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Streamlined Compression Techniques for Medical Images

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ABSTRACT

By and large in remedial field checking performed on the little part of a picture anyway it comes to fruition high cost and less transmission speed as a result of its gigantic picture measure. Continuously it is to a great degree troublesome errand to diminish the degree of the picture without loss of information. At this situation by using some pressure strategies which are having the ability of higher remaking quality we will diminish the span of the picture. In any case, the nature of a photo expect a key part in the solution. On account of this reason we proposed upgraded pressure procedures. As a piece of this method we are performing district based division procedure by part the picture into two locales, ROI and NONROI which are trailed by applying LOSS and LOSSLESS pressure strategies. By applying different wavelets for ROI and NONROI pictures, we will register the pressure proportion and recognize the best appropriate wavelet procedure. By then we will finish our requirements i.e. picture with high transmission speed, less cost and less size. At long last compacted picture should be transmitted through flexible and web organizations. This examination article guarantees bolster for the destitute society with in regards to savvy who are enduring with ailments.

I. Introduction

Medical images are essential in therapeutic field; it assumes a basic part in medicine. Consistently Terabytes of image data is produced in the field of medical imaging, in the form of computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), X-rays and ultrasonography images. Usually the medical images possessed more memory space due to its resolution factor. Transmission and storage of uncompressed videos/ Images would be extremely costly and impractical. Frame with 352x288 contains 202,752 bytes of information. Recoding of uncompressed version of this video at 15 frames per second would require 3 MB. One minute→ 180 MB storage. 24-hour → 262 GB. Using compression, 15 frames/second for 24 hour→1.4 GB, 187 days of video could be stored using the same disk space that uncompressed video would use in one day. Nonetheless the storing and transmission of this vast size of medical images is a tough task. To conquer this type of disadvantages, the image compression technique is most significant in remedy. In this image compression by reducing the number of bits and by removing the redundant information the image should be compressed. By applying compression techniques on images we will loss quality of the image. But the quality of an image plays a central role in medicine.

As a part of this research we collected number of MRI images from various scanning centers. One of the MRI image which is shown in the below Fig.1 collected by us from GE MEDICAL SYSTEMS, during Lalitha Hospitals, Kottapet in Guntur.

So we proposed a new type of technique for medical images i.e. Region Based Coding (RBC). Here our medical image should be divided into two dissimilar regions named as ROI and NONROI. ROI stands for the Region of Interest and it is the necessary part which contains the main information. The other part is NONROI which is unnecessary part. Which are clearly shown in the Fig.1

Fig1.MRI image.

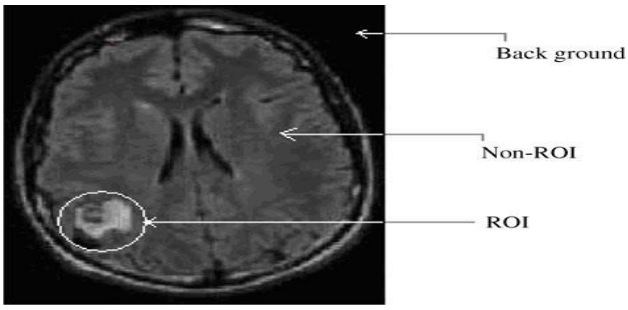

Fig 2.Differentiate ROI and NONROI parts.

After isolating of an image we are applying various compression techniques. We have ton of compression techniques. Mostly error free compression is preferable for data reduction and it offers compression ratio of 2 to 10. Some of error free techniques are Huffman coding, arithmetic coding, Run length coding, Bit plane coding. Not only in medicine, it also played a main role in video conferencing, remote sensing and Facsimile transmission. From the most recent two decades data compression is growing excessively.

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Here we need aid utilizing Loss and Lossless compression techniques. After that we are transmitting the image through wireless devices. This phenomenon is known as telemedicine. Telemedicine is important in medical analysis therapy and patient care.

Segmentation

Wherever the progression of isolating an image into divergent regions known as segmentation. Image compression should be performed based on the similarity and discontinuity of the intensity values. We have ton of segmentation techniques which are shown in the Fig.3.

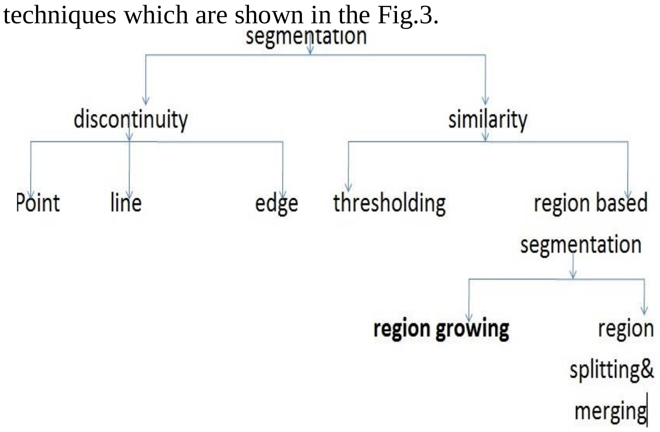

Fig 2a. Classification of Image Segmentation

PROPOSED method

State of review of art for this research article is In ROI based image compression; compression will be based on region of interest so that we get required output without any loss.

In the process of applying loss and lossless compression techniques to the segmented medical image we are exhausting wavelet techniques. IWT will utilize for lossless compression and dissimilar true compression techniques will use for the Lossy compression for finding different parameters. By comparing those quality metrics we will recognize most suitable method.

IWT (Integer wavelet transform)

IWT is also called as Lifting Wavelet Transform. Generally a signal transform is used to transform a signal to a different domain, perform some operation on the transformed signal and inverse transform it, back to the original domain. This means that the transform has to be invertible. In case of no data processing we want the reconstruction to be perfect, i.e. we will allow only for a time delay.

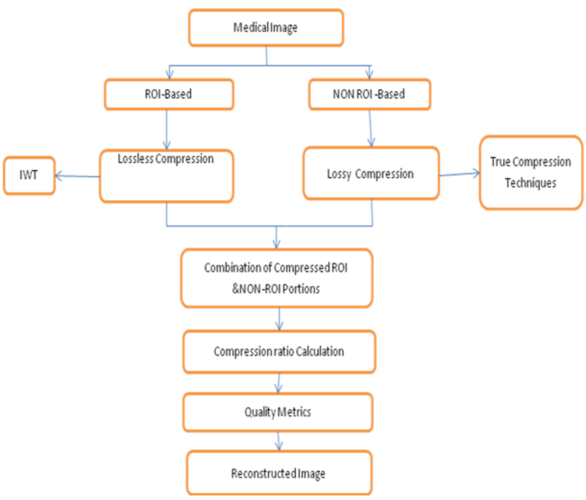

Fig 2b. Block diagram of proposed system.

As will be clear from our intermezzo the polyphase matrix is a matrix of Laurent polynomials and since we demanded that its determinant be equal to 1, we know that the filter pair (h,g) is complementary. The lifting theorem now states that any other finite filter g^{new} complementary to h is of the form.

$$g^{new}(z) = g(z) + h(z)s(z^2)$$

where s(z^2) is a Laurent polynomial. This can be seen very easily if we write g^{new} in polyphase form (see also the footnote with equation) and assemble the new polyphase matrix as

$$P^{new}(z) = \begin{bmatrix} h_e(z) & h_e(z)s(z)+g_e(z) \\ h_0(z) & h_0(z)s(z)+g_0(z) \end{bmatrix} = P(z)\begin{bmatrix} 1 & s(z) \\ 0 & 1 \end{bmatrix}$$

As can be easily verified the determinant of the new polyphase matrix also equals 1, we can apply the lifting theorem to create the filter $\tilde{h}^{new}(z)$ complementary to $\tilde{g}(z)$.

$$\tilde{h}^{new}(z) = \tilde{h}(z) + \tilde{g}(z)\tilde{s}(z$$

With the new dual polyphase matrix given by

given by

$$\tilde{p}^{new}(z) = \begin{bmatrix} \tilde{h}_e(z)+\tilde{g}_e(z)\tilde{s}(z) & \tilde{h}_0(z)+\tilde{g}_0(z)\tilde{s}(z) \\ \tilde{g}_e(z) & \tilde{g}_0(z) \end{bmatrix} = \begin{bmatrix} 1 & \tilde{s}(z) \\ 0 & 1 \end{bmatrix}\tilde{p}(z)$$

What we just did is called primal lifting , we lifted the low-pass subband with the help of the high-pass subband.

Embedded Zero tree Wavelet (EZW)

The embedded zero tree wavelet (EZW) coding was first introduced by J.MShapiro. This is the mostlaid-back and resourceful technique for the compression of information in an image. For the compression of a binary file we have to know about the some preceding properties and the structure of the file in order to exploit the irregularities and undertake the stabilities. The Wavelet transformation will produce the information about the binary file and it can be represented in a binary tree format with the root of the tree having superiors possible of containing a greater pixel magnitude level than that of the branches of the root.

Set Partitioning Algorithm

The SPIHT algorithm (set partition into hierarchical tree) is the best technique in terms of compression performance. It is exclusive technique Which does not directly transmits the contents of the sets, the pixel values, or the pixel coordinates, it transmit the decisions made in each step of the progression of the trees which defines the structure of an image. Because only decisions are being transmitted, the pixel value is defined by what points the decisions are made and their outcomes, while the coordinates of the pixels are defined by which tree and what part of that tree the decision is being made on. The advantage to this is that the decoder can have an identical algorithm to be able to identify with each of the decisions and create identical sets along with the encoder. Beforehand, the SPIHT was considered for lossy data *ROI-based image* Compression.

Now a day by merging the IWT with the SPIHT, it provisions both the lossy and lossless compression. One of the key advantages of exhausting SPIHT coding technique is, it supports embedded coding along with progressive transmission, which is suitable for telemedicine.

Simulation Results

In this paper we have taken dissimilar medical images and compressed those images by using Integer wavelet transform and true compression techniques.

The figures which are shown in the below represents the results of our project. As a part of this research we collected number of MRI images from various scanning centers.

One of the original medical image which is shown in the below collected from GE MEDICAL SYSTEMS, during Lalitha Hospitals, Kottapet in Guntur. The above image represents the MRI scanning of brain part. It contains tumor part which is diagnostically more important than other so it is consider as ROI part. And the remaining part is considered as a NONROI part

Fig 3.Original image.

Fig 4.Selection of ROI Part.

After taking a medical image we have to select our necessary part. As a process of this we are using a function IMFREEHAND for the selection of ROI part. A freehand region of interest can be dragged interactively using the mouse. By using this function we selected the necessary part which is shown in the above Fig.4.

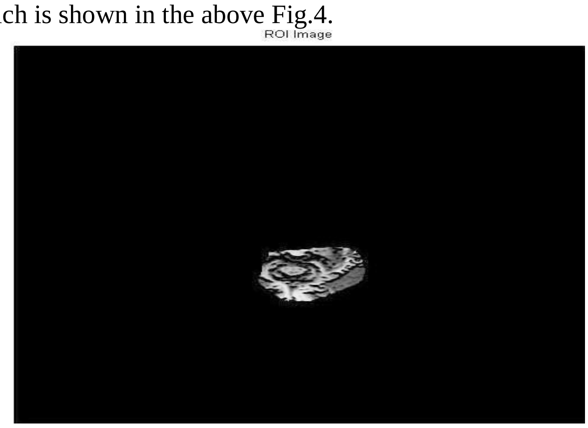

Fig 5.Separated ROI Part.

Separated ROI Part

Fig 6.Separated NONROI Part

After the selection of ROI part we have to segment the image in to two regions one is ROI and another one is NONROI. For this purpose we used ROIFILT2 function. After this phenomenon we will get the separated ROI and NONROI images which are shown in the above Fig.5 and Fig.6.

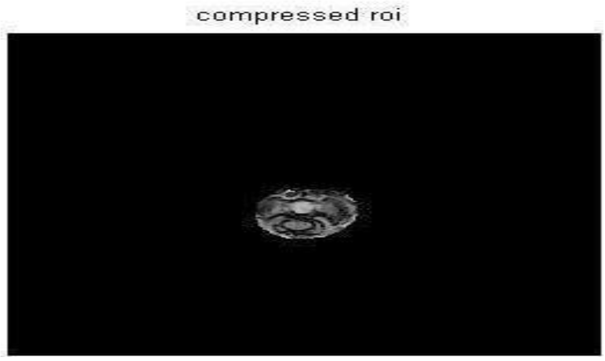

Fig.7.Compressed ROI Region

Here the Segmentation will be followed by the Compression techniques. ROI part will be Compressed by using lifting wavelet transform by utilizing the function LFTWAVE

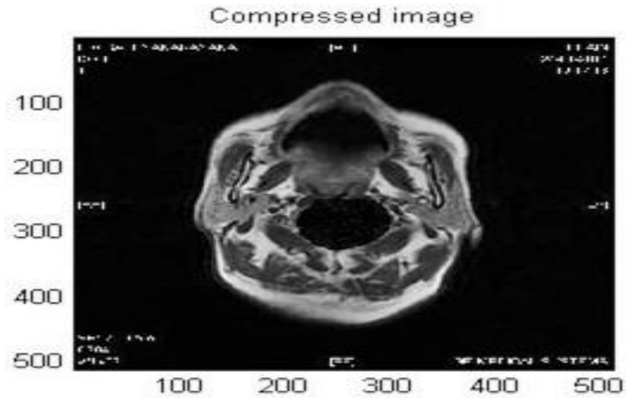

Fig 8.Compressed NONROI Region.

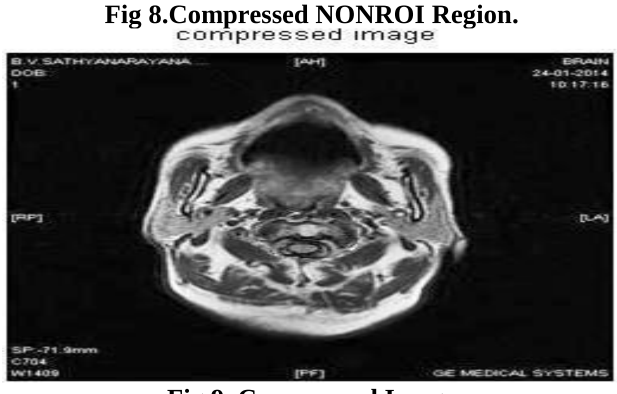

Fig.9. Compressed Image

We use wcompress method for compression of NON-ROI part. Wcompress True compression of images using wavelets.

Table 1.Technique EZW, Level = 4.

PARAMETERS	WAVELETS						
	Haar	Db	Sym	Coif	Bior	rbio	Dmey
M.S.E	0.085	0.115	0.118	0.115	0.408	0.208	0.115
MAX.ERROR	2	2	2	2	4	3	2
L2-NORM RATIO (in %)	100	100	100	100	99.99	100	100
P.S.N.R	58.79	57.51	57.39	57.51	52.02	54.95	57.50
B.P.P	4.025	3.475	3.53	3.42	2.82	4.71	3.492
COMPRESSION RATIO(in %)	50.32	42.43	44.13	42.75	35.31	58.99	43.66

No of encoding loops =12

Table 2. Technique SPIHT, level= 4.

PARAMETERS	WAVELETS						
	Haar	Db	sym	Coif	bior	rbio	Dmey
M.S.E	2.726	1.832	1.319	1.647	1.543	5.234	1.414
MAX.ERROR	97	68	82	46	69	48	37
L2-NORM RATIO (in %)	99.78	99.82	99.84	99.83	99.89	100.06	99.83
P.S.N.R	43.78	45.5	46.93	45.96	46.25	40.94	46.63
B.P.P	2.028	1.788	1.778	1.742	1.835	3.399	1.765
COMPRESSION RATIO(in %)	25.35	22.36	22.23	21.78	22.95	42.5	22.07

No of encoding loops= 12

Table 3. Technique STW, level= 4No of encoding loops= 12.

PARAMETERS	WAVELETS						
	Haar	Db	Sym	Coif	bior	rbio	Dmey
M.S.E	0.267	0.250	0.257	0.250	0.294	0.230	0.248
MAX.ERROR	3	2	2	3	4	2	3
L2-NORM RATIO (in %)	100.02	100	100	100	99.99	100	100
P.S.N.R	3.85	54.14	54.02	5.14	53.44	54.51	54.17
B.P.P	3.707	2.797	2.808	2.754	2.799	4.148	2.789
COMPRESSION RATIO(in %)	39.63	34.96	35.11	34.43	34.99	61.86	34.87

Table 4. Technique WDR, Level= 4No of encoding loops= 12.

PARAMETERS	WAVELETS						
	Haar	Db	Sym	Coif	bior	rbio	Dmey
M.S.E	2.36	1.502	0.979	1.318	1.43	5.234	1.085
MAX.ERROR	97	67	82	45	68	48	37
L2-NORM RATIO (in %)	99.91	99.93	99.96	99.95	99.97	100.06	99.95
P.S.N.R	44.4	46.37	48.22	46.93	46.58	40.94	47.78
B.P.P	4.784	4.006	4.031	3.91	3.227	5.538	4.018
COMPRESSION RATIO(in %)	59.8	50.08	50.39	48.89	40.34	69.24	50.23

Table 5. Technique ASWDR, Level= 4No of encoding loops= 12.

PARAMETERS	WAVELETS						
	Haar	db	Sym	Coif	bior	rbio	dmey
M.S.E	2.36	1.502	0.979	1.318	1.43	5.235	1.085
MAX.ERROR	97	67	82	45	68	48	37
L2-NORM RATIO (in %)	99.91	99.93	99.96	99.94	9.97	100.06	99.95
P.S.N.R	44.4	46.36	48.22	46.93	46.58	40.94	47.78
B.P.P	4.496	3.790	3.795	3.714	3.042	5.198	3.784
COMPRESSION RATIO(in %)	56.20	47.03	47.43	46.47	38.03	64.98	47.3

V. Conclusion

Every image contains some redundant information, which needs to be identified by the user to obtain compression. The IWT is recommended for critical medical application because of its perfect reconstruction property. In this research we used dissimilar compression methods for the

Measuring of the quality metrics by comparing those parameters we found the best compression method for NONROI region.

We performed improved compression techniques on the image this tends to fast transmission and less cost of the scan and also less storage capacity. By this analysis we make sure that the lesson in the cost of the image may helpful to society and fast transmission speed of the image may be useful to therapeutic field.

Table 6. Comparison of Compression Methods.

	Parameters					
Compression Methods	**M.S.E**	**MAX ERROR**	**L2-NORM RATIO (in %)**	**P.S.N.R**	**B.P.P**	**COMPRESSION RATIO(in %)**
EZW	.085	2	100	58.79	4.025	50.32
SPIHT	2.726	97	99.78	43.78	2.028	25.35
STW	0.267	3	100.02	3.85	3.707	39.63
WDR	2.36	97	99.91	44.4	4.784	59.8
ASWDR	2.36	97	99.91	44.4	4.496	56.2
SPIHT-3d	2.726	97	99.78	43.78	2.009	25.12
LVL-MMC	198.9	207	99.83	25.14	0.135	1.7
GBL_MMC_F	60.09	89	98.88	30.34	0.358	4.48

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