Efficient JPEG-LS for Lossless Compression of Rib Cage with Visual Quality Preservation

Abd Abrahim Mosslah, Reyadh Hazim Mahdi and Hind Khalil Abrahem

ABSTRACT - The evolution that has occurred over the past years has increased the demand for telemedicine so that compression of medical images has become an important need. In medical imaging, images belong to the patient, a small percentage of which represents the blood vessels which help the medical staff in the diagnosis. While the rest of the parts of the image are less important in the process of diagnosis and can be priced higher than others. However, the quality of these parts is important for visual perception of the image. Current methods press the front and back images of the vascular Images are through different-techniques. In the research, We use the neural-network In order to remove the valves, the algorithm in this proposed technique has the ability to remove the rear panels.

***Index Terms* — Medical Image Compressing, Lossless Method, ROI, N-ROI, Low-Pass-Filter, (JPEG-LS) Compression and PSNR.**

I. INTRODUCTION

Rib cage disease is a threat to human health and the source is important to provide us with information to diagnose is the image of Rib cage, There was a need to transfer medical information remotely between hospitals as a result of the distance and time reduction of the debris of the patient, all this gave the pressure of medical pictures much attention, We face some disadvantages in image compression, such as loss of image quality,

with this we get an excellent compression ratio and the methods used in the compression depend on the method of removing the iteration in the frequency field, which makes the compressed image asymmetric with the original image,

Manuscript received Jan 20, 2021; revised Jan 20, 2021. (Call for Paper distribution 2019, but the conference was postponed due to the Corona pandemic, noting that the last revision of the manuscript was on 06-01-2021).

The research was supported by the University of Anbar and Mustansiriya University.

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An example is coefficients DCT, One example of loss of medical image compression methods has been suggested in [1]. Which in turn works in the field of wavelet field coefficients As well as the inclusion of a second example, as proposed Giovanni [2] Which focuses with high precision DCT coefficients for photo block, An important thing that fits medical applications, medical images can be restored completely after loss of data in the compression process The most common applications in this field of image compression research depend on pixel prediction in the spatial field.

When imaging the vessels, we should focus on the percentage of loss of compression that is necessary for the image. It is noticeable here that a large percentage of the image represents the background, so the main rib cage must be preserved fully, in order to maintain areas of great importance in the diagnosis and compression without loss, Here we must focus on the pressure without loss of importance for the whole picture, and we may note this in the picture of the vessels, and thus be large space for each frame used as a background, and here must maintain the main arteries and this helps us in terms of diagnosis (constriction, blockage), and to maintain Important areas for diagnosis DLC lossless compression technique was proposed, This technology (DLC (diagnostically lossless compression)) in turn divides the area into the area of interest is divided into the first regions, which include areas that have a role in determining the diagnosis, Partial pixel/pixel values for digital image insertion can be considered a fractional segment of pixels only part of the images

- The Vocational education to facilitate services
- Develop screening techniques and reduce social welfare costs [3]. And the second region non-ROI contains the background image.

In this study, we note that non-ROI is a part of the image, whereas ROI represents the quality of the ROI, which can estimate the original quality of the image, the watermark is carried out in the fields of conversion as in wavelets or DCT. This field is continuously in use by many compression algorithms as in the standard JPEG algorithm [4]. Chaabouni et. al. The compressed ROI implemented by (JPEG-LS) [3] and a lossy-compression-algorithm May be

ISBN: 978-988-14049-2-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

used with wavelets, Ström et al [5]. Compression NROI and ROI These are done using (S-transform) and loss of the (zero-tree), respectively. Shuai et. al. Shearlet is used to-compress the ROI and fractional coding in the wavelet conversion of N-ROI and in another method DLC the compression pressure tree without loss and the fractional compression techniques are applied to ROI and N-ROI, respectively [6]. In this paper, we divide the image used to (ROI-NROI) through our network (CNN) and then propose-a hierarchical-approach that divides each of these regions into blocks and then into sub-blocks. In order to avoid the typical effects of the compression method of the conversion range, we use a filtering feature. The function of this filter is to improve the visual aspects of the image as well as remove more Of the iteration after this compression is applied (JPEG-LS) [7] on the resulting image.

II. OVERVIEW OF LOSSLESS COMPRESSION MODERN METHODS

Interest has recently increased with the use of pressure systems in biometric systems. However, emphasis is placed on the techniques of loss, because in this context, compression is studied precisely. For example, [8], (JPEG, JPEG2000, PRVQ, SPIHT), as well as the compression of images on the accuracy of selected fingerprint recognition. This is one of the results indicates the application of lossless-compression algorithms that use strong trends in fingerprint-images, despite the presence of hills and valleys, it was found when conducting a survey following a dominant ridge procedure we improved cryptographic results without loss compared to PNG and JPEG-LS [9].

Image-compression-algorithms are browsing without loss as :

JPEG-2000 is the following ISO-ITU-T standard for fixed image encoding, which is based on DWT and the assignment of post-pressure

(JPEG) lossless version This technique is not similar to the JPEG standard, where lossless-version JPEG it takes the place of DCT-integer instead of DCT-traditional.

(S + P) A technique to obtain lossless image compression, like wavelet conversion, where Said. and William. A. Pearlman proposed a true multi-path transformation called (S + P) [10].

JPEG-LS technology is the most recent ISO-ITU-T standard for uninterrupted lossless image encryption. It is the source of (LOCO) encryption using the middle edge detection and later prediction and the (Golomb) coding, which refers to two modes (operation and normal modes) [11].

CALIC is an image codec that has the ability to adjust without loss [12]. This is a tuning the technique is based on the current pixels, pixel context to be encoded (that is, the setting is pixels of some predefined predetermined-patterns). This method has the ability to learn from the errors reported in previous predictions.

Lossless-JPEG (L-JPEG) this feature was observed and put a late addition to JPEG technology in (1993) through the use of different clearly technique than the lost JPEG-standard [13]. Based on a forecasting scheme that relies on the nearest neighbors (left-top, top-eft) and Using Ethernet encryption in the error prediction. It if be noted that (Ken Murchison about Oceana grid Ltd) composed An Patavium extending the IJG backing for JPEG lossless. This method is acknowledged in therapeutic imagine the place will be utilized within advanced cameras to compress raw images as well as used in DNG and despite all this has not been widely adopted.

PNG is the basic format for a compressed file without losing and storing images. PNG graphics are a (W3C) recommendation for still image encoding that has been developed and used as a free-to-use (GIF) with many of the latest features and their integration, based on the interoperable code and predictive schema [14].

WinRAR This technique is an archive of computer files as well as an in the (Eugene Rochel) proposal of the data compression tool) and used in 1993. It is one of the rare techniques that rely on the idea of creating archives (RAR) in the original.

III. PROPOSED MEDICAL IMAGE COMPRESSING AND LOSSLESS METHOD

In the field of telemedicine, the process of using medical image compression has become a necessity in this field. The vast data stored from the medical images of large numbers of patients using the various imaging techniques produced by a large number of medical images by storing the disease data resulting from imaging techniques Different: DSA (digital subtraction angiography), DSA (computed tomography), MRI (magnetic resonance imaging), PET (positron emission tomography), and Etcetera medical imaging techniques. Figure (1) shows some medical images As a result of the above, it would be helpful if medical images are compressed by storing information as the basic image for image restructuring. Image compression operations consist of two stages

- Search for image data properties, graylisted graph, entropy images, links, and functions.
- Create appropriate compression techniques to obtain a picture of these characteristics [3].

ISBN: 978-988-14049-2-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

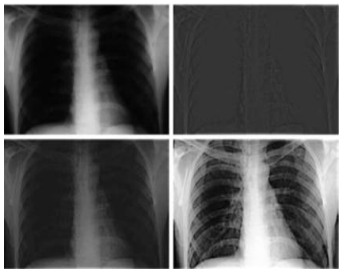

Fig. 1. A, B, C, D (a) X-ray image A chest (b) Result of low-pass filter with Gaussian filter (c) Result of JPEG-LS (d) Result of JPEG-LS with PSNR

In this work, we segmenting rib confine images into ROI (Region from claiming Interest) and N-ROI through utilizing our CNN (convolutional neural network), Similarly to those schemas On our paper. Here the system may be Toward utilizing a hierarchic approach with a partition the principle area under obstructs. Also, these squares under sub-blocks, for the sum (ROI) all. Through the use of a specified coefficients DCT the frequency ratio can be reduced to determine which transactions must be evacuated. The point when we utilize the edge-detector careful to avoid. The block resulting from the compression of the conversion range, and to further improve the visual aspects of the image we need a smoothed filter as well as removing further redundancy, To achieve a positive result between the compression ratio and the image information we use JPEG-LS compression [15] which applies to the resulting image from previous operations. To illustrate the idea of the proposed method is done in Figure (2) As for the segmented of the image we use the proposed CNN framework. The network is provided with medical images in a grayscale Rib cage images as input Then the procedure a region of interest probabilities' map, Which estimates a foreground / ROI Region. With this method, we divide the (NROI) pixels into blocks and thus reduce the frequency by eliminating (DCT) coefficients, In the end, the algorithm can be error-free and predictable to work effectively on the resulting image, Background areas contain an N-ROI where there are a lot of redundancies which are removed.

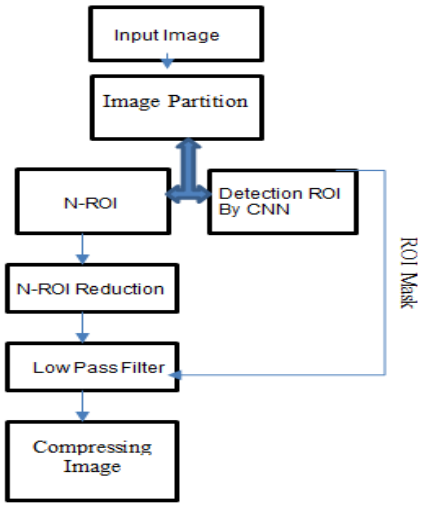

Fig. 2. General graph of proposed method

The steps of the proposed method are as follows:

A. ROI Detection by CN

In the image, order may be utilized CNN Furthermore Awhile ago planned What's more spoke to in [16], this system will be a system dependent upon those Patavium the place you get those rib confine pictures Which need aid to grayscale and span 33 x 33. Then, correct these images by producing a probability map (a pixel having a place of the ROI). As followed in [16], When a threshold is applied to the created likelihood map, the dismembered rib cage is obtained segmented, Then, the biggest part joined Similarly as (ROI) for different parts will be backed Likewise (NROI).

B. Image-Partitioning

Here the image is partitioned into a block in the form of a matrix consisting of 8 x 8 rows and each consists of four sub-blocks. As a result, we get two sub-blocks, one of them is NROI if have all of its pixels and all the other block are called ROI if they contain all their pixels. For ROI blocks, we check their sub-square Furthermore check. Them whether they are sub-ROI blocks (We do not change anything) or no, Figure (3) shows how the hierarchical algorithm performs by decreases entropy for more ROI regions. While the application of image partition, which is used as a measure to reduce entropy, is illustrated.

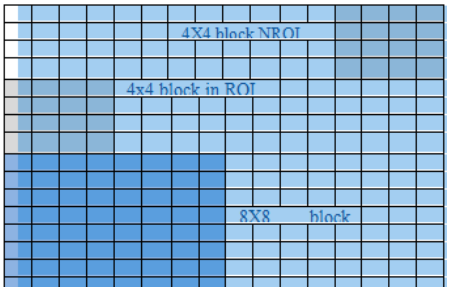

Fig. 3. Representing the hierarchical block of the image

C. *Entropy Reduction Non-ROI*

Here we utilize DCT coefficients on uproot the redundancies the place we trade DCT high back coefficients with zero's to in block N-ROI. Utilizing those (JPEG-LS) algorithm, those yield image size is decreased, then afterward those last layering will be executed without loss, this will be examined in area IV, should figure out whether it will be low coefficient we utilize the city piece separation of the city about coefficient crazy of the block, on this limit they would utilized a zigzag-coefficient examine is comparative with JPEG [17]. Here the primary coefficient from DCT should be maintained Which leads to the calculation of Equation (1).

$$Y = \sum_{\max 64, y_o + N_{Edge}}^{\max 64, y_o + N_{Edge}} \begin{matrix} \text{for } 8 \times 8 \text{ block} \\ \text{for } 4 \times 4 \text{ block} \end{matrix} \quad (1)$$

Where:

ISBN: 978-988-14049-2-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

- Blocks that have more important edges are the most
- The parameter is representing a variable can be adjusted
- The term is representing the number of pixel edges in the array
- The edges can be obtained by the technique of (canny-edge-detection)

We will find the margins on the entire image before dividing them into blocks-sub-blocks if these edges are accepted this means that we ignore the value of N_{Edge}. The last step of the algorithm at this stage is the blocks of tile and sub-blocks to reach the low entropy image.

D. Low-Pass- Filter.

A filter used to pass Low recurrence signal and low-frequency signals that are higher over those cut-off recurrences. The genuine sum about weakening to each recurrence differs relying upon the particular channel configuration. Homogeneity is essentially considered a low process in the frequency band. There are many models used as low-pass filters, Butterworth and Gaussian low-pass filter [1,18]. These filters are ideal in the simplest low-pass filter is the filter that cuts-off all Fourier transforms high-frequency components that are more than a distance away from a specified distance D of the conversion. In some cases, there are protective effects in the image. To remove this effect, a Gaussian filter is applied.

E. JPEG-LS Compression

For the ideal reconstruction of the original image of the compressed images is adopted technique lossless image compression, typically, data reconstructed in lossy compression differ from the original data. Compared to the lossless way of compression, the Lossless method does not lose any data, a simple calculation process uses only a small amount of power. Most of the algorithms used in image compression are lossy. This indicates the loss of some data when performing the encryption process. This is logically acceptable because the human eye does not have the ability to distinguish some differences. When using the Gaussian filter, we do not remove the elements from the ROI pixels because they may cause a wrong doctor diagnosis, so ROI pixels are replaced in the filtered image. Finally, JPEG-LS is used in the application to compress the N-ROI smoothing image [18].

IV. SIMULATION RESULT

For the test in this experiment in the rib cage image dataset used in the test, which includes 44 images and takes 512 x 512 pixels. The method proposed in this paper focuses on barter between compression and (PSNR) alludes will top sign to commotion ratio, presume those JPEG-LS measure is known as (NO) for those first images, same time JPEG-LS measure of the diminished picture entropy foundation may be (NB) Similarly as in figure (4).

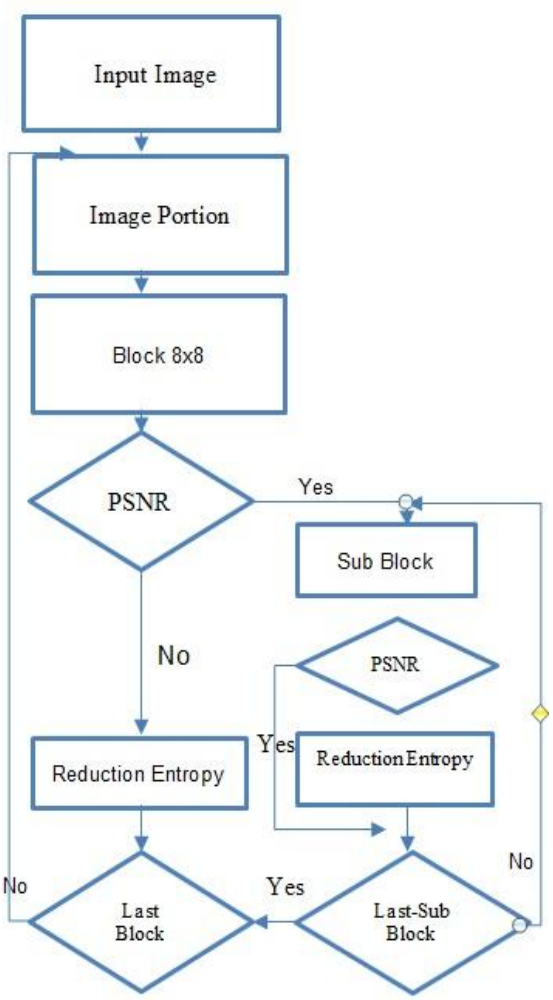

Fig. 4. A Complete Proposed Block Diagram

Then the CR (compression-ratio) represent as CR = NO / NB. In scientific terms, background information can be removed to increase in compression ratio with all the details of the image to increase PSNR. We evaluate the main objective of the system and PSNR and the compression ratio. This is done by calculating the calculated averages on all the images used in the test. This leads us to calculate the PSNR by the following equation:

$$\mathrm{PSNR} = 10\,\mathrm{Log}_{10}\left\{\frac{\mathrm{MAX}^2_{\mathrm{Orig}}}{\mathrm{MSE}}\right\} \quad (2)$$

Where: The most extreme worth of the first picture force level (255 for 8-bit images) and same time MSE is pointing of the square-error of the ROI pixels which will be calculated through the following equation:

$$\mathrm{M\Sigma E} = \frac{1}{N_G}\sum_{(i,j)\in ROI_G}\langle I_{orig}(i,j) - I_{proc}(i,j)\rangle^2 \quad (3)$$

ISBN: 978-988-14049-2-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

Where: I_{orig} *and* P_{orig} Which represent the original images and image processing, respectively, are the number of pixels in the ROI of the truth-ground ROI_G. While PSNR is calculating on the truth-ground for the ROI. While the ROI we obtained is different from the ground-truth for differencing values of Y_O. And to assess the effect of taking the edges into consideration. So we first do two simulations, the first using the (Canny-edge-detector) technology while the other without this technique, This represents the working parameters Y_o results in an 8 x 8 block, in this way each circle refers to a choice to Y_o. This is what we see as the upper left circle of each colour, is 1, while the lower right circle is. It should be borne in mind that our use of the edges of canny will significantly improve the performance suggested in this paper, here you should note that the constant compression-ratio for PSNR it will show us that the blue curve is more clear than the red curve, In order to obtain a good standard for selecting Y_o a new graph to be drawn, we take the following procedure to take the compression ratio values with the PSNR values to generate, This criterion depends on accuracy and on the compatibility of values, and thus has a good range of choice from 8 to 24. Knowing that we maintain the all coefficient of 16 DCT in (44) block. the benefit of this measure is to reduce distortions in the edges and boundaries of ROI, this is done using a Gaussian filter on only 44 blocks, The Gaussian filter has a good σ variance and generates high values leading to high compression ratios, although all this has some disadvantages in reducing the PSNR and optical image quality, the value of the threshold depends on the choice of variation applicable to Y as well as the amount of blocks, We do not have a measurement but according to high precision of the visual images can tell that a good choice for the parameter will be 1. In the canny-edge-detection technique, we have chosen a threshold value of 0.15. This reduction in threshold value will increase the number of edges detected. Eventually, we will get the highest PSNR value. But this will result in a reduction in the pressure ratio, and with careful consideration you will notice a precise model image as well as compressed versions according to the method proposed in this paper and the coefficient JPEG standard.

V. CONCLUSION

In this paper, we follow the algorithm of dividing the image ROI-NROI through our proposed-network (CNN) and then follow a hierarchical chain that divides each of these areas into blocks and then divide these blocks into sub-blocks. Here we have to note that ROI filters reduce the frequency by eliminating specific DCT parameters in order to determine which transactions can be removed. From this stage, the process of the edge detector is initiated and the precautions must be taken to avoid the typical effects of the compression method of the conversion range. Here a filter must be used to improve the demonstrate the visual aspects of the image clearly and more reduce redundancy. After this procedure, JPEG-LS compression is on the resulting image.

ACKNOWLEDGEMENT

The author's wild like to thank Anbar University (www.uoanbar.edu.iq) Anbar-Iraq for the support in the prevention work.

The author's wild like to thank Mustansiriyah University (www.uomustansiriyah.edu.iq) Baghdad-Iraq for the support in the prevention work.

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ISBN: 978-988-14049-2-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)