Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 5, May 2015, pg.407 – 415

RESEARCH ARTICLE

A WAVELET BASED BIOMEDICAL IMAGE COMPRESSION WITH ROI CODING

Pooja Sharma
Department of ECE, ITM University, Haryana, India
pooja.sharma312@gmail.com

Dr. Rekha Vig
Department of ECE, ITM University, Haryana, India
rekhavig@itmindia.edu

Abstract -- Medical images are the high quality critical images with high resolution. To improve the effectiveness of different processes on medical images, it is required to reduce the size of images. Compression or encoding mechanisms can be applied to reduce the image size. But the challenge is here to preserve the important image information. In this work, a DCT and DWT based hybrid model is defined to perform medical image compression. To analyze the effectiveness of this model, the ROI extraction on compressed image is performed. The experimentation here is applied on brain images. The obtained results shows that the presented work has provided the visually effective ROI extraction on compressed medical images. The experimentation on multiple images is performed in terms of compression ratio, MSE and PSNR value analysis.

Keywords – Compression, Medical Image, DWT, DCT, ROI

I. INTRODUCTION

Medical Image processing is one of the core applications to perform clinical study and to provide the diagnosis treatment based on organ image analysis. The medical processing is defined under some specific constraints such as image format specification, medical organ sensitivity, operational sensitivity etc. The accuracy and effectiveness of integrated operation is depend on the quality of the image itself. Generally, the medical images are high quality images with effective resolution. But to capture the effective information from these images, it is required to process the feature extraction approaches. Processing on these raw medical images is time consuming because of the quality and resolution of image. Because of this, there is a requirement to improve the effectiveness of these integrated operations without affecting the quality of results. One of such approach is defined in this paper. In this paper, the organ ROI extraction is obtained from compressed medical image. The presented approach has preserved the image information and provided the extraction of this information in an effective way. In this paper, DWT and DCT based hybrid model is defined to perform image compression and later on variation analysis based segmentation approach is applied to extract the image ROI. In this, some of the associated terms to the medical imaging are described.

Medical image segmentation is to obtain the interior representation or specific organ so that the medical analysis and intervention can be obtained on the image or organ. This processing also extent the processing data along with the specification of non-medical associated information. This medical domain is also formed with the specification of data streaming so that the effective information representation for medical area can be obtained. The medical image processing model adapted in most of applications is shown in figure 1.

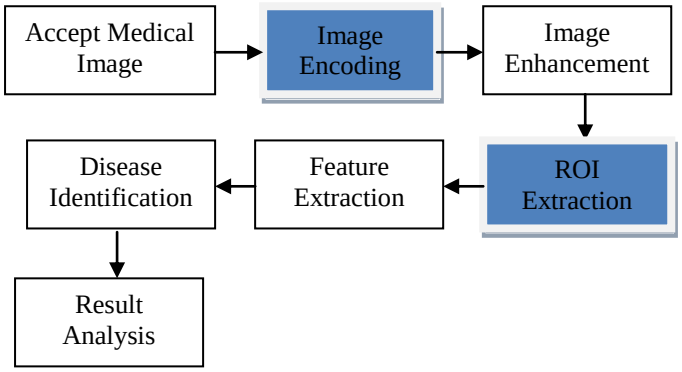


Figure 1 : Medical Image Processing Model

Here figure 1 is showing the basic image processing adapted by any diagnosis application applied on medical image. The blocks that are highlighted in this model are improved as per the work in this paper. According to this model, as the image is extracted it is in raw form. On this image, the encoding process is applied to transform in required form. This encoding can be perform to change the image resolution, format, compression etc. After this encoded image is processed for diagnosis algorithm. Once the encoded image obtained, the improvement in the image features accomplish using image enhancement operations. In this stage, the image filters are applied to reduce the noise over the image and to improve the image features. This filtered image is processed under high level segmentation process to separate the image areas. These area separations basically divide the image into two or more segments so that the relative and required segment can be processed. After processing applied on the required image segment, the features are extracted from the image. These features are specific to the organ or the diagnosis begins analyzed. Finally, based on the feature analysis, the disease identification is performed. The evaluation stage is defined as the post processing stage to perform the analysis on algorithmic process. The work stages in this paper involved compression and ROI extraction.

