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Image Compression on Biomedical imaging using DCT and LZW Lossless Approach

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***Abstract*—There are various applications of image processing like satellite imaging, biomedical imaging, remote sensing and radar imaging where the size of the image and quality of the image is most important but it requires a lot of space to store at the places due to the high bandwidth of the communication of the original image. In these applications we apply the image compression techniques to store the data and reduce its space for storage time. There are various factors which affecting the compression like spatial resolution, bit depth, noise, image sizing, viewing distance, etc. Biomedical imaging focuses on the capture of images for both diagnostic and therapeutic purpose. The biomedical images can be displayed by the high bit resolution and we have to convert the high bit resolution into the low bit resolution for displaying the images. This problem is occurs mostly on the low-cost or small devices. In this paper, we capture the 2D images for resolving. The resolution of the 2D images is very high so it takes more space for storage. If the size of the image is very high then it is not easy to send the image without compression. We focus on the 2D images compression which convert the high bit resolution into low bit resolution and we compress the 2D biomedical images with the help of the Discrete Cosine Transform (DCT) and apply the Lempel-Ziv-Welch (LZW) lossless image compression technique.**

Keywords*— Lossless compression, Biomedical images, 2D images, LZW, DCT.

I. Introduction

An image is an object that records the information about visual perception of the human being like two dimensional image, three dimensional images, etc. An image processing is any type of the signal processing for which input is simply the image and the output is the characteristics of the image. Image compression is the technique which is used to compress the images in the form of reduction of the storage space and in cost. Biomedical images are the technique to capture the images from the human being for the clinical purpose. Biomedical images have persistent to advance across a wide range of applications from diagnostics to tailored therapy to mechanistic understanding of biological processes. Lossless image compression technique is used to compress any image without losing the information regarding to image and this technique is used to remove any redundant information.

Biomedical images are obtained from positron emission tomography (PET) and other nuclear medicine imaging modalities play an important role in modern biomedical research and clinical diagnosis, proving a window to internal human biochemistry that was not previously available [1].

Lossless image compression either treats the image as 1-D text sequence or the 2-D text sequence, but in this paper we treat the image as 2-D text sequencing. There are various techniques to compress the images which is lossless like Huffman coding, run-length coding, Lempel-Ziv-Welch (LZW) compression algorithms, etc. In this paper we simply compress the biomedical images via LZW compression algorithm. In this algorithm we perform the raster scan on the images. In this algorithm coding assigns the fixed length code words to variable length sequences of the coding symbols without a prior knowledge of symbol probabilities. This paper shows the compression on biomedical images which is captured as a 2D image and after compression us simply converting the high bit resolution into the low bit resolution. Discrete Cosine Transform (DCT) is in which we have to make a transformation on the images. Transformation is the process which shows the conversion of one form into the other. In DCT we have to process the 2D biomedical images into the processing blocks. Discrete Cosine Transform is used compress the images and then we also decompress the images using the inverse transform.

Section II describes the literature survey of the biomedical images compression, section III describes the proposed model, section IV describes the steps for lossless image compression on biomedical images, section V describes the results and section VI describes the conclusions and future scope.

II. Literature Survey

N. Sriraam and R. Shyamsunder have put forth a method for 3D medical image compression using 3-D wavelet coders. Zixiang Xiong has proposed a Lossy to Lossless Compression method of Medical Volumetric Data Using 3-D Integer Wavelet Transforms. Compression and the Decompression

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Strategies for a Large Volume of Medical Images were proposed by Karthik Krishnana et al. [2]

Apart of so many advantages of Discrete Wavelet Transform, Discrete wavelet transform do not justify wide replacement of DCT to avoid blocking artifacts. Discrete Cosine Transform is a technique for converting a signal into elementary frequency components, widely used in image compression. The rapid growth of digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high-definition television (HDTV) has increased the need for effective and standardized image compression techniques. [3]

There are many research papers that propose 1D Discrete cosine transform technique to modify an image so as to get the compressed data or image model. [4] Shows a discrete wavelet technique to compress the images using wavelet theory in VHDL, Verilog. [5] Shows FFT approach for data compression. That its histogram has a desired shape. [6] Shows the lossless image compression algorithm using FPGA technology. [7] Has shown an image compression algorithm using verilog with area, time and power constraints. [8] Has shown a simple DCT technique to for converting signals into elementary frequency components using mathematical toolbox. [9] Shows comparative analysis of various compression methods for medical images depicting lossless and lossy image compression. [10] Shows Fourier analysis and Image processing technique. [11] Shows Image compression Implementation using Fast Fourier Transform. [12] Depicts a comparative study of Image Compression using Curvelet, Ridgilet and Wavelet Transform Techniques.

