Elysium Journal of Engineering Research & Management

P-ISSN: 2347-4408
E-ISSN: 2347-4734

A Statistical Pattern Recognition Approach for Tracking Left Ventricle Endocardium

V.Abuhanifa[1] and D.John Pragasam[2]

[1]*P.G.Scholar, M.E VLSI Design, Sethu Institute of Technology, Madurai, Tamil Nadu, India*
[2]*Assistant Professor, Dept. of ECE, Sethu Institute of Technology, Madurai, Tamil Nadu, India*

Abstract— The Left Ventricle endocardium has a difficult problem can be determined by a new statistical pattern recognition approach. In this pattern, resampling algorithm along with the current time step is estimated and appearance, motion and shape of the current images are segmented. The new presence of the left ventricle shape is decoupled for reducing the running time complexity. Thus the proposed model uses diastole and systole motion of a heart which is used to identify the problem present in the left ventricle. The left ventricle endocardium problem is identified by comparing with the data set of healthy cases and the deviation of left ventricle is identified by Statistical Image Reconstruction (SIR) Algorithm. The nonconformity of left ventricle to that of healthy cases is used for easy diagnosis.

Keywords — Left Ventricle Segmentation, Particle Filters, Dynamical Model, Discriminative Classifiers.

1. INTRODUCTION

The most important steps for estimating the heart health is the tracking and segmentation of the Left ventricular (LV) endocardial border from an ultrasound sequence. It is used to measure the ejection fraction and assessing the regional wall motion. A whole automatic LV segmentation system has the potential to streamline the clinical work-flow and minimize the inter-user variability. Current state-of-the-art automatic LV tracking and segmentation methodologies are based on a function that takes into account the image to be segmented (and perhaps all previous and future images), the contours produced in the past (and possibly the future contours), and the appearance, motion and shape models. Thus the dynamical model, where the state is represented by the LV contour, and the observation comprises the input sequence frames. In general, the LV appearance can be categorized by a dark region and signifying the blood pool inside the chamber, surrounded by the epicardium, endocardium and myocardium, which are violently depicted by a brighter state. The gray value sharing and specific spatial texture of each region vary substantially among various sequences (and even within each sequence). Because of the following problems in the LV imaging using ultrasonic devices: quick motion during low signal to noise ratio, systole phase, edge dropout, the appearance of the shadows image obtained by the exact properties and settings of the ultrasound machine, dense muscles and the anisotropy of the ultrasonic image development.

Researchers utilized the motion and shape models to apply the constraints on the segmentation process due to large deviation. However, the representation of all possible shape patterns and variations has verified to be a difficult event given the huge variability of LV structures due to the anatomy of heart (specifically regarding the hearts containing some kind of cardiopathy), and the inter-user variability of the LV manual annotation. For this reason, the motion model controls the detection space to a little area of the state space where the LV contour is expected to be found at each time instant of the sequence.

2. RELATED WORK

3-DT MRI data was utilized for segmenting the left ventricle of the heart to optimize the time and segmented level. In this paper, we present a novel and in-built approach to combine 3-D spatial and temporal (3-D + time) magnetic resonance imaging (MRI) data in an integrated segmentation algorithm to excerpt the myocardium of the left ventricle. A novel level-set segmentation process is developed that concurrently explains and tracks the boundaries of the left ventricle muscle. The expectation maximization algorithm tracks the myocardial deformation over the cardiac cycle optimally with the help of information about the cardiac temporal evolution which was encoded in a parametric work structure. The expectancy step deforms the level-set task while the maximization step updates the prior temporal model parameters to perform the segmentation in a non-rigid sense.

In a conventional method, an information fusion approach is used for tracking. In this paper, we proposed a

P-ISSN: 2347-4408
E-ISSN: 2347-4734

complete fusion design in the knowledge space for robust shape resulting, rectifying unresolved from the system dynamics, subspace shape model and heteroscedastic measurement noise in a best manner, and. We also utilize facts obtained from the initialization of groundtruth where it is available. The new work structure is implemented for tracking the myocardial edges in noisy echocardiography sequences. The performance of the proposed work structure was superior to the conventional algorithm of shape-space-constrained tracking by a significant margin.