A) Medical Image Compression

Medical Image compression is the algorithm applied on images to perform image encoding so that the size of image will be reduced. The compression is here defined under information preserving constraints such as lossy and lossless image compression. The lossy image compression reduces the image size without caring about the associated image information whereas the lossless image compression is intelligent processing approach that preserves the effective image information. This algorithmic process basically works on redundant information, non-significant image areas that can be discarded over the image. In medical imaging, the lossless image compression is required that will not affect the relative organ information.

B) Image Segmentation

The image segmentation is the process basically applied on the input image to extract the image features or the image part. Segmentation can be applied to locate the image components, regions or the features. These regions or features can be taken in the form of contour extraction or texture analysis so that the effective image information will be preserved. The segmentation plays important role in medical imaging to identify the critical image area based on which the diagnosis can be applied over the image. Segmentation is divided into two stages. High level segmentation basically separates the

image parts or segments in generalized way such as ROI extraction or the background separation. The low level segmentation is based on the associated application and process such as to identify the organ diagnosis.

In this work, a hybrid model is defined to perform the effective image segmentation on compressed medical image. In first stage, the DWT and DCT based approach is defined to perform the image size reduction and later on applied the variation analysis to extract image ROI. In this section, the significance of medical imaging and associated operations is defined. A standard model for medical image processing is presented in this section. In section II, the work defined by earlier researchers is discussed. In section III, the proposed work model along with algorithmic approach is presented. In section IV, the results obtained from the work are presented.

II. LITERATURE SURVEY

Lot of researchers haveworked on different stages of medical imaging model. Some of the work defined by those researchers on compression stage and feature extraction stage is discussed in this section. Author[1] presented a hybrid model using combined algorithmic approaches called DWT, DCT and Huffman Encoding for preserving the image quality during compression. Chandan Singh Rawat[2] have worked on domain level for compression ratio analysis. Author defined the work under associated compression approaches and distance based method to obtain the information generation. Author obtained the significant outcome under compression generation and associated information formation approach. Author also applied the information analysis method to measure the quality of the algorithmic process. Monika Narwal[3] defined a work on feature analysis based compression approach. Author generated the information based on the information analysis which is applied to extract the probabilistic estimation. Author applied the quantization method to generate the effective image features. Sandhya Sharma[4] presented the component separation model along with compression integration to identify the unique image features. Later on the quantization is applied to generate the effective component form. Moh'dAli Moustafa Alsayyh[5] also presented the DCT and DWT based combined model under vcctor quantization to perform image compression. Author used the feature modeling to improve the compression accuracy. Aree Ali Mohammed[6] defined the DWT approach for feature extraction and coefficient extraction. Author defined a quantization vector based upon adaptive feature exploration so that the information loss over the image will be reduced. Mrs.S.Sridevi[7] presented a compression model to resolve the issues associated with medical images. Author defined the key exploration and extraction under quantization modeling so that the information diagnostic can be obtained. Author reduced the diagnostic errors under fidality loss measurement.

Author [8] presented a method to process the information extraction on CT images under abdominal information analysis. Author applied the work on organ for content based information retrieval. Author defined the model to extract the diagnosis information extraction under potential measures so that the information quantization and the early detection of cancer disease will be obtained. Author defined the work on various medical images including DICOM and CT scan images. Author[9] defined a work on ROI extraction and region generation using mathematical morphology and watershed algorithm approaches. Author used the integrated flooding method to identify the organ bounds. Author also used the hierarchical segmentation to explore the image features. Author[10] defined a work on reconstruction process under distance adaptive analysis. Author used the ultra eroded image to identify the structural information from the image. Author also defined the extraction of image features under various measures. Author obtained the shape and appearance anlaysis to generate the segmentation part over the image under sensitivity and noise analysis.

