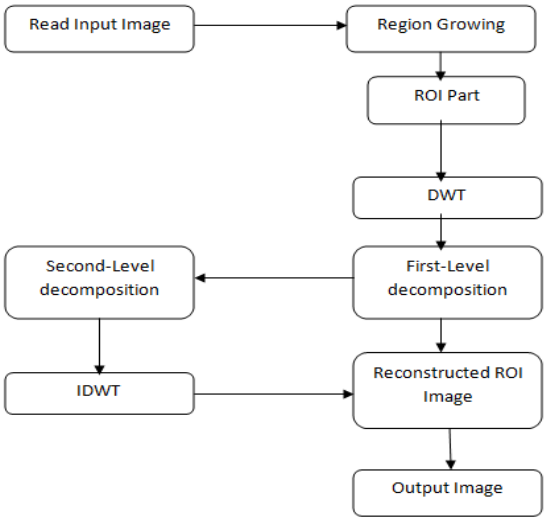

Figure 1.1 Data flow of proposed method

IV. CONCLUSION AND FUTURE WORK

Today, some of diseases can be detected using medical imaging methods. One of the problems that physicians encounter with it to store the medical images. This storage occupy more area for storing images long time as there is need to keep the

record of numerous patients and these images also contain redundancy. So there is need to identify redundancy and compress images. The various types of compression techniques are studied in this work such as lossy and lossless. This work discusses ROI-based medical image compression. This region of interest based compression techniques helps to reduce the size of the image without degrading the quality of the important data. Wavelet method is recommended for ROI-based medical image applications because of the perfect reconstruction with low complexity of the image. Further, the haar wavelet transform (lossless compression) is applied on the ROI part to compress the image. Then decode the image using IDWT method. This proposed technique give best performance in terms of computation and speed of computation is high. It was observed that the proposed algorithm has better performance as compared to other algorithms. Moreover, the proposed algorithm is also compared with some standards and already developed algorithms. Furthermore, resulting parameters (such as PSNR, MSE, and entropy) are calculated and compared with existing algorithm.

Future Work

This image compression work is further extended for three-level decomposition of DWT technique and can get better results with the help of different types of threshold techniques. Further, this work can be performed on color scale and real time images.

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