Even if numerous studies have been developed in this field of interest, compression of biomedical images [13] remains an important issue. Since the emergence of digital acquisition in medical imaging, the data production is continuously growing. In recent years, it has been subject to a quasi-exponential increase, in particular, because of an extensive use of MRI images and, even more, computed tomography (CT). These are both volumic modalities that can be viewed as a sequence of 2-D images (slices). The successive improvements of acquisition equipment tend to amplify the resolution of those images, which intensifies the mass of data to archive [14]. All this makes them really much more cumbersome than other imaging modalities. This is why we focused on CT and MRI [15].

III. Proposed Model

The objective of the proposed model is to compress the 2D biomedical images without reflecting any loss. In this model we simply capture the images in the Red-Green-Blue (RGB) format, and then convert the RGB image into the Gray form. Block processing is in which we have to divide the images into the blocks, the blocks are in the form of matrix. The size of the matrix we define using the matrix function in the MATLAB.

After performing the block processing we apply the Discrete Cosine Transform for compressing the images and if we use the LZW compression algorithm on that compressed image which comes after the DCT then image is found without any type of loss. Again we have to decompress the image by using the LZW decompression algorithm then after apply the inverse of the Discrete Cosine transform. Finally the original image is getting after performing the decompression on the images.

Proposed model of the lossless image compression is shown in the Fig. 1.

A. *Discrete Cosine Transform*

DCT is used to divide the image into the blocks. DCT is compress the images which is in the RGB form but firstly convert the RGB component of the images into the Gray level format. It compresses the images by using the threshold value to the 200. This is applies on the gray images and then compress the images in the block form. After compressing we have to decompress the images with the help of the Inverse Discrete Cosine Transform (IDCT).

B. *Lempel-Ziv-Welch*

LZW algorithm is the lossless image compression technique. In the LZW algorithm, we use the static dictionary. After scanning the whole image we have to make changes on the given static dictionary. And then we store all the information about the image in the new dictionary, this is the final output is found in the form of the RGB or in the Gray component.

IV. Steps for Lossless Image Compression on Biomedical Images

Lossless image compression is compressing the original image by implementing the steps:

Input: Original image
Output: Compressed image
Begin
Step1: Initialize parameters.
Step2: Read the original image in MATLAB.
Step3: Convert this original image (RGB) into the Gray.
Step4: Perform the Block processing.
Step5: Apply the Discrete Cosine Transform on the original image.
Step6: Compressed image found.
Step7: Perform the LZW compression algorithm on the compressed image for further compression.
Step8: For decompression we simply perform the inverse of the Discrete Cosine Transform.
Step9: Decompressed image found.
End

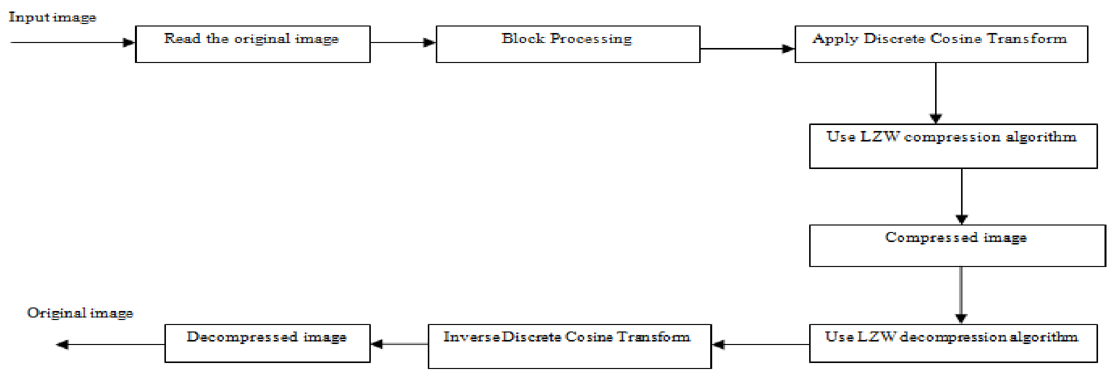

Figure. 1. Proposed Lossless Image Compression Approach

V. Results

For compression we took one biomedical image in .jpg format and other is in .png format. First image is in the .jpg format. In this we show the membranes in the mind and compress that with MATLAB. Figure 2 shows the original image which is used for the experiment.

Figure. 2. Original Image

`Figure 3 shows the histogram of the original image (.jpg format).

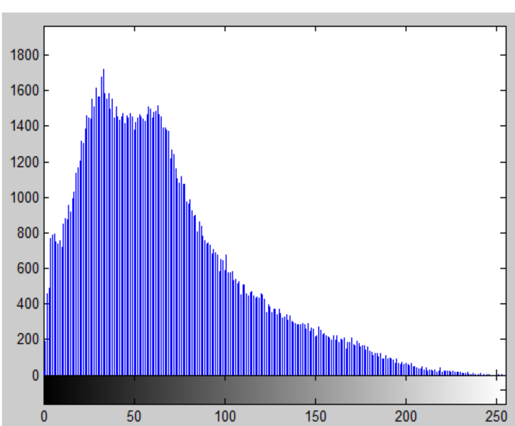

Figure. 3. Histogram of Original Image

Figure 4 shows the compressed form of the original image (.jpg format).

Figure. 4. Compressed Image

Figure 5 shows the histogram of the compressed image (.jpg format).

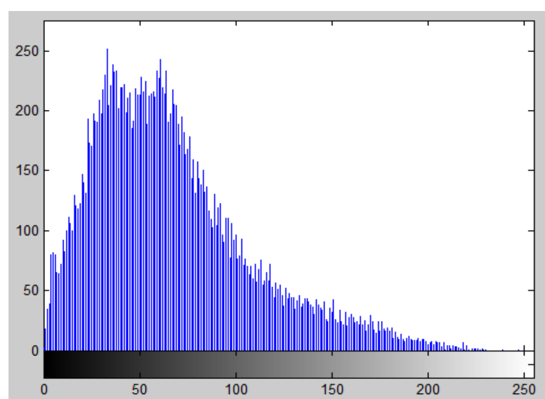

Figure. 5. Histogram of compressed Image

Second image is taken in the .png format. Figure 6 shows the original image in the .png format for the compression.

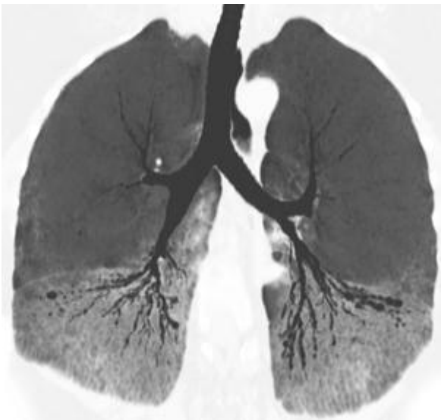

Figure 6. Original Image in .png format

Figure 7 shows the histogram image of the original image (.png format).

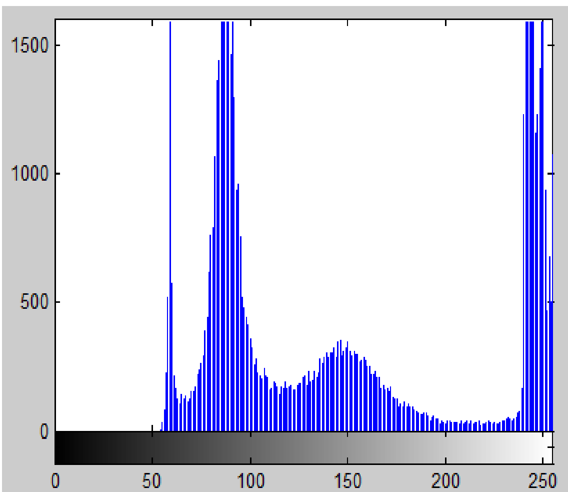

Figure 7. Histogram of original image

Figure 8 shows the compressed image of the original image (.png format).

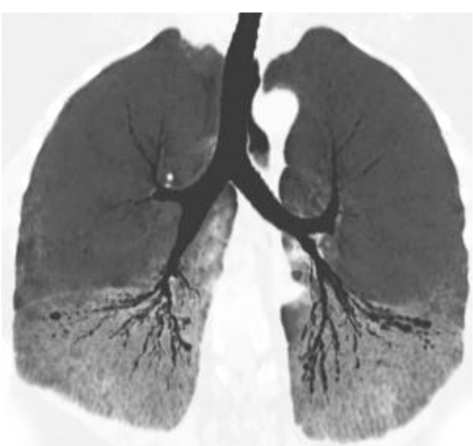

Figure 8. Compressed image

Figure 9 shows the histogram of the compressed image (.png format).

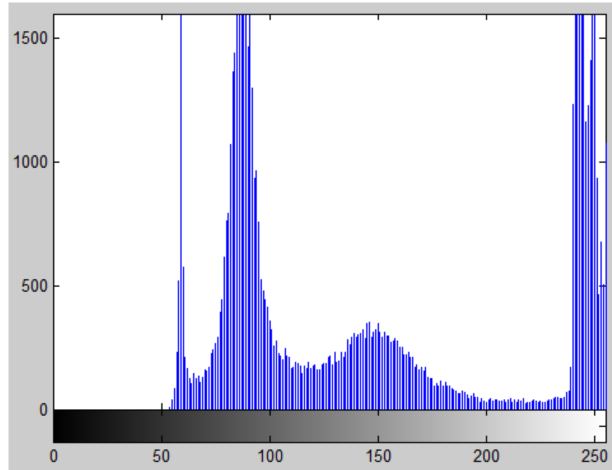

Figure 9. Histogram of compressed image

VI. Conclusion and Future Scope

In this paper we compare images and their histogram before compression and after compression using DCT function. This provides a compressed image without any loss of information. The whole experiment was performed over 2d images but it can be also apply on 3d images by using different compression functions.

We need to more compression on the biomedical images then we simply change the some parameters for the images or we taken some type of the transform techniques and then performing LZW technique.

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