III. PROPOSED WORK

In the existing paper, a hybrid wavelet based approach is defined to improve image compression. The hybrid form generates using combination of two orthogonal transformations. The decomposition approach here defined to analyze the image under multi-resolution properties. This tranformation can be applied at multiple levels and with specification of differnt number of components in each resolution. Author defined a mathematical tool called Kronecker product to generate the matrix.

A) Kronecker Product

It is considered to generate the relevant resultant value that satisfy the requisite condition relative to the transform. The Kronecker product is used as a mathematical formula given as

$$C=AxB = [a_{ij}\ B]$$

Where Size of A = m1 x m2

Size of B = n1 x n2

Size of C = m1n1 x m2n2

The result matrix C obtained from the work is given as:

$$[C] = \begin{bmatrix} a_{11}B & a_{12}B & \cdots\cdots & a_{1m_2}B \\ a_{21}B & a_{22}B & \cdots\cdots & a_{2m_2}B \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{m_11}B & a_{m_12}B & \cdots\cdots\cdots & a_{m_1m_2}B \end{bmatrix}$$

Here A and B both are orthogonal matrices. C is also an orthogonal matrix that includes the properties of both A and B and combined in C. The properties of the integrated system are given below

a) Orthogonal

The hybrid wavelet form is defined with orthogonality principle i.e.

$$H_w^{-1}=H_w^t$$

b) Flexibility

In this wavelet, the components are transformed in different ways such as the combination of p,q can if both are factors of n. A and B can be interchanged. The value of i can be modifed from i_o to i_{n-1}.

IV. RESEARCH METHODOLOGY

In this present work, a hybrid model is defined to perform the information extraction from compressed medical image. The presented work is defined in two main phases. In first phase of this model, the compression is applied over the medical image. This compression model is content preserving model defined using DCT integrated DWT approach. According to this hybrid approach, the medical image decomposition is performed at three different levels and then obtained the coefficients of the image. Once the cofficents are extracted, the next work is to divi de the image in smaller blocks. On each block, the encoding is performed using different function. This encoding process defined using matrix based mapping as well as using DCT approach. The encoding process is defined in such a way that the higher intensity pixels will be preserved over the image and the low intensity pixel can be eliminated from the image. After this stage, the image information can effectively preserve from the image and obtain the compressed blocks. These coefficient blocks are then combined using inverse DWT approach. Once the image is constructed, the compressed form of image is obtained.

After this compression stage, the ROI extraction is performed based on the intensity variation analysis. To perform this, the image information is extracted in terms of integrated intensity range analysis. Based on this range analysis, the segments over the image are defined and the image content mapping to the segments is done based on minimum distance analysis. Once the segments are obtained, the average intensity analysis is performed to identify the integrity of these segments. This cyclic process continued till the effective image information is not obtained from the work. In this work, the image is divided in four main segments. These segments are able to represent the background area, foreground area, effective image component area and non-component area.

