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Nuchal Translucency(NT) Detection For Chromosomal Abnormalities From Ultrasound Fetal Images

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ABSTRACT:
In the recent past, the non invasive prenatal diagnoses of chromosomal disorders have been focused by researchers for detecting Down Syndrome (DS) fetus. Down syndrome or Trisomy 21 is recognized as severe and common chromosomal abnormality occurring approximately once in every 800 to1000 live births and the risk increase with the maternal age. It is found from the literature that the Down syndrome is a genetic condition most commonly caused by the extra number 21th chromosome. Affected babies are likely to suffer from severe mental disability and have a high chance of physical disabilities, affecting in particular the heart, gastrointestinal tract, eyes and ears.

Keywords: *Down syndrome, Nuchal translucency thickness,canny edge detection, first-trimester screening, trisomy 21,ultrasound.*

INTRODUCTION:

Ultrasound imaging is widely used in the diagnosis of fetuses due to its noninvasive nature, real time display, low cost and continuing image quality improvements. In the ultrasound image, the nuchal translucency (NT)[1] which is the accumulation of fluid in the nuchal region can be shown for fetuses during the first trimester. The canny operators are utilized for segmenting the nuchal translucency region and the exact thickness can be estimated. As the NT thickness is of few millimeters, a small variation in the measurement made by the sonographer may lead to wrong diagnosis. The computer aided evaluation is expected to enhance the NT thickness measurement.The computer aided measurement overcomes the problems .Nuchal translucency (NT) thickness is the most effective marker of trisomy 21 and all other major chromosomal defects. Increased NT is also associated with many fetal defects, genetic syndromes and an adverse pregnancy outcome.The use of NT in the assessment of accurate patient specific risks for chromosomal and other abnormalities necessitates adherence to a standard measurement technique in order to achieve uniformity of results among different operators.

A good sagittal section of the fetus should be obtained and the NT should be measured with the fetus in the neutral position. The maximum thickness of the subcutaneous translucency between the skin and the soft tissue overlying the cervical spine should be measured. Inorder to avoid underestimation during measurement of the NT, the operator should aim to place the calipers at the point of maximum echo genicity, which lies in the center of the nuchal membrane rather than at its inner border. However, as this is the semi-automated system ;does not avoid the need of expert doctor .

The expert radiologist capture the images and extraction of proper NT region.The proper measurement of NT thickness is done by placement of calipers on anatomical structures of

the fetus, in sagital view of extracted NT region and for this process there is the need of expert doctor or radiologist .

METHODS:

The Block diagram of the proposed image processing system is shown in Fig1. The various process involved in NT measurement is provided in this section. The fetus image is obtained from the ultrasound system and subjected to preprocessing for the extraction of features

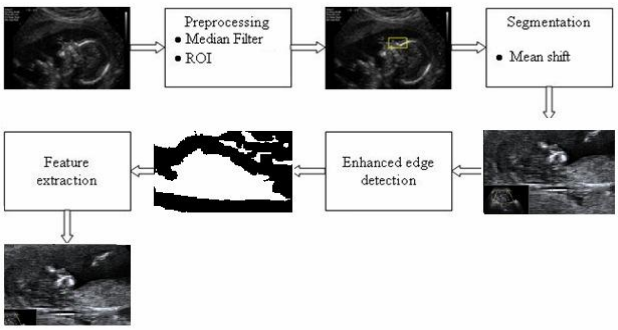


Figure. 1. Proposed Image Processing System

Figure 2 Mid-sagittal section of the fetal head and upper thorax

Step 1: Image Acquisition Using Ultrasound System-Images are acquired from Sonography System Mindray DP 6600 Black and White System. This application can help directly to process on the image using GUI of Matlab-R2012a.The image enhancement is done manually by taking multiple samples .The preprocessing is done on acquired images by converting images into gray scale image and then converting it into binary formate. Histogram of binary image is taken and then Histogram equalization is done.

Step 2: Removal Of Speckle Noise -Each of the medical imaging devices is affected by different types of noise. For example, the ultrasound images are affected by Speckle noise.Ultrasound images can contain more noise content – especially speckle noise is first added and then removed.In an image with added noise, much of the high frequency content is due to noise .This information is useful in the development of models for noise removal.

