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To Enhance the Medical Images Using Aura Transformation

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Abstract:
An important and vital form to extract important and critical information from medical images is image processing. Distortion during image acquisition may lead to wrong diagnosis of the disease and thus may lead to negative conditions for the patient. So to overcome this problem the concept of aura transformation is used. In this, a structuring element is predefined and then it is compared to the complete pixel distribution relatively. This relativity is measured in terms of aura measure. This shows promising results and could be implemented on practical medical imagery for enhanced performance.

Key Words: Image Enhancement; Aura Transformation; Tm; PSNR; MAXERR; L2ART; ENTROPY; Neighbourhood element

1. Introduction

Medical imaging is an important source of diagnosing the malfunctions inside human body. Some crucial medical imaging instruments are X-ray, Ultrasound, Computed Tomography (CT), and Magnetic Resonance Imaging (MRI). Medical ultrasound imaging is one of the significant techniques in detecting and visualizing the hidden body parts. There could be distortions due to improper contact or air gap between the transducer probe and the human body. Another kind of distortion that may occur during ultrasound imaging is due to the beam forming process and also during the signal processing stage [1]. In order to overcome through various distortions, image processing has been successfully used. Image processing is a significant technique in medical field, especially in surgical decisions. Converting an image into homogeneous regions has been an area of hot research from a decade, especially when the image is made up of complex textures. Various techniques have been proposed for this task, including spatial frequency techniques. Image processing techniques have been used widely depending on the specific application and image modalities. Computer based detection of abnormal growth of tissues in a human body are preferred to manual processing methods in the medical investigations because of accuracy and satisfactory results. Several methods for processing the ultrasound images have been developed. The different methods of analyzing the scans can be classified under five broad categories. These are methods based on statistics (clustering methods), fuzzy sets theory, mathematical morphology, edge detection, and region growing. Image processing of ultrasound image allows extracting the invisible parts of human body and provides valuable information for further stages of the quantitative evaluation. Various methods have been proposed for processing ultrasound scans to make effective diagnosis [2]. However, there is still a scope for improvement in terms of the quality of processed images. Recently, an effective technique called aura, introduced by Rosalind W. Picard and Ibrahim Elfadel, has been reported and applied for the analysis of the textures, restoration of the distorted images, and segmentation of the geometrical patterns [3]. Even though many techniques have been used for analysis of the ultrasound images, the broad use of aura based techniques has not been reported yet.

2. Ultrasound Imaging

Ultrasound imaging plays crucial role in cardiology, obstetrics, gynecology, abdominal imaging, etc., due to its non-invasive nature and capability of forming real time imaging. Medical Ultrasound imaging is done by using ultrasonic waves between 2 to 20 MHz range without the use of ionizing radiation. The basic principle in ultrasound imaging is that the ultrasonic waves are produced from the transducer and penetrates in the body tissues and when the wave reaches an object or a surface with different texture or acoustic nature, some fraction of the this energy is reflected back. The echoes so produced are received by the apparatus and changed into electric current. These signals are then amplified and processed to get displayed on CRT monitor [4]. The output image so obtained is known as ultrasound scan and the process is called as ultra sonogram. There are different modes of ultrasound imaging. The most common modes are (a) b-mode (the basic two-dimensional intensity mode), (b) m-mode (to assess moving body parts (e.g. cardiac movements) from the echoed sound), and (c) Color mode (pseudo coloring based on the detected cell motion using Doppler analysis) [2]. Ultrasound imaging technique is inexpensive and is very effective for cyst and foreign element recognition inside the human body.

Figure 1: Ultrasound image of a fetus in the womb, viewed at 12 weeks of pregnancy (bidimensional-scan)

3. Aura Transformation

Aura transformation is mainly used for analysis and synthesis of textures. It is defined as the relative distribution of pixels intensities with respect to a predefined structuring element. The matrix computed from the local distribution of pixel intensities of the given texture is called aura matrix. Aura set and aura measure are the basic components of the aura based texture analysis. Aura set describes the relative presence of one gray level in the neighborhood of another gray level in a texture and its quantitative measure called aura measure. Xuejie Qin and Yee Hong Yang also used the aura based framework and showed that basic gray level aura matrices (BGLAM) can uniquely represent the given texture. A neighborhood element is used to calculate the relative presence of one gray level with respect to another. The concept of Aura has also been applied to 3D textures to generate the solid textures from the input samples automatically without user intervention. The results computed using weighted-aura matrix distance, outperform Wei and Levoy's method and are comparable to that proposed by Jagnow, et. al. Various techniques have been investigated for image processing in literature [5-9] [3]. Our present work is based on recently proposed BGLAM (Basic Gray-Level Aura Matrices) mathematical framework , which is developed based on the aura concepts (i.e., aura sets, aura measures, and aura matrices) [7]. The aura transformation for texture analysis and synthesis may have many advantages. The main advantage is that the input texture image is not needed once the aura matrix has been calculated. This reduces the storage

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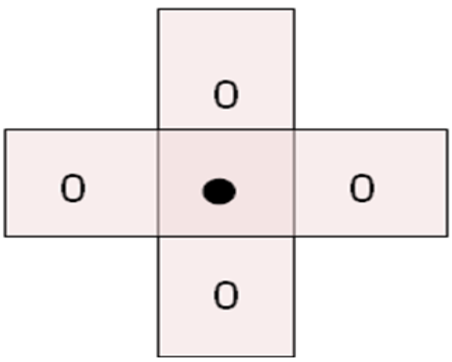
and computational complexity. Another advantage is that aura matrix is independent of its orientation. Hence each texture can be uniquely represented. In addition, this technique may further be used for constructing aura based distance measures for comparing the textures. The aura can also be explored for implementing different types of digital filters and also to estimate the boundary of different components in images of solids and fluids [4]. The output texture can be generated by the concatenation of the input texture sample that introduces a very serious problem of propagating the distortions present in the input sample to the synthesized texture. The sources of distortion may be due to the presence of random noise, wrinkles, foldings, cracks, rusting, etc. Further, the problem is inflated if these distortions are present near the edges. The net result of these distortions may be unpleasing and distracting effects developed in the synthesized output textures [4].

4. Mathematical Background of Aura

As discussed earlier, aura is a significant technique for analysis and synthesis of textures. The mathematical framework of aura is defined in [3] [4]. The input texture is represented as an ordered set of pixel intensity values. It is denoted by *S* and has the size N×M.



(a)

0	**0**	**0**	**0**	**0**	**0**	**0**
0	**1**	**1**	**1**	**1**	**1**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**

b)

0	**0**	**0**	**0**	**0**	**0**	**0**
0	**1**	**1**	**1**	**1**	**1**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**1**	**0**	**0**	**0**
0	**0**	**0**	**0**	**0**	**0**	**0**

(c)

Figure 2: Example of an aura on a binary lattice with four nearest neighbours system. (a) A sample binary lattice S, where the subset A is the set of all 1's and B the set of all 0's. (b)The structuring element of the neighbourhood system (c) The set of shaded sites is the aura set of A with respect to B.

The structuring element is a collection of pixel intensities taken from site where it is placed on the input texture image. After placing this element at a particular site, the intensity values taken from two sets called Set A and Set B are matched with the pattern of the pixel values of the image just below the structuring element. The choice of shape of the structuring element depends on the nature of analysis and the input image. The values of intensities used for A and B depends on the input image and the nature of the analysis. Various schemes for assigning the intensity values to sets A and B lead to different aura patterns. In general, the structuring element is denoted by N ={Ns , sϵS}, where, Ns is one of the elements (single pixel intensity) taken from the set S or its subset A or subset B. The elements around which the aura is to be determined are taken from the set A. The intensity values of the surrounding elements are taken from the set B. The set of matching patterns in the given texture image as per the structuring element is called aura matrix.

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Mathematically, the aura of A w.r.t. B is given by,

$$\vartheta_B(A) = \bigcup_{s\in A}(N_S \cap B) \qquad (1)$$

The total number of aura patterns obtained for a combination of pixel intensity values taken from set A and set B according to the structuring element is called the aura measure for that combination and is given,

$$m(P_A, P_B) = \sum_{P_t = P_{AB}} |P_t \cap P_{AB}| \qquad (2)$$

Where |Pt ∩ PAB| represents the total number of elements in the given set. P_A and P_B are the patterns formed by taking elements from set A and set B, respectively according to the structuring element. P_t the pattern formed in the input texture at the position where the structuring element is currently placed. P_{AB} is the pattern formed from the elements set A and set B. Hence the aura measure for a combination of P_A and P_B at a particular site in the input texture is equal to total number of matchings of all possible patterns formed from set A & set B with respect to the pattern formed below the current position of the structuring element. It should be noted that the matching of patterns is to be computed only at the sites where the intensity values in the input texture are identical to the elements in set A.

The matrix of all the patterns which can be formed for different combinations of the intensity values taken from set A and B with respect to the given structuring element is called aura matrix. For simplicity the image textures are analyzed using their gray level representations. GLAM (Gray-Level Aura Matrix) defines the aura measure for a typical the structuring element and the texture image shown in figure 2 between S_i and S_j using the relation.

$$[a_{i,j}] = m[S_i, S_j] \qquad (3)$$

Where S_i and S_j are the ith and jth gray levels in the range {0≤i, j≤1} [9].

5. Methodology and Technique used

From the literature survey, it is concluded that limited work has been done using the concepts of aura based transformation. Our previous investigations have shown that aura transformation may be enhanced by modifying some of the concepts of aura technique [11-15]. In the present work, the basic concept of aura is further modified to widen its application area. Here, modified aura concept has been used for investigating and enhancing the quality of medical images for better medical diagnosis. The modified aura based algorithm is shown in Fig. 3 in the form of a flow chart.

In preprocessing step, the input ultrasound images are converted to gray scale and it's modified to reduce the number of computations. The reduction depends on the expected size and texture of the abnormal region in the scan. Different types of normal and diseased ultrasound images are processed for investigating the effect of aura on the neighborhood structures of the images.

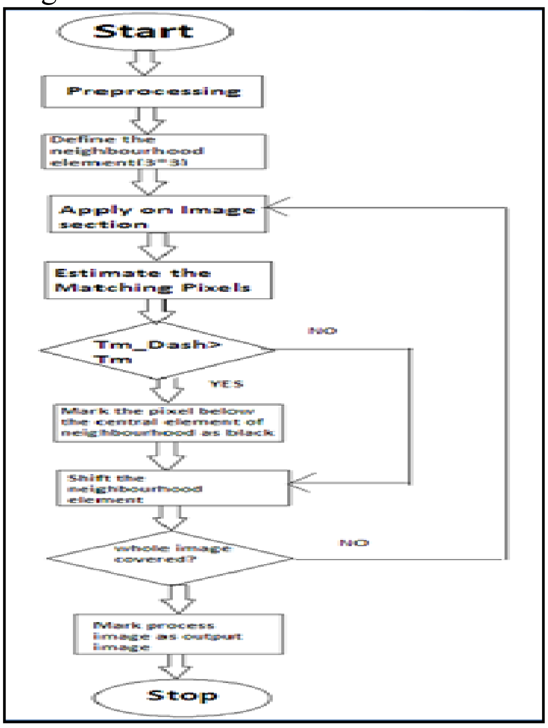

Figure3: Research Methodology

The input image is processed using this structuring element by traversing it pixel by pixel on the whole image. The pixel corresponding to the central element of the neighborhood element is marked as black, otherwise left unchanged. This process is repeated for the entire input image. The investigations have been carried out with different values of both the thresholds and input ultrasound images.

6. Results and Discussions

The investigation carries out using the various ultrasound images as input image. The result is stored in Excel file for different Tm value.

Input:

Figure 4: Input Image1

Table1: Values for Different Tm values of input image1

Tm	MSE	PSNR	MAXERR	L2RAT	ENTROPY
1	3569.28692	12.604989	255	0.001792769	0.046420222
2	3569.11594	12.60519705	255	0.001840586	0.061910518
3	1.709044	45.80327117	224	0.999522039	0.982169475
4	0.210316	54.90208048	167	0.999941182	0.978733239
5	0.011852	67.39288718	42	0.999996685	0.977553095
6	0.00044	81.69627684	6	0.999999877	0.977099344
7	0.000016	96.08960378	2	0.999999996	0.977035036
8	0	65535	0	1	0.97703296
9	0	65535	0	1	0.97703296

Output:

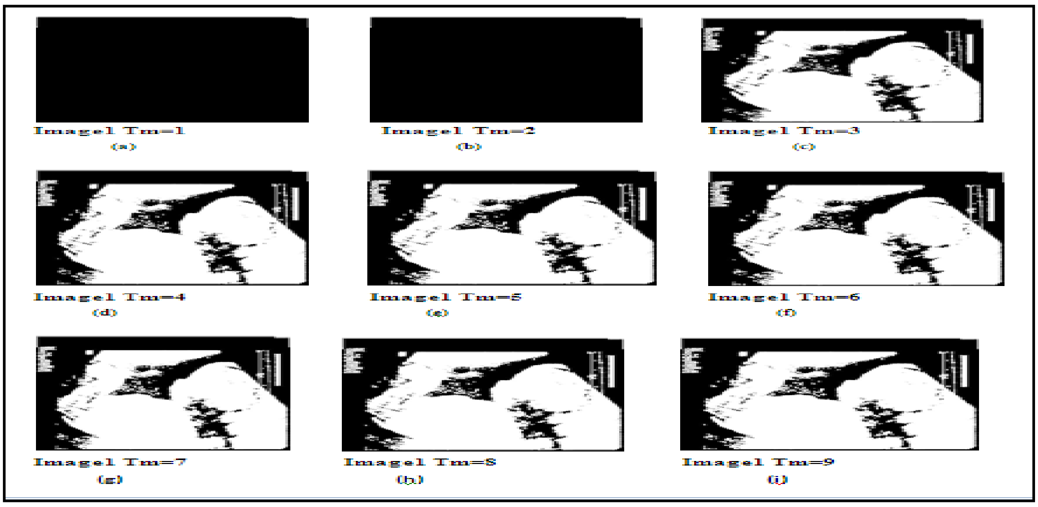

Figure 5: Output images for input image1 with different Tm values.

The image for value of Tm from 1-9 is shown above. Various parameters i.e MSE, MAXERR, PSNR, L2RAT, ENTROPY are calculated for each image. From these we result in the enhancement of the image. And this gives the better results. The quality of the image is better as the PSNR value is good. We can apply to the various images and it gives the resulting 9 Images as Tm value from 1-9 respectively.

7. Conclusion:

The investigation is enhancing the quality of the ultrasound images using modified aura based transformation. This transformation technique is relatively less expensive, simple, and less time consuming.

The duration for processing the image is very less. The investigations showed that the processed ultrasound images were enhanced in quality. The enhanced image is helpful in predicting the diseases inside the human body more effectively and accurately.

References:

[1] N. K. Ragesh, A. R. Anil, Dr. R. Rajesh, "Digital image denoising in medical ultrasound images: a survey," in Proc. ICGST AIML-11 Conference, 2011, Dubai, UAE.

[2] P. S. Hiremath, T. P. Akkasaligar and S. Badiger, "Visual enhancement of digital ultrasound images using multiscale wavelet domain", International Journal of Pattern Recognition and Image Analysis, vol.20, pp.303- 315, 2010.

[3] P. Abrol, D. Padha, P. K. Lehana, "Application of Aura in Identification of Textural Objects", PCTE.

[4] David Sutton, Radiology and Imaging for Medical Students. 7th Edition. Churchill Livingstone.

[5] Faten Abed Ali Dawood, R. W , "Automatic Boundary Detection of Wall Motion in Two-dimensional Echocardiography Images", Journal of Computer Science 7 (8): 1261-1266 , 6, 2011.

[6] Gagandeep Kour, S. P Singh," Image Decomposition Using Wavelet Transform" ,.International Journal Of Engineering And Computer Science ISSN:2319-7242 volume2 , 4, 12 Dec,2013.

[7] Juan Shan, H. D. (n.d.). "A completely automatic segmentation method for breast ultrasound images using region growing". 6.

[8]Parveen Lehana, S. D ,"Investigations of the MRI Images using Aura Transformation", Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.1 , 10, February 2012.

[9] sandeep arya, s. k., "Image enhancement technique on Ultrasound Using Aura Transformation", International Journal in Foundations of Computer Science & Technology (IJFCST), Vol. 2, No.3 , 10, may 2012.

[10]http://en.wikipedia.org/wiki/ultrasound images.

[11] P. Abrol, D. Padha, P. K. Lehana, "Application of Aura in Identification of Textural Objects", PCTE Journal of Computer Science, vol.3, issue no.2, Jul-Dec, 2008.

[12] P. Abrol, D. Padha, P. K. Lehana, "Effect of Distortion on the Synthesized Textures using Aura based Techniques", in Proc. National Conference on Video, Cyber Learning and Electronics, 2008, NITTTR, Chandigarh.

[13] P. Abrol, D. Padha, "Textural Visualization: Algorithm and Analysis", PCTE Journal of Computer Sciences, vol.3, issue no.1, pp. 54-58, Jan-June, 2007.

[14] P. Abrol, D. Padha, P.K. Lehana, I. Gandotra, "Transmission of Synthesized Textures over Low Bandwidth Networks", in Proc. AICTE sponsored National Conference on Next Generation Computing and Information Systems, , 2007, MIET, Jammu.International Journal in Foundations of Computer Science & Technology (IJFCST), Vol. 2, No.3, May 2012.

[15] P. Abrol, D. Padha, P. K. Lehana, "Development of a DSP based Textural Visualization System", in Proc. UGC sponsored National Seminar on Data Mining Techniques & Applications, Dept. Of Computer Applications, 2007, M. C., Kerala, pp. 23-2.