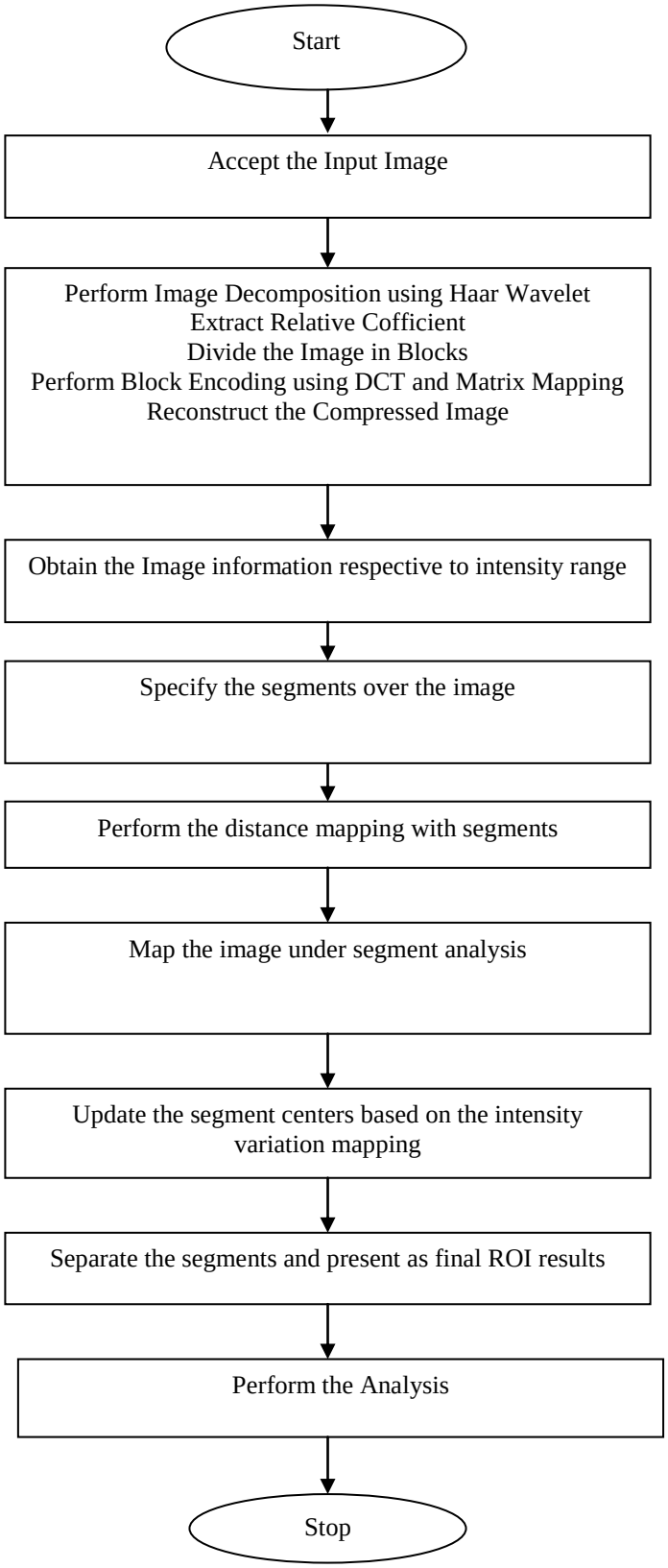


Figure 3 : Research Model

A) Segmentation

Segmentation is defined to generate the different segments or the ROI partition based on the content level mapping. This approach is used for the effective area generation over the image under unsupervised learning approach. The identification of classes are performed based on the segment specifcaiton. The steps to perform the analysis are given here under

1. Identify the intensity variation range over the image and split it in number of required segments over the image.
2. Perform the distance adaptive mapping to identify the content segment identification.
3 .Recompute the weights of these segments based on the variation analysis.
4. Repeat process 2 and 3 till the variation in the center position is not optimized.

B) DCT

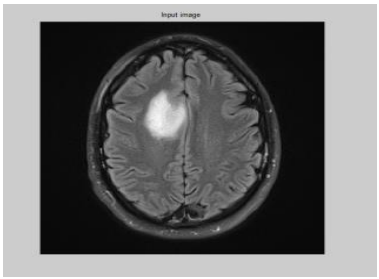
In this work, DCT is used as the integrated encoding approach to perform the block specific image transformation. This encoding mechanism actually decomposes the image in sub bands while maintaining the quality of the image. The DCT provides the image encoding from spatial to frequency domain. The medical image is divided into different intensity bands. The middle band is defined as the effective image area that is required to achieve loss less compression. This image part is elected in the image to provide the effective image encoding. DCT is defined on block mode so that the relatively effective compression will be obtained from the work.

C) DWT

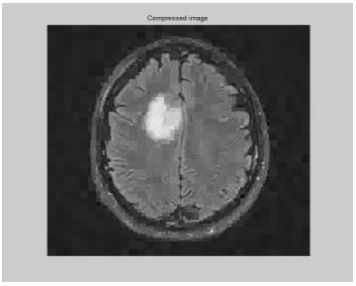
DWT is the the main decomposition algorithm used to analyze the image on different intensity vectors. This decomposition approach is defined with the use of wavelet function. This function itself represented by a mathematical function that actually divide the image in frequency domain based on the resolution anlaysis. The decomposition approach provides the image division based on the resolution level division in which the high pass filters and low pass filters are separated over the image. The DWT function defined here is specified with transformation vector and coefficient. This derivation or transformation is defined along with parametric specification and translation vector. The decomposition process generates different coefficient under frequency variations. These variations are obtained in terms of high and low vectors using which effective image compression can be obtained. In this work, DWT is used as the core model to perform the medical image compression. The Haar function is here used as the integrated function to extract the coefficients of the image. In this work, three level DWT is applied for decomposition

V. RESULTS

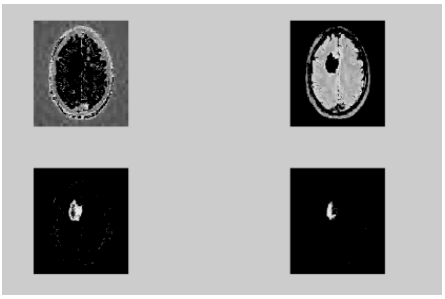
The experimentation of work is applied on multiple medical images. These images are in jpg format and includes the brain images. The images have different resolution and to obtain the normalized form, the images are converted to 256x256 size images. The sample image form is shown in figure 3(a). The results of the work is analyzed using existing and proposed approach. The proposed approach results are shown in figure 3(b) and 3(c) whereas the existing approach results are shown in figure 4.



(a) Input Image



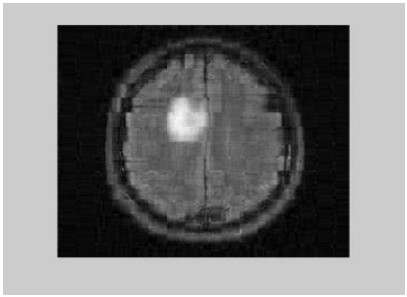
(b) Compressed Image



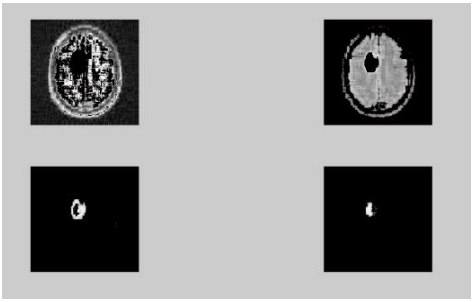
(c) Extracted ROI Image

Figure 3 : Processed Medical Image

The figure is showing the input image, the compressed image form and the extracted ROI image. The visualized results shows that the effective information extraction and segmentation is performed on the compressed image.



(a) Compressed Image



(b) Extracted ROI Image

Figure 4 : Hybrid Wavelet Tranformation (Existing)

Here figure 4 is showing the results of existing hybrid wavelet transformation. Figure 4(a) is showing the compressed image outcome. The result shows that the existing approach has given some information loss so that the image contents are modified. 4(b) is showing the extracted ROI image. The components are not completely visible.
These results shows that the component extraction in case of proposed approach are more clear than existing approach. The work is performed on multiple medical images and the analysis is performed in terms of compression ratio, MSE and PSNR values. The experimentation is applied on three different images. The results obtained from the work are given as:

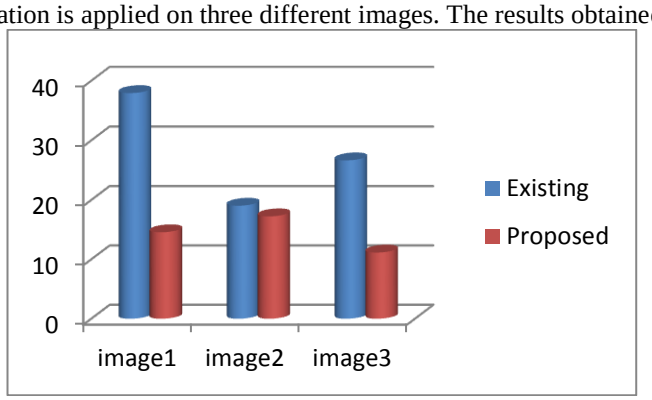


Figure 5 : Compression Ratio Analysis

As shown in the figure 5, the existing work has provided the high compression rate. But because of this compression, the information loss occur in the image.

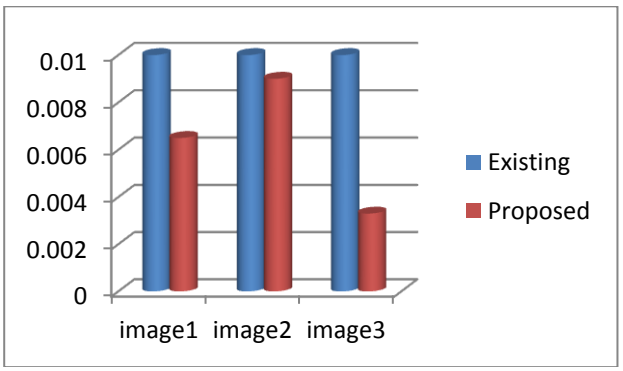


Figure 6 : MSE Analysis

Here figure 6 is showing the MSE value analysis. The MSE value of proposed work is lower which shows that more accurate compression is obtained in this proposed work.

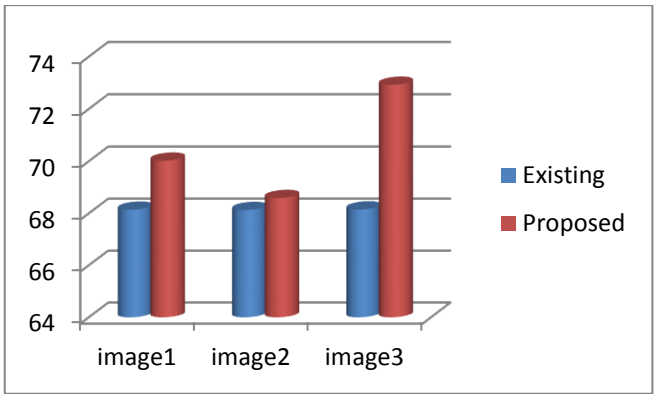


Figure 7 : PSNR Analysis

The figure 7 is showing the PSNR value analysis. The results shows that the PSNR value obtained in case of proposed work is much higher then existing approach. It shows that the quality compression image is obtained from the proposed work.

VI. CONCLUSION

In this present work, a compression adaptive model is defined to extract the effective ROI over the medical images. The experimentation shows that the effective information extraction and segmentation is done by preserving the information contents after compression process. The DCT adaptive DWT has maintained the effective intensity pixels so that the information loss is minimum. The experimentation of work is also applied on multiple medical images, the results shows that the compression in the existing work is high because of which some of the information contents are lost. This information loss degraded the quality in terms of MSE and PSNR values.

REFERENCES

[1] Harjeetpal singh," Hybrid Image Compression Using DWT, DCT & Huffman Encoding Techniques", *International Journal of Emerging Technology and Advanced Engineering* 2012, ISSN 2250-2459.

[2] Harjeetpal Singh," Image Compression Hybrid using DCT , DWT , Huffman", *International Journal of Scientific & Engineering Research* 2012, ISSN 2229-5518.

[3] Chandan Singh Rawat," A Hybrid Image Compression Scheme using DCT and Fractal Image Compression", *The International Arab Journal of Information Technology* 2012.

[4] Er.Monika Narwal," Image Compression By Hybrid Transformation Technique", *International Journal of Advanced Research in Computer Science and Software Engineering* 2013, ISSN: 2277 128X.

[5] Sandhya Sharma," Image Compression using hybrid of DWT,DCT and Huffman Coding", *International Journal for Science and Emerging Technologies with Latest Trends* 2013, ISSN No. (Online):2250-3641, ISSN No. (Print): 2277-8136.

[6] Moh'dAli Moustafa Alsayyh," Image Compression Using Discrete Cosine Transform and Discrete Wavelet Transform", *Journal of Information Engineering and Applications* 2013 ISSN 2224-5782 (print) ISSN 2225-0506 (online).

[7] Aree Ali Mohammed," Efficient Hybrid Transform Scheme for Medical Image Compression", *International Journal of Computer Applications*2011 (0975 – 8887).

[8] Haralick, R.M., and Shapiro, L.G. "SURVEY: Image Segmentation Techniques", *Computer Vision Graphics Image Processing*, 1985, 29, pp. 100-132.

[9] Vincent L. and Soille P. "Watershed in Digital Space: An Efficient Algorithm Based on Immersion Simulations," *IEEE Transactions on Pattern Analysis and Machine*Intelligence, vol. 13, no. 6, pp. 583-593, 1991

[10] Lee, J.S.L., Haralick, R., and Shapiro, L., "Morphologic Edge Detection", *Proc. 8th International Conference Pattern Recognition*, Paris (France), 1986, pp. 369-373.

[11] J. B. T. M. Roerdink and A. Meijster, "The watershed transform: Definitions, algorithms and parallelization strategies," *Fundamenta Informaticae*, vol. 41, pp. 187–228, 2000.

[12] C.Johnson, R.MacLeod, & J.Schmidt, "Software Tools for Modeling, Computation, and Visualization in Medicine", *CompMed 94 Proceedings*, World Scientific, 1995.

[13] http://www.mathworks.com/products/ matlab/tryit.html

[14] https://wiki.nci.nih.gov/display/CIP/LIDC

[15] http://www.radiologyassistant.nl/en/460f9fcd50637

[16] Dr. H.B.Kekre, Dr. Archana Athawale, Dipali Sadavarti, "Algorithm to generate Wavelet Transform from an Orthogonal Transform," International Journal of Image Processing, vol. 4, no. 4, 2011, pp. 444 455.

[17] Dr. H.B.Kekre, Dr. Tanuja Sarode, Sudeep Thepade, "Inception of Hybrid Wavelet Transform using Two Orthogonal Transforms and It's use for Image Compression," *International Journal of Computer Science and Information Security*, vol. 9, no. 6, 2011.

[18] S. Bacchelli and S. Papi, "Image denoising using principal component analysis in the wavelet domain," *J. Comput. Appl. Math.*, vol. 189, no. 1,pp. 601–621, Jun. 2005.

[19] Kekre, Sarode, Tanuja ,Vig, Rekha, " A new Multi Resolution Hybrid Wavelet for Analysis and Image Compression" , in *International Journal of Electronics*, 2013

[20] Ilias Maglogiannis, George Kormentzas, " Wavelet Based Compression with ROI Coding Support for Mobile Access to DICOM Images over Heterogeneous Radio Networks". *IEEE Transactions on Information Technology in Biomedicine*, VOL. 13, NO. 4, July 2009

[21] Dr. H.B.Kekre, Dr. Archana Athawale, Dipali Sadavarti, "Algorithm to generate Wavelet Transform from an Orthogonal Transform," *International Journal of Image Processing*, vol. 4, no. 4, 2011, pp. 444- 455.