'Speckle' is a multiplicative noise.The above function adds multiplicative noise to the image I, using the equation J = I+n*I, where n is uniformly distributed random noise with mean 0 and variance v. The default for v is 0.04.The mean and variance parameters for 'speckle' noise types are always specified as if the image were of class double in the range [0, 1]. If the input image is of class uint8 or uint16, the imnoise function converts the image to double, adds noise according to the specified type and parameters, and then converts the noisy image back to the same class as the input.

Median filter is a best order static, non- linear filter, whose response is based on the ranking of pixel values contained in the filter region. Median filter is quite popular for reducing certain types of noiseA major advantage of the median filter over linear filters is that the median filter can eliminate the effect of input noise values with extremely large magnitudes.

Step 3: Identification Of NT (ROI)-As this is a semi-automated method which we developed for measurement of the NT. In this method, the operator places an adjustable box over the relevant area at the back of the fetal neck. The system draws a line through the center of the nuchal membrane and another line at the edge of the soft tissue overlying the cervical spine. The system then identifies the largest vertical distance between the two lines.

Step 4:Applying Segmentation Algorithm For Segmenting The ROI-Mean shift algorithm -The Mean shift algorithm[2][3] has been found to be efficient in the segmentation of medical images due to its inherent advantages such as less noise, simple and provides better feature analysis . In the proposed work, the Mean shift analysis has been utilized for segmenting the NT region . Any segment with pixels that share similar features will group together and may form clusters with a densely populated center in the feature space. The shift procedure detects clusters by determining modes in a parametric density function iteratively. The feature vector consists of the pixel position and gray value.

Step 5: Edge Detection Of The ROI By Canny Edge Detection- The segmented image is then subjected to canny edge detection for enhanced visibility of edges for further processing of the image.

This specifies the Canny method for edge detection in image for the Canny method. thresh is a two-element vector in which the first element is the low threshold, and the second element is the high threshold. If you specify a scalar for thresh 0.3 scalar value is used for the high threshold.

Step 6: Binary Masking Of The Entire Image- Feature extraction of only the NT region from the entire fetus image ,following steps are taken in this semi-automated system.

1)Get Inputs from Mouse,Select 4 Seed Points in Image

2)Select polygonal region of interest

3)Create Buffer for ROI

4)Create Buffer for NONROI

5)Display both ROI and Non ROI images

Step7: The Measurement Of Thickness Of Nuchal Translucency-is done by Placement of calipers on anatomical structures of the fetus, in sagital view of extracted NT region. The measurement is taken in Euclidian distance and then converted into mille meters.

Case no in 11 GW	Length in Ed	Lenght in MM	Case no in 12 GW	Length in Ed	Lenght in MM	Case no in 13 GW	Length in Ed	Length in mm
1	26	4.96	1	6	1.15	1	2.88	0.55
2	12	2.29	2	7	1.34	2	30	5.73
3	13	2.48	3	4.25	0.81	3	6.5	1.24
4	17.5	3.34	4	3.91	0.75	4	6.5	1.24
5	10.5	2.00	5	4	0.76	5	4.25	0.81
6	7.25	1.38	6	3	0.57	6	4.75	0.91
7	8	1.53	7	12	2.29	7	17	3.25
8	7.75	1.48	8	15	2.86	8	3.75	0.72
9	9.5	1.81	9	10	1.91	9	27	5.15
10	7.75	1.48	10	6.5	1.24	10	3.5	0.67

DISCUSSION:

This study included 40 patients. The patients' ages ranged from 21 years to 45 years . The mean value of nuchal translucency (NT) was 2.18 mm – the minimum value was 0.9 mm and the maximum value was 14 mm. The most frequent chromosomal abnormality[4] was trisomy 21 . The measurement of NT helped to correctly classify 16 fetuses out of 23 fetuses with chromosomal alterations The risk of the abnormal baby was increased[5] 2.7 times significantly (95% CI 1.1-6.0 and $P < 0.01$) in the group of advanced maternal age (≥35 years old). the most frequent chromosomal aberration was trisomy 21 (16 cases) followed by trisomy 18

