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Efficient Segmentation of the Foetal Ultrasound Image Using Smoothing Algorithm

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ABSTRACT: Ultrasound (US) imaging is the modality of choice in many clinical applications compared to other imaging modalities, such as computed tomography (CT). US images are patient-specific, operator-dependent, and machine specific. However these US images are affected by signal dropouts, artefacts, missing boundaries, attenuation, shadows, and speckle, making US one of the most challenging modalities to work with. Earlier work presents qualitative and quantitative segmentation evaluation of the representative selection method submitted to Challenge US: Biometric Measurements from Fetal Ultrasound Images. In this a total of five teams submitted their results to the fetal head sub-challenge and two teams to the fetal femur sub-challenge, including one team who attempted both. The results of the fetal head sub-challenge shows good performance whereas a fetal femur sub-challenge faces the problem in solving a very hard segmentation problem, since the object of interest has strong appearance changes within the object. To deal with this problem the present work proposes smoothing algorithm to smoothen the other elongated objects are present around the femur bone. This algorithm works by computing the optimal fixed range bandwidth in the US image. Finally the proposed work is experimentally evaluated and thus obtains improved result when compare with the existing system.

KEYWORDS: Segmentation, Smoothing algorithm, Optimal fixed range bandwidth, Performance evaluation

I. INTRODUCTION

In imaging science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging. Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).

The paper is organized as follows. A brief introduction about the related work is presented in the next section, followed by the details about the existing systems & the proposed system. System implementation is followed next by the conclusions and the references.

II. RELATED WORK

This work[1] presents that new measurements of the fetal femur can be made using 3D ultrasound and these novel dimensions can be used to show growth differences between fetuses and variations in femoral shape. In this femoral volume during maternal intervention is not monitored but improved performance is obtained. This work[4] presents a

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semi-supervised image segmentation method that relies on a non-local continuous version of the min-cut algorithm and labels or seeds provided by a user. The segmentation process is performed via energy minimization. This method is not applicable in 3D-Medical images. Promising segmentation results is obtained for textures and real-world objects. Ultrasound (US) has been shown to be a safe and effective imaging modality in detecting pregnancy complications such as breech presentation. The non-invasiveness of this technique, alongside its cost efficacy and availability have promoted its uptake in the developed world for routine pregnancy scans and examinations. However the use of US is far less common in low income countries, particularly in rural areas, as there is a lack of training for effective use of this technology and accurate interpretation of the images as well as a relatively high cost associated with the current US devices. Recent technological advancements in the field have led to lower-cost and portable US devices, facilitating its

III. EXISTING SYSTEM

In existing system, automatic segment anatomical structures is presented to measure standard obstetric biometric parameters, from 2D fetal ultrasound images, taken on fetuses at different gestational ages (21 weeks, 28 weeks, and 33 weeks). The segmentation challenge was formed by 4 sub-challenges, named fetal head, fetal abdomen, fetal femur, and whole fetus. Five teams participated in the head sub-challenge and two teams in the femur sub-challenge, including one team who tackled both. Nobody attempted the abdomen and whole fetus sub-challenges. For the head sub-challenge, several groups produced results that could be potentially used in clinical settings. The femur sub-challenge had inferior performance to the head sub-challenge due to the fact that it is a harder segmentation problem and that the techniques presented relied more on the femur's appearance.

IV. PROPOSED SYSTEM

In proposed the problem in femur sub-challenge is handled by using smoothing algorithm. Two teams participated in this sub-challenge. Both methods relied on appearance and edge information extracted directly from intensity values. The two teams used the following methods. First one is Multilevel Thresholding Combined with Edge Detection and Shape-Based Recognition; second method is Morphology-Based Approach. The result obtains from these two methods results hard segmentation of fetal US image. The result shows that some other elongated objects are present around the femur bone, causing methods to fail in certain situations. These objects are removed by using smoothening algorithm. This algorithm computes optimal fixed range bandwidth. Then for each image, spatial bandwidths using lateral profile of US probe is assigned. Then the pilot density using local spatial scales were computed. Finally adaptive mean shift procedure is defined and executed which efficiently results the smoothened part of region in the image. Experimental result of proposed system provides better result when compare with the existing system.

V. SYSTEM IMPLEMENTATION

In this section, the existing system is implemented in the Matlab software & the simulation results are presented along with brief discussions about the work taken up in the PG project.

A. Segmentation using Multilevel Thresholding Combined with Edge Detection and Shape-Based Recognition

In this module, multilevel thresholding approach is used to segment the fetal skull combined with edge detection and shape-based recognition. This approach makes use of the difference in intensities between the bone and the image background, and assumes that hard tissue (bone) appears brighter than the surrounding objects in the US images. The methodology is based on multiple intensity level thresholds. For each binary image obtained, the connected components are retrieved and a measure of thinness and elongation is calculated. The candidate objects are found after applying empirically chosen thresholds. A size constraint was also applied to remove small objects. The objects resulting from the multi-thresholding were grouped into a cluster from which mean edge contrast was calculated to estimate the best object intensity representation. The binary image contains spurious objects due to other structures appearing in the images.

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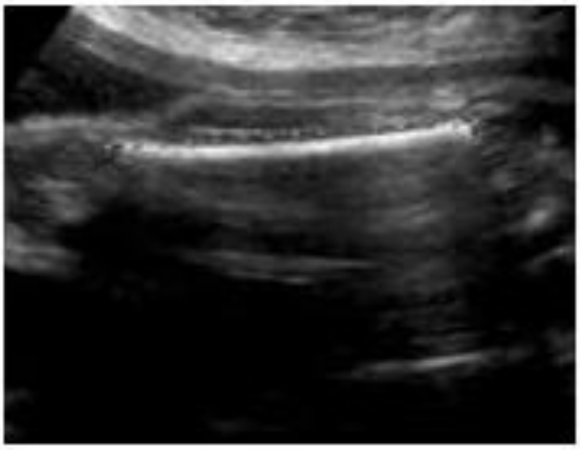

Fig. 1 :Original Image

Fig. 2 :Edge based segmentation

In this module, for smoothening the elongated object of the ultrasound image, variable bandwidth mean algorithm is used which is given by the equation …...

$$M_v(x) = \frac{\lambda}{n^{-1}\sum_{i=1}^{n}\tilde{f}(x_i)} \cdot \frac{h_0^{\,2}}{2/c} \cdot \frac{\tilde{\nabla} f_k(x)}{\tilde{f}_G(x)}$$

The above equation is the fixed bandwidth mean shift. It shows that the adaptive bandwidth mean shift is an estimator of the normalized gradient of the underlying density.The above equation is the fixed bandwidth mean shift. It shows that the adaptive bandwidth mean shift is an estimator of the normalized gradient of the underlying density.

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Fig. 4 :Elongated object

Fig. 5 :Femur Image

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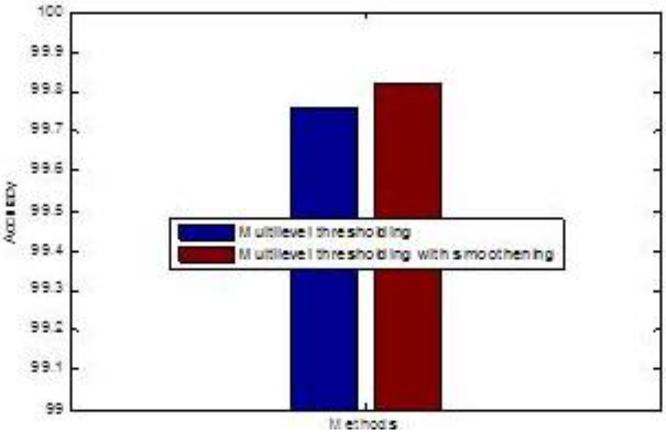

Fig. 6 : Performance evaluation

Performance evaluation

In this module, accuracy of the proposed work is evaluated. Proposed work shows better performance when compared to existing system.

VI. CONCLUSION

In this work a thorough qualitative and quantitative segmentation evaluation of the representative selection of current methods submitted to Challenge US: Biometric Measurements from Fetal Ultrasound Images, held at ISBI 2012. The images were selected to incorporate the different qualities, reflective of a real antenatal clinical environment. Three different gestational ages were assessed to incorporate image variability across gestation. Several experts manually delineated the objects of interest to define the ground truth, which was used within the evaluation framework. For the effective segmentation smoothening algorithm is chosen by using which the accurate and efficient segmentation of ultra sound images are done. The experimental results prove that the proposed work provides better result than the existing work.

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BIOGRAPHY

Mrs. Pavithra Chandrasekhar was born in Bangalore, Karnataka, India on September 8, 1984& received the B.E. Degree (Bachelor of Engg.) from Acharya Inst. of Tech..(VTU, Belgaum) in the year 2006 in ECE branch, M.Tech.degree in RF Communications from the prestigious Jain University (Bangalore) in the year 2010 respectively. She has got a teaching (academic), research experience of nearly 8 years in various engineering colleges and is currently working as Assistant Professor in the department of Electronics & Communication Engg.in HKBK College of Engg., Bangalore, Karnataka, India. Her areas of interest are Signals & Systems, Digital Signal Processing, Image Processing, Wireless Communications, Satellite Communications, RF Communications, Basic Electronics, Field Theory, Digital Communications, etc. She has published more than 2 dozen papers in various national & international conferences & journals, also attended more a dozen workshops/FDPs.

Dr. T.C. Manjunath was born in Bangalore, Karnataka, India on Feb. 6, 1967 & received the B.E. Degree (Bachelor of Engg.) from R.V. College of Engg. (Bangalore Univ., B'lore) in the year 1989, M.E. degree in Automation, Control & Robotics from the prestigious Govt.'s LD College of Engg., (Gujarat Univ., Ahmadabad) in the year 1992 and Ph.D. in Systems & Control Engineering from the prestigious Indian Institute of Technology Bombay (IIT Bombay) in the year 2007 respectively. He has got a teaching (academic), research & administrative experience of more than 26 years in various engineering colleges all over the country (Karnataka, Gujarat, Maharashtra) and is currently working as Principal in HKBK College of Engg., Bangalore, Karnataka, India. He has worked in the levels of Lecturer, Asst. Prof., Prof., i/c HOD, Prof. & Head, Director-Research, i/c Principal & as Full time Principal in the various institutions where he has worked so far. He has also worked as a Project Assistant and as a Research Engineer in the Systems and Control Engineering (IIT Bombay, India) and worked on control of space launch vehicles using FOS feedback technique in IITB.