Real-time segmentation in Active Geometric Functions. In this paper, a novel creation work structure of the minimal surface problem, called active geometric functions (AGF), is proposed to reach truly real-time act in segmenting 4D ultrasound records. A particular sample of AGF depends on modeling of finite element, and Hermit surface descriptors was implemented and evaluated on 35 4D ultrasound data sets with a total of 430 time frames. Quantitative comparison to manual tracing illustrated that the proposed method grants LV contours near to manual segmentation and that the inconsistence was comparable to inter-observer tracing variability. The potential of such real time segmentation will allow the innovative approaches such as interactive acquisition of image with interventional guidance and online segmentation.

3. PROPOSED WORK

We proposed a new complete automatic methodology for the LV tracking and segmentation using ultrasound data. The creativity of our approach are influenced in a new active model depends on a SIR formulation, where the main novelties are with respect to the new observation and transition models. We illustrated that the proposed observation model, based on deep neural network, can be learned with training sets of limited size. Also decoupling the non-rigid and affine detections and using a gradient-based search scheme prove to be simple but effective approaches to reducing the running time difficulty. Finally a motion model that does not commit to a specific heart dynamical regime, and that combines the transition and observation model results to build a proposal sharing shows effective tracking accuracy.

According to the results, our approach is more accurate than other state-of-the-art DB-guided and deformable template methodologies and correlates well with inter-user statistics. In the future, we plan to address the issues with the development of a semi-supervised approach to minimize the dependence on a rich initial training set, and with the implementation of an approach to automatically determine the likely positions, rotation and scales of the LV in the test image. In future work, we are going to proceed on a shape model which seeks less requirement of training set, similarly to the DNN used for the appearance model. Moreover, we decide to apply this approach to other anatomies and other techniques related to medical imaging.

4. ARCHITECTURE DIAGRAM

The Architecture of the proposed system is shown in Fig 1.

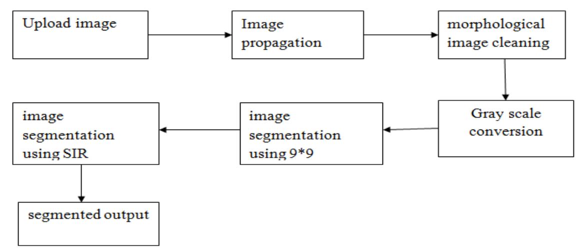


Fig 1. Architecture Diagram

5. METHODOLOGY

5.1 Vertical Projection Algorithm (Novel Skew identification Technique)

During image scanning, skew is certainly introduced into the received image. Since the algorithms for analysing the layout and recognition are basically very susceptible to the page skew, then the modification and skew identification in images were the critical steps before layout examination. In this paper, a novel skew identification technic depends on straight-line fitting is proposed.

In an image which was scanned, there might be some black edges that not only affect the algorithm accuracy but also increase the computing cost. In order to avoid the possible negative effects of black edges, the edges of an image should not be considered in the selected sub-region. Furthermore, the expansion of the sub-region should be carefully selected to achieve higher speed and better accuracy. The selected sub-region R should satisfy the following condition:

$R = \{(x, y) \mid w_1 \leq x \leq w_2,\ h1 \leq y \leq h_2,\ (w_2-w_1) \geq nW_c, (h_2-h_1) \geq kT_h \}$ (3.1)

P-ISSN: 2347-4408
E-ISSN: 2347-4734

Here, Wc is the average width of the alphanumeric characters, and T_h is the space threshold between the neighbouring text lines. Given that the width of a image is W and the height is H, the left boundary of the sub-region should be w_1=W/3, the right boundary w_2=W*2/3, the top boundary h_1 = H/3 and the bottom boundary h_2 = H*2/3.

5.2 MIC (Morphological image-cleaning) Algorithm.

Morphological openings and closings are useful for the flattening of gray-scale images. However, its need for reducing image noise is limited by their inclination to remove important, thin features from an image along with the noise. In this paper represents a description and analysis of a new morphological image cleaning algorithm (MIC) that preserves thin features while eliminating noise. MIC is also used for gray-scale images affected by low amplitude, random, dense, patterned or random noise. Such noise is typical of still-video or scanned images. MIC differs from other morphological noise filters in that it handles residual images, the variations between the morphologically smoothed versions and original image. It estimates residuals on a many different scales through a sharing of morphological size. It junks regions in the different residuals that it justifies to contain noise. MIC creates a cleaned image by recombining the managed the enduring images with a levelled version.

Colour digital images are made of pixels, and pixels are nothing but the amalgamation of primary colours. The channel A in this context is the grayscale image with the similar size of a colour image, created by any one of these primary colours. For instance, an image from a usual digital camera will have a red, green and blue channel.

An RGB image has three channels: blue, red and green. RGB channels violently chase the colour receptors in the human eye, and are utilised in computer displays and image scanners.

If the RGB image is 24-bit (the industry standard as of 2005), then the red channel contains 8-bit, green channel contains 8-bit and blue channel also contains the 8-bit. Basically, the image can be divided into three images (one for each channel), where each image can store discrete pixels with conventional brightness concentrations between 0 and 255. If the RGB image is 48-bit (very high resolution), then the r- channel, b-channel and g-channel shares 48-bit into 3-sets, each contains 16-bits.

5.3 Gray Scale Algorithm

Morphological openings and closings are useful for the smoothing of gray-scale images. In photography and computing, a grayscale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest. Gray scale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only the two colours, black, and white (also called *bi-level* or *binary images*). Grayscale images have many shades of gray in between. Grayscale images are also called unicolor, denoting the presence of only one (mono) colour (chrome).

Grayscale images are often the result of calculating the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.), and in such cases they are unicolor proper when only a given frequency is captured. But also they can be synthesized from a full colour image; see the section about transforming to grayscale.

5.4 9cross9 algorithm

We introduce a numerical approach to solve variation problems on manifolds represented by the Grid Based Particle Method (GBPM) recently developed. In this process, we propose a splitting algorithm for image segmentation on manifolds represented by unrelated sampling particles. To enhance a fast minimization algorithm, we introduced a new splitting approach by generalizing the 9*9 algorithm. To proficiently implement the resulting method, we incorporate with the local polynomial approximations of the manifold in the GBPM. The resulting method is flexible for segmentation on various manifolds including closed or open or even surfaces which are not oriental. Image segmentation aims to partition a given image into several non-overlapping domains based on statistical similarities such as means, sharings and structure tensors. In the past several decades, many methods have been proposed in order to consider this issue including the expectation maximization (EM) methods, level set methods and graph cut methods etc. The key difficulty of the image segmentation task is to provide a stable and fast algorithm for working well with low quality images. For example, the images may contain heavy noise and weak edges. To get a robust segmentation result under noise, some smoothness constraints of the partitioned domains have to be executed in the segmentation cost functional.

P-ISSN: 2347-4408
E-ISSN: 2347-4734

6. RESULTS & DISCUSSIONS

This section presents the results of the proposed system.

Fig 2. Login form

Figure 2 shows the login form for the user where user can login to their respective account by giving user name and password.

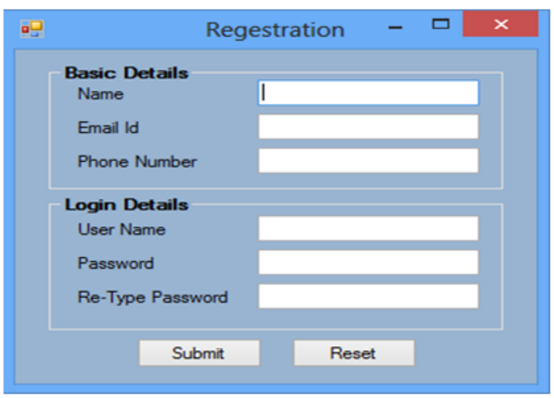


Fig 3. Registration Form

The new user register their details in registration form which is shown in the fig 3

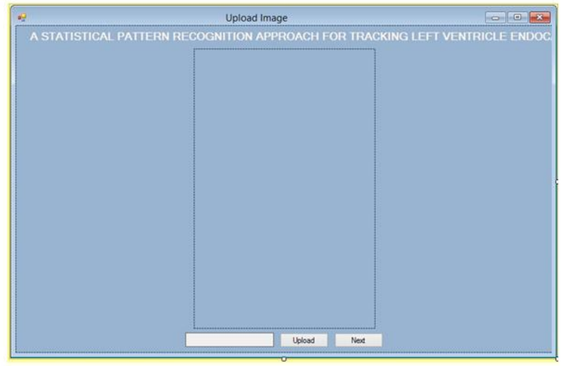


Fig 4. Image Upload Form

The ultrasonic image is uploaded by the user where the image can be used for further processing.

After an image is uploaded:

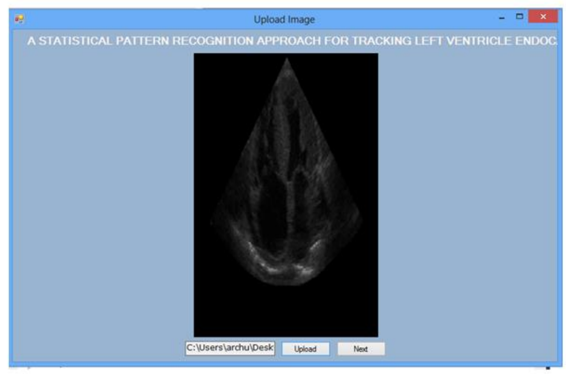
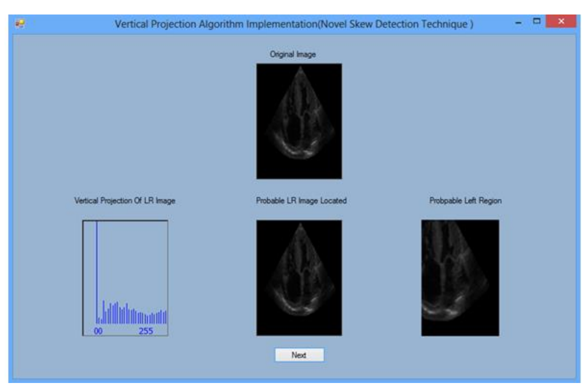


Fig 5. Uploaded ultrasonic image

This is the Screenshot that shows an ultrasonic image uploaded by the user.

Vertical Projection Algorithm Implementation Form:



P-ISSN: 2347-4408
E-ISSN: 2347-4734

Fig 6. Original image after applied vertical projection algorithm

The original image is transformed into probable left region which is done by using vertical projection algorithm is shown in the fig 6.

MIC (Morphological image-cleaning) Algorithm Implementation Form:

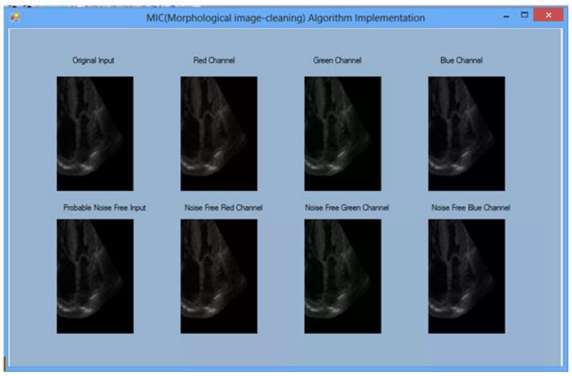


Fig 7. Image applied with Morphological image-cleaning

Fig 7 shows the image with increased intensity of RGB pixels and its noises removed.

Grey Scale Algorithm Implementation Form:

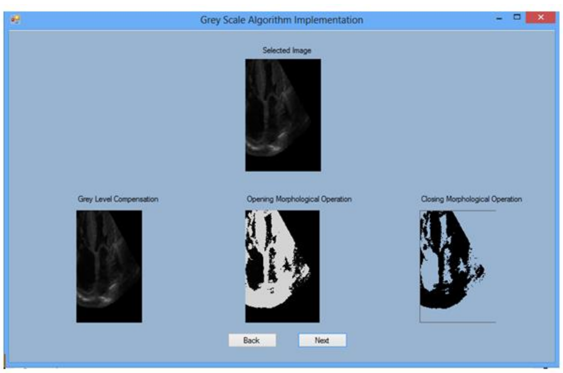


Fig 8. Image applied with Grey Scale Algorithm

The given image is transformed into grey scale image which is shown in fig 8.

9cross9 Algorithm Implementation form:

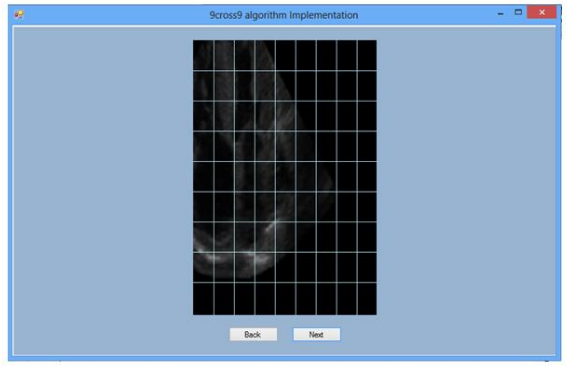


Fig 9. **9cross9 Algorithm applied image**

Fig 9 shows the screenshot that shows an image with 9cross9 for clarity.

7. CONCLUSION

We proposed a new entire automatic methodology for the LV tracking and segmentation using ultrasound data. The novelty of our approach are centered in a new active model based on a SIR formulation, where the main novelty are with respect to the new observation and transition models. We proved that the proposed observation model, based on deep neural network, can be learned with training sets of limited size. Also decoupling the affine and non-rigid detections and using a gradient-based search scheme prove to be simple but effective approaches to reducing the running time complexity. Finally a motion model that does not commit to a specific heart dynamical regime, and that combines the transition and observation model results to build a proposal sharing shows effective tracking accuracy. According to the results, our approach is more accurate than other state-of-the-art DB-guided and deformable template methodologies and correlates well with inter-user statistics.

8. FUTURE WORK

In the future, we plan to address the issues declared with the development of a semi-supervised approach to minimize the dependence on a rich initial training set, and with the adaptation of an begin to determine the likely positions, rotation and scales of the LV in the test image automatically. We have to plan to proceed on a shape model that the requirement of the training set is less, similarly to the DNN used for the appearance model. Moreover, we decided to apply this approach to other anatomies and other imaging techniques related with medical sector.

P-ISSN: 2347-4408
E-ISSN: 2347-4734

REFERENCES

1. Yu, Li, Yi Guo, Yuanyuan Wang, Jinhua Yu and Ping Chen. "Segmentation of Fetal Left Ventricle in Echocardiographic Sequences Based on Dynamic Convolutional Neural Networks." *IEEE Transactions on Biomedical Engineering*, (2016).
2. Gao, Lianli, Jingkuan Song, Feiping Nie, Fuhao Zou, Nicu Sebe and Heng Tao Shen. "Graph-without-Cut: An Ideal Graph Learning for Image Segmentation." In *Proceedings of the Thirtieth AAAI Conference on Artificial Intelligence*, 1188-1194: AAAI Press, 2016
3. DeVore, GR, B Polanco, G Satou and M Sklansky. "Ep03. 04: Evaluation of Transverse Systolic Displacement (Tsd) of the Right (Rv) and Left Ventricle (Lv) of the Fetal Heart Using 2d-Speckle Tracking." *Ultrasound in Obstetrics & Gynecology* 48, no. S1 (2016): 278-278.
4. Mahmoudi, Sidi Ahmed, Mohammed Ammar, Guillaume Luque Joris and Amine Abbou. "Real Time Gpu-Based Tracking and segmentation of the Left Ventricle on 2d Echocardiography." In *International Conference on Bioinformatics and Biomedical Engineering*, 602-614: Springer, 2016.
5. Nascimento, Jacinto C, Gustavo Carneiro and António Freitas. "Tracking and Segmentation of the Endocardium of the Left Ventricle in a 2d Ultrasound Using Deep Learning Architectures and Monte Carlo Sampling." *Biomedical Image Segmentation: Advances and Trends*, (2016): 387.
6. Wang, ZhenZhou. "An Efficient and Robust Method for Automatically Identifying the Left Ventricular Boundary in Cine Magnetic Resonance Images." *IEEE Transactions on Automation Science and Engineering* 13, no. 2 (2016): 536-542.
7. Ondruska, Peter, Julie Dequaire, Dominic Zeng Wang and Ingmar Posner. "End-to-End Tracking and Semantic Segmentation Using Recurrent Neural Networks." *arXiv preprint arXiv:1604.05091*, (2016)
8. Yang, Fan, Huchuan Lu and Ming-Hsuan Yang. "Robust Superpixel Tracking." *IEEE Transactions on Image Processing* 23, no. 4 (2014): 1639-1651.
9. Godec, Martin, Peter M Roth and Horst Bischof. "Hough-Based Tracking of Non-Rigid Objects." *Computer Vision and Image Understanding* 117, no. 10 (2013): 1245-1256.
10. Q. Duan, E. D. Angelini, and A. Laine, “Real time segmentation by active geometric functions,” Comput. Methods Programs Biomed. vol. 98, no. 3, pp. 223–230, 2010.
11. Y. Zhu, X. Papademetris, A. Sinusas, and J. Duncan, “Segmentation of the left ventricle from cardiac MR images using a subject-specific dynamical model,” IEEE Trans. Med. Imag., vol. 29, no. 3, pp. 669–687, 2010.
12. G. Carneiro and J. C. Nascimento, “Multiple dynamic models for tracking the left ventricle of the heart from ultrasound data using particle filters and deep learning architectures,” in Conf. Computer Vision and Pattern Rec. (CVPR), 2010.
13. M. Jolly, H. Xue, L. Grady, and J. Guehring, “Combining registration and minimum surfaces for the segmentation of the left ventricle in cardiac cine MR images,” in MICCAI, 2009.
14. O. Bernard, D. Friboulet, P. Thevenaz, and M. Unser, “Variational B-spline level-set: A linear filtering approach for fast deformable model evolution,” IEEE Trans. Imag. Proc., vol. 18, no. 6, pp. 1179–1991, 2009.
15. M. Lynch, O. Ghita, and P. Whelan, “Segmentation of the left ventricle of the heart in 3-D+T MRI data using an optimizednonrigid temporal model,” IEEE Trans. Med. Imag., vol. 27, no. 2, pp. 195–203, 2008.
16. Z. Qian, D. Metaxas, and L. Axel, “Boosting and nonparametric based tracking of tagged MRI cardiac boundaries,” in MICCAI, 2006.
17. P. Abolmaesumi and M. R. Sirouspour, “An interacting multiple model probabilistic data association filter for cavity boundary extraction from ultrasound images,” IEEE Trans. Med. Imag., vol. 23, no. 6, pp. 772–784,Jun. 2004.
18. P. Abolmaesumi, S.E. Salcudean, W.H. Zhu, M.R. Sirouspour, and S.P. DiMaio, “Image-guided control of a robot for medical ultrasound,” IEEE Trans. Robot. Autom., February 2002.