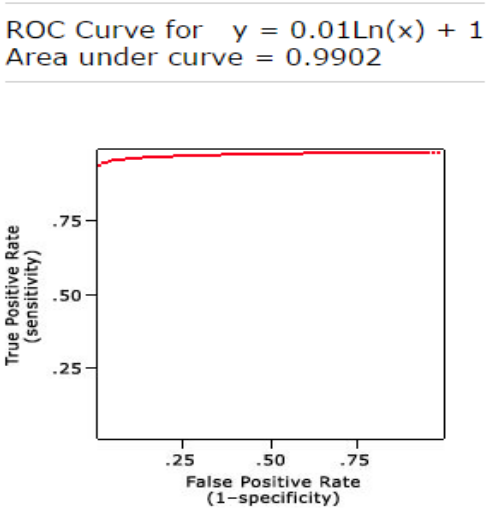
RESULTS: 1Euclidian Distance=5.238 mm

Diagnostic level	TP	TN	FP	FN
1	y			
2	y			
3	y			
4			y	
5	y			
6	y			
7	y			
8	y			
9	y			y
10		y		

Receiver Operating Characteristic:

Receiver operating characteristic or simply ROC curve is a graphical plot which illustrate the

performance of binary classifier system .It is created by plotting the fraction of true positive values out of the total actual positive (TPR=True Positive Rate) vs fraction of true false positive out of the total actual negative (FPR=False Positive Rate) .TPR is known as sensitivity and specificity if (TNR=True Negative Rate) it is a probability that test result will be negative. The accuracy of the semi automated system for measurement of NT thickness is 90%.



CONCLUSION:

The Nuchal Translucency thickness measurement[6] is made to identify the Down Syndrome in screening first trimester fetus . Canny operators can utilized for segmenting the nuchal translucency region and the exact thickness has been estimated the fetus in the 14th week of Gestation is expected to have a nuchal translucency thickness of 1.87±0.25mm.The semi-automated system[7] reduces substantially the within- and between-sonographer variation in the measurement of NT achieved using the traditional manual approach. However, the semi-automated system does not avoid the need for appropriate training of sonographers. The measurements of NT[8] for normal and abnormal fetus need to carry out. It is concluded that the computer aided measurement will provide valuable information[9] to the physicians to take accurate decision. The normal fetus with gestation week of 14 must not have greater than 2.12 mm of NT thickness.

REFERENCES*:*

1. A.P.Souka,E.Krampl,S.Bakalis,V.Heath and K.H. Nicolaides "Outcome of pregnancy in chromosomally normal fetuses with increased nuchal translucency in first trimester" , Ultrasound Obstet.Gynecol.Vol.18,2001.PP.9-17
2. B. Georgescu, I. Shimshoni, and P. Meer, "Mean shift based clustering in high dimensions: A texture classification example," in Proc. ICCV, Oct. 2003, pp. 456–463.
3. Mark Fashing and Carlo Tomasi,"Mean Shift is a Bound Optimization",IEEE Transaction of Pattern Analysis And Machine Intelligence,October 5, 2004 .
4. KH.Nicolaides,"Nuchal translucency and other first-trimester sonographic markers of chromosomal abnormalities", A Journal of Obstet Gynecol 2004; 191: pp45–67.
5. Piotr Sieroszewski, Malgorzata Perenc. Elzbieta Bas-Budecka, Jacek Suzin, "Ultrasound diagnostic schema for determination of increased risk for chromosomal fetal aneuploidies in the first half of pregnancy",Journal of Appl Genet, 2006.pp 177-185,
6. Lee Y, Kim M, Kim M." Robust border enhancement and detection for measurement of fetal nuchal translucency in ultrasound images". Med Biol Eng Comput 2007; 45:1143–1152.
7. J. Moratalla,K. Pintoffl,R.Minekawa, R. Lachmann, D. Wright and K. H. Nicolaides Harris Birthright Research Centre for Fetal Medicine, King's College Hospital, London and Department of Mathematics and Statistics,University of Plymouth, Plymouth, UK and GE Medical Systems Kretztechnik GmbH & Co OHG,

Zipf, Austria, "Semi-automated system for measurement of nuchal translucency thickness",Ultrasound Obstet Gynecol ,2010; 36: 412–416,Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/uog.7737

8. Pasquini L, Tondi F, Rizzello F, Pontello V, Paoletti E, Fontanarosa M. "Impact of tissue harmonic imaging on measurement of nuchal translucency thickness". Ultrasound Obstet Gynecol 2010; 36: 423–426.
9. Grang´e G, Althuser M, Fresson J, Bititi A, Miyamoto K, Tsatsaris V, Morel O. "Semi-automated adjusted measurement of nuchal translucency: feasibility, reproducibility and benefits". Ultrasound Obstet Gