 ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

# A Comparative Study of Enhanced ROI Techniques

[1]Navneet Kaur Kang, [2]Sanyam Anand
[1]Student of M.Tech, LPU, Phagwara, Punjab, India
[2]Assistant Professor, LPU, Phagwara, Punjab, India

**Abstract**
In medical imaging system, image compression is the important task. Economic and effective image compression techniques are needed to minimize the storage volume of medical database in hospitals while maintain the image quality. There are certain regions in an image which demands high quality where small quality reduction might alter subsequent diagnosis. A Region Of Interest (ROI) - based approach is used to separate the important medical data and the background data. This paper proposes four enhanced ROI techniques having common objective to separate the image as foreground and background to improve the compression process. The four techniques are Mixed Raster Contour layering, block-based, region growing and hybrid active contour algorithms. Various experiments performed revealed that all the techniques are efficient to separate the input image into IR and NIR.

**Keywords**
Region of Interest, MRC Layering, Block-based Segmentation, Region Segmentation, Active Contour

## I. Introduction

Medical images are very important in the field of medicine. Many of medical imaging techniques such as Computed Tomography (CT) are used to develop the medical images, produce a sufficient data which requires a large storage area. An average 12-bit X-ray image is nearly 2048 pixels by 2560 pixels dimensionally, converting to a file of size 10,485,760 bytes [2]. An expressive transmission cannot be achieved if the image compression is not efficient, which helps in reducing the file sizes at the same time preserving the image quality. At first, the compression of medical images begun with using the image preservation techniques such as Scan pixel difference [11], which is pursued by intra and inter-frame redundancy reduction [9] [10] considered linear. The main challenge coped by medical compression techniques is that there is constant change in the imaging devices and as they used the different techniques to produce the medical images, so the new compression techniques are required [1]. Comprehensively, there are two compression techniques available i.e., lossless and lossy. In the lossless compression technique, when the decompression of compressed image is conducted, the image retrieved is same as the original image before compression. In the case of lossy compression technique, the image which is compressed if decompressed, the image retrieved is not same as the original image before compression, some of information is lost. The compression ratio of the lossy technique is more than the lossless technique. But the lossy compression techniques are not used extensively in medical imaging. There may be the loss of data which contains useful information, affecting the diagnosis of the patient [3]. In this paper we discussed the proposed ROI techniques which are used segmenting the image into IR and NIR regions. The techniques are MRC Layering, Block-based segmentation, Region Segmentation and the last one is Active Contour technique.

## II. Region of Interest (ROI)

The techniques based on Region of Interest (ROI) based have high compression ratios as well as preserving the high image quality.ROI based techniques involves both the lossless and lossy compression to compress the image. In it, lossless techniques are used on the interested regions of the image that are important for diagnosis which requires high image quality, while lossy techniques are used on the non-interested regions where image quality does not matter. The image is divided into two regions i.e., IR region which is compressed using Lossy JPEG algorithm [5] and NIR region which is compressed using lossless JPEG algorithm [6].The ROI compression model is shown in Fig. 1.

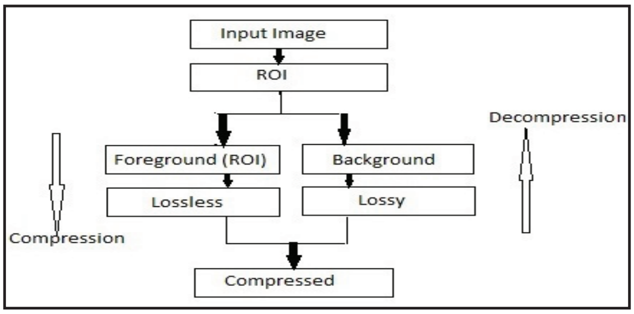


Fig. 1: Compression Model Based on ROI

## III. Proposed ROI Techniques

### A. Layer-based Segmentation

In this approach, the steps involved are the image is divided into IR and NIR layers, compression of each layer with an appropriate encoder is used to compress each layer, combination of the whole into one meaningful stream for transmission of storage and diagrammatically given in fig. 2. In layer-based approach, two planes i.e., rectangular and the mask plane are created from the original image where the rectangular plane represents the IR and NIR regions of the image and the mask layer determined that in the final image, which appropriate layer is selected. After acknowledged segmentation, a specific compression is used to compress each layer. Many of the algorithms used Mixed Raster Content (MRC) in image compression field. ([7-8]). After the image is decompressed, there is Halo effect on decompressed image which degrades its quality, which can be handled with average data filling method.

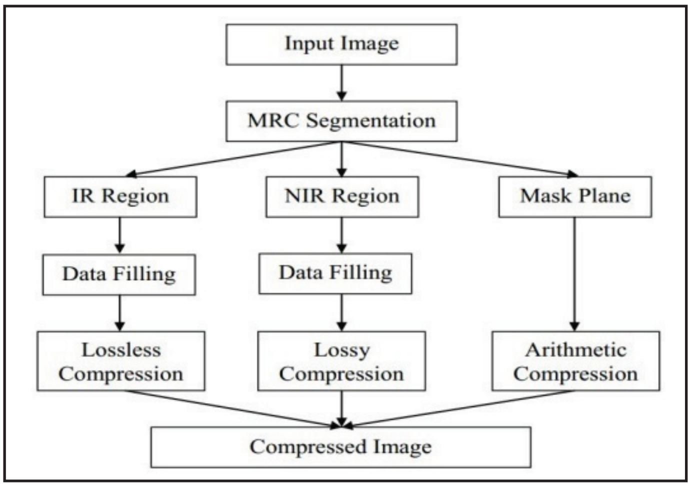


Fig. 2: Process of ROI-MRC Segmentation Algorithm

An image is segmented into the interested region, non-interested region and a mask layer image by the MRC model. The following Eq.1 is used by mask layer to create the last image from the IR/NIR layers where IR is interested region and NIR is non-interested region.

IMAGE = (1-M) * IR + M * NIR  $M \in \{0, 1\}$  (1)

On the corresponding position, a pixel is selected for the interested and non-interested regions with its dependency on mask values on specific position. It can be 0 for interested region and 1 for non-interested region. The IR layer is flooded through the mask onto the NIR layer. The MRC has two methods i.e., plane decomposition and the plane composition process. The classification of the image is done by plane decomposition and the plane composition has been used at the time of decompression [14]. After composition, the layers are generated, which create a halo effect. Those layers are sparse matrices having missing areas which is the cause of a 'halo' effect. To get rid of halo effect, a simple average data filling technique is used which processes both the IR and NIR layers. The steps involved are given below.

**Step 1:** Divide the picture into squares of size 8x8.
**Step 2:** Blocks lying totally in the NIR are left in place.
**Step 3:** Blocks lying totally in the IR are loaded with the general picture mean.
**Step 4:** Partially void blocks are then filled by utilizing an iterative approach that propagates values from the current pixels, utilizing general picture mean value.

Thus, the enhanced MRC approach with the data filling method has the Steps described below.

**Step 1:** The image is segmented into IR and NIR layers.
**Step 2:** Generate the binary mask layer
**Step 3:** Apply data filling to remove the halo effect.
**Step 4:** Compress IR utilizing lossless JPEG, NIR utilizing lossy JPEG and mask layer utilizing JBIG compressors.
**Step 5:** Combine results into one compelling stream.

When the interested and non-interested regions and the binary mask layer are recognized, then the IR and NIR regions are compressed using any of the lossless and lossy technique while compression of mask layer is done by Joint BI-level Image expert Group (JBIG).

### B. Block-Based Segmentation

In the block based segmentation uses a block classification method that has low computational complexity, which is the most significant characteristic required in real-time medical imaging systems. In the case of medical image, each region follows approximate object boundaries and is made of rectangular blocks. The Block compression model in ROI is based on the analysis of local data using histogram and the block classification algorithm to segment the image into IR and NIR.

First, the image is segmented into 16x16 sized blocks. The algorithm of ROI-BLK is based on two properties, i.e., histogram and the gradient of the block and in each block, every pixel value are classified into three classes as per the pixel's intensity value i.e., low-gradient pixels, mid-gradient pixels and high-gradient pixels. Then the histogram distribution for every pixel group is evaluated. The non-interested region blocks extensively contain only low gradient pixels while interested region contains mid-gradient and high gradient pixels. Each block is recognized using a block map and the block map is then compressed using an Arithmetic coder. The algorithm is initiated by evaluating the probability of value of the intensity, i, considering i = 0 to 255 from the Eq. (2).

$p_i$ = freq(i) / $B^2$  (2)

where B denotes a block size and a value of 16 is used in the experiments. Next, the mode (m1, … , mx) is evaluated and the cumulative probability around the mode m has been calculated using Eq. (3).

$$c_n = \sum_{m-A}^{m+A} p\text{i}. \quad (3)$$

The block type is judged by four thresholds at the time of classification of block and the decision rules are defined. The segmentation results showed that the usage of these threshold values produced improved results. After segmentation, the compression of non-interested region are done by using any lossy technique and interested region is compressed using lossless technique and the block map is compressed using an Arithmetic Coder.

### C. Enhanced Region-Segmentation

It is a method, in which the elicitation of the region of the image is conducted on the basis of information of the intensity values and edges of the image. In it, a seed point is required that can be selected by an operator manually. After selecting a seed point, the pixels are extracted which are attached to the initial seed with the similar intensity values. Distinguishing the regions in the group having some common characteristic between a pixel and its adjacent pixels is the main objective of the region growing segmentation. These characteristics can be intensity values of the given image or specified texture patterns of every region, and the whole procedure is iterated for each boundary pixel in the image. The algorithm of region-merging is used where the edges which are delicate are disappeared and edges which are strong enough remain inviolate, if the adjacent regions are found. The steps involved are given below:

1. First, select an irregular seed pixel and measure it with the neighboring pixels.
2. The locale is produced from the seed pixel by abutting in neighboring pixels that are close, growing the measure of the district.
3. As when the expansion of one district ends, then the other seed pixel which does not have a place with any area is chosen and the procedure proceeds.
4. The entire method proceeded till all pixels fit in with the extremely same area.
5. The calculation is exceptionally steady concerning clamor. It is conceivable to exploit a few picture properties, for example, low inclination or ash level power esteem, on the double, while utilizing locale developing calculation.

At the last of algorithm, there are two conditions that determines the candidate pixels and ensures that the selected seed point is highly identical to its neighbours and is not a boundary region. For it, the relative Euclidean distance [12] between the seed point and its neighbours has been calculated using eq. (4).

$$\text{Di} = \frac{\sqrt{P - NPi}}{\sqrt{P * P}} \quad (4)$$

where P denotes the seed point and i denotes its 8 neighbouring pixels. After integrating the automated process of initial seed selection, the enhanced region growing algorithm is evaluated.

Automatic Selection of Initial Seeds is given as follow:
1. Divide the image into 16x16 blocks
2. For each block, i, ($1 \geq i \leq N$)
3. Calculate threshold T

ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

- Initialize T as average of maximum and minimum intensity
- Repeat Steps iii to v till T converges
- Group pixels into two groups, G1 and G2, where G1 has pixels whose intensity value is greater than T and G2 have pixels whose intensity value is less than T
- Calculate Mean (μ1 and μ2) and Standard Deviation (σ1 an σ2) of G1 and G2 respectively.
- Re-estimate T, T = 0.5 * [(μ1 and μ2) + (σ1 and σ2)] and goto step 3

4. Calculate total variance (TV) and mean variance (MV)
5. Calculate Seed Threshold, T

S = TV + MV

6. Determine pixels with Ts< T and select them as initial candidate seed points
7. Selected seed point only if both the conditions listed below are satisfied.

- The candidate seed pixel point must have the similarity higher than TS.
- The maximum relative Euclidean Distance to the candidate seed's eight neighbours should be less than TS.

The steps of algorithm are as follow:

- Apply programmed seed determination calculation to acquire starting seeds for region growing.
- Measure the separation between seed point and its neighbors
- Check the neighboring pixels and add them to the range on the off chance that they are like the seed
- Repeat steps 2 and 3 until no more pixels can be included

### D. Enhanced Active Contour based Segmentation or Hybrid Active Contour based segmentation (ROI-HAC)

The active contour technique has become quite popular for a variety of applications, particularly image segmentation and motion tracking. Active Contour algorithms are of two forms of models i.e., Snakes and Explicit. The idea used behind it is that the manually defined an initial guess, that is moved further by various forces. The active contour is preceded by the forces directed by the images to edges of the objects in the image (Figure 3).

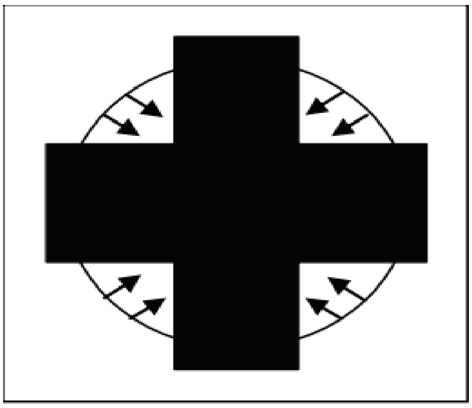

Fig. 3: Active Contour-An Example

The steps of ROI- HAC Based Algorithm are as follow

1. Obtain initial contours from region growing algorithm
2. Set the contour shape as circle and obtain the initial assumed distance.
3. At the beginning of each iteration, calculate external energy ($E_{ext}$) with respect to x and y separately.
4. Call level set algorithm for all N iterations and then find shortest traveling time from a point x to boundary x Estimate Energy ($E_{ext}$) and calculate Partial Differential Equation

Determine distance, curvature terms, gradient and speed

Update level set function

if Iterations □ N then Reinitialize seeds. Calculate change and record in contour

End

End

### V. Display Segmented Image

The method combines a few little portions and detaches picture foundation by considering the separation between the forces of locale. All gatherings with comparable intensities are assembled together. After division, the NIR area is layered utilizing one of the lossy routines proposed and IR district is compacted utilizing one of the lossless coders.

### References


[1] V.Radha, Member, IAENG, "A Comparative Study on ROI-Based Lossy Compression Techniques for Compressing Medical Image", Proceedings of the World Congress Engineering and Computer Science 2011, Vol. 1, WCECS 2011.

[2] Janaki. R, Dr.Tamilarasi.A,"Enhanced Lossy Techniques for Compressing Background Region of Medical Images Using ROI-Based Encoding", IJCSET |December 2011 | Vol . 1, Issue 11, pp. 690-695.

[3] R.Loganathanand, Dr.Y.S. Kumaraswamy,"Active Contour Based Medical Image Segmentation and Compresson Using Biorthogonal Wavelet and Embedded Zerotree", Indian Journal of Science and Technology.

[4] Weinberger, M.J., Seroussi, G., Sapiro, G,"The LOCO-I lossless image compression algorithm: Principles and standardization into JPEG-LS, IEEE Transactions on Image Processing, Vol. 9, Issue 8, pp. 1309-1324, 2000.

[5] Weinberger, M.J., Seroussi, G., Sapiro, G,"The LOCO-I lossless image compression algorithm: Principles and standardizations into JPEG-LS, IEEE Transactions on Image Processing, Vol. 9, Issue 8, pp. 1309-1324, 2000.

[6] ITU-T Recommendation T.44,"Mixed Raster Content (MRC), Study Group-8 Contribution, 1998.

[7] Eri, H., YI, J., Charles A,B.,"Segmentation for MRC compression, Proceedings of SPIE, The International Society for Optical Engineering, Color imaging. Conference, Vol. 6493, San Jose, California, USA), 2007.

[8] Assche, S.V., Rycke, D.D., Philips, W, Lemahieu, I., "Exploiting interframe redundancies in the lossless compression of 3D medical images", Data Compression Conference, pp. 575, 2000.

[9] Hu, J., Wang, Y, Cahill, P.T.,"Multispectral code excited linear prediction coding and its application in magnetic resonance images", IEEE Transactions on Image Processing, Vol. 6, No. 11, pp. 1555 -1566, 1997

[10] Takaya, K, Tannous, C.G.,"Information preserved guided scan pixel difference coding for medical images, WESCANEX 95, Communications, Power, and Computing, IEEE Conference Proceedings., Vol. 1, pp. 238-243, 1995.

[11] Shih, F.Y., Cheng, S.,"Automatic seeded region growing for color image segmentation, Image and Vision Computing", Science Direct, Vol. 23, pp. 877– 886, 2005.

[12] Janaki. R, Dr. Tamilarasi. A,"Enhanced ROI (Region of Interest Algorithms) for Medical Image Compression", International Journal of Computer Applications, Vol. 38,

No. 2, January 2012.

Navneet Kaur is Student in Lovely Professional University Jalandhar (INDIA) and pursuing the M. Tech from Lovely Professional University Jalandhar in India. Her area of interest is Digital Image Processing.

Sanyam Anand is Assistant Professor in Lovely Professional University Jalandhar (INDIA) and he is pursuing P.hd from NITTTR. His Research interest includes Image Processing, Data mining and dataBases.