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# SURVEY OF MEDICAL IMAGE PROCESSING TECHNIQUES

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**Abstract:** Medical image processing is one of the most eminent image processing fields in this era. This is because of the big revolution in information technology that is used to diagnose many illnesses and saves patients' lives. There are many image processing techniques used in this field, such as image reconstructing, image compression, segmentation and many more. Image compression is a mandatory step in many image processing procedures. Image compression is a most significant tool which reduces the burden of storage and transmission over network. Hence, the medical images need to be transmitted very fast and it required to store with a minimum capacity. Thus, image compression is used to reduce the redundancies and irrelevant information in image and represents it in shorter manner to achieve efficient archiving and transmission of images. Image compression is the process of reducing irrelevant and the redundancy of the image data in order to store or transmit data in an effective manner. Image compression minimizes the size of an image (in bytes) without degrading the quality of an image to an acceptable level. In this paper, we have presented the work done in the field of medical image compression.

***Keywords: Medical Image Processing; Compression; Compression Techniques***

## I. INTRODUCTION

In this earlier multimedia scenario, the various disputes are the optimized use of storage space and also bandwidth. In order to shrink the storage space of pictures and transmission of information with customize limited bandwidth availability, Image compression plays a vital role by retreating the size of image and to exploit the bandwidth in economical and valuable manner without condescendingthe superiority of image [1]. Medical image processing utilization for human illness diagnoses has been the focus of many researchers during the last decade. This is due to the huge development of many medical imaging technologies, such as magnetic resonance imaging (MRI), computed tomography (CT), digital mammography and many more. As a result, researchers have got a great motivation to improve image processing techniques that can be used on medical images to be more accurate and efficient.

## II. IMAGE COMPRESSION TECHNIQUES

The image compression techniques are broadly categorized into lossy and lossless compression techniques. Lossy image compression generates reconstructed image with some degradation, whereas lossless preserves the whole image information. Lossless compression approach is preferred for archival purposes and often for healthcare imaging, engineering drawings, comics etc.Lossy compression approaches are used where each detail of image is not so crucial. Lossy techniques are perfect for natural images such as photographs in applications where slight loss of image detail is acceptable.

The lossy compression approach that produces hardly noticeable differences may be called visually lossless[1]. The general compression model is shown in Fig.1. Figure.1. General Compression Model The fundamental principle of compression is to remove redundancy and irrelevant data. These redundancies i.e. inter-pixel, psycho-visual, coding redundancies can be removed by using mapper, quantizer and symbol encoder respectively as shown in Figuree 1. In case of lossy compression, all these three redundancies can be removed but in case of lossless compression, only inter-pixel and/or coding redundancies are removed. In case of lossy compression, an additional component quantizer is used. As the result of quantizer is irreversible, so it may loss in image details. [2]

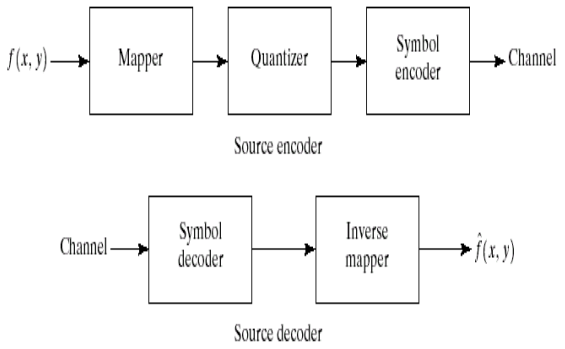


**Figure 1: Source encoder and decoder for image compression and decompression**

- **Techniques for lossless image compression:** a) Run-length encoding is considered as default method in PCX and as one of possible in TIFF,BMP and TGA
- Huffman Coding
- Area image compression
- Golomb Coding
- DPCM and Predictive Coding
- Chain codes
- Entropy encoding technique
- LZW (Lempel-Ziv-Welch)

 

***B. Techniques for lossy compression:***

a) *Decreasing Color Space*- In this technique the color space is reduced to the most general colors in the image. The selected colors are mentioned in the color palette in the description of the compressed image. Each pixel just references the index of a color in color palette; this method can be combined with dithering to avoid pasteurization. [1]

b) *Chroma Subsampling* - This technique takes benefits of the truth that the person eye perceives spatial changes of intensity more persuasively than those of color by averaging or dropping some of the chrominance content in the image. [1]

c) *Discrete Cosine Transform coding* - This is afourier-related transform and more effective as compared to Discrete Fourier Transform. It is mainly used to convert spatial domain to frequency domain. In this, we retain low frequency components and reduce the contribution of high frequency components using DCT. [9]

d) *Discrete Wavelet Coding*-The performance of DWT is better than DCT. The discrete wavelet coding is application of sub-band coding which is based on that the coefficients of a transform that decorrelates the pixels of an image can be coded more efficiently than the original image. It pack most important visual

information into small no. of coefficients, the remaining coefficients can be quantized coarsely or truncated to 0 with little distortion.[9]

## III. RELATED WORK

Many years ago, medical images were treated either as 1-D text sequence or 2-D text sequence, but now days they can also be treated as 3-D text sequencing. Compression in medical image becomes an important research area. A lot of work is done to solve the problem of compression in medical images. Following are the some image compression techniques used in medical image processing:

Sadhana Singh, PreetiPandey(2016) proposes a techniques which can be used to compress medical report without any loss of information and send to another place. The report can be an X-ray, computed radiography or any other medical image. The technique explained in this paper is LZW (Lempel-Ziv-Welch) based on ROI (Region of Interest) which will show only important region of image. LZW compression works on single codes after replacing the strings of characters and it also adds a new character of strings in the dictionary in the encoding process. But in decoding we convert that single code into the characters of strings by using the static dictionary. [3]

Victor Sanchez, J.Bartrina-Rapesta(2014) introduced improvement in HEVC (High Efficiency Video Coding) intra coding processwhich provides opportunity to improve medical image compression in image archiving and communication system. The loss less technique explained in this paper is for grayscale anatomical medical images, such as magnetic resonance imaging, computed tomography and X-ray. They use HEVC intra coding process to accurately predict edge information by performing intra prediction using sample-wise differential pulse code modulation (DPCM) with an increased range of directionalities. [4]

D. J. AshpinPabi, P. Arunaet al. (2016) focus on quality of medical image. For acceptable quality, they proposed a technique based on intensity value of pixels. The proposed algorithm contains two levels of compression. In the first level, to reduce correlation of intensity level, average between neighbors of particular pixels is evaluated and assigned to the pixels of original image. For three dimensional forms, ie rows, columns and diagonal, same pixel assignment is extended. In second level, to maintain acceptable quality, the proposed tri-mode encoding scheme is used. The compression decoder is used to decode encoded bits. The proposed method is tested in magnetic resonance imaging(MRI) images of brain which provides best results than existing methods.[5]

PalakJangbari, Dhruti Patel (2016) explained a technique used to reduce transmission bandwidth and storage requirement for medical image. The proposed technique is based on ROI (Region of interest), the region which is most important than other parts of image. In this, the ROI is detected using saliency map technique, after that ROI is coded at available bits and non- ROI is coded at fewer bits. The loss less compression is used for ROI and lossy compression is used for non-ROI. By this method, the target region will be preserved while the numbers of bits required for coding will be reduced. Thus, it will lead to reduced transmission and storage requirements.[6]

Rahul Sharma, C.Kamargaonkaret al.(2016) proposed a hybrid technique for medical image compression so that image can be efficiently stored and sent over network. The hybrid model works with region of interest. To preserve the quality, the region of interest (i.e. diagnostically critical region) is compressed using loss less algorithm and other regions are compressed using lossy algorithm. The model will provide high compression rate with good quality image.[8]

K Gopi, Dr. T. Rama Shri (2103) shows medical image compression techniques based on wavelet transform. The wavelet based compression technique contains transformation/mapping, quantization and lossless symbol encoding. For transformation, discrete wavelet transform and lifting schemes are introduced. The paper has explained different techniques based on wavelet transform. The results for haar wavelet, Daubechie wavelet, Biorthogonal Wavelet, Coiflet wavelet, Symlet wavelet and Demeyer Wavelet are also compared.[10]

AmiraMofrehet. al.(2016) proposed a new loss less image compression techniques which is named as LPC-DWT-Huffman (LPCDH). The proposed technique maximizes compression of image. The LPCDH technique includes three steps. In first step, the image is passed through LPC transformation. Then, the waveform transform is applied on output of first step. In last step, wavelet coefficients are encoded by using Huffman coding. The results shows that the proposed technique has more compression ratio as compared to Huffman coding and DWT-Huffman coding. [11]

## IV.PERFORMANCE PARAMETERSUSED IN LOSSY IMAGE COMPRESSION

There are many terms has been used for calculating the quality of the image. It can be classified into two types: Subjective or Objective. The subjective measures which means it is measured by observer's judgment. The evaluation is done using rating scale like {-1, 0, 1} for {worse, same, better}. The objective measures are involved by mathematical function of input and output of compression process. The following are main three terminologies used for calculating the lossy compression:

*(A) Compression Ratio (CR)*

It is used to calculate the ratio between the uncompressed (original) image and the compressed (processed) image.
Uncompressed Image
Compression Ratio = Compressed Image ----------(1)

*(B) Mean Square Error (MSE)*

The most commonly used measures are calculating between the original and reconstructed images of which mean square error (MSE) being the similar common calculations. The compression algorithm must be such efficient that to reduce the mean square error but it is unable capture the artifacts like blur images or blocking artifacts.[7] It is calculated by using the formula as given below:

$$\text{MSE}= \frac{1}{MN}\sum_{i=1}^{M}\sum_{i=1}^{N}(f(i,j)-f^{'}(i,j))^2 \quad (2)$$

*(C) Peak Signal – to – Noise-Ratio (PSNR)* The advantage of PSNR is easy to compute, but it does not visualize perceptual quality. [7] It can be defined via mean square error. It is calculated by using the formula as given below:

$$\text{PSNR}= 20\log_{10}\left(\frac{N}{RMSE}\right)dB \quad (3)$$

## V. CONCLUSION

In this digital world, the medical image processing plays a crucial role in hospitals. But due large size of these images, sometimes it becomes very difficult to store and transmit these images through the network. Thus, it becomes necessary to reduce the size of image without losing any required detail. The paper gives an up to date survey of different compression techniques that can be used efficiently to compress the image. The performance evaluation parameters CR, MSE, PSNR are also given in paper used to evaluate the performance of compression in various related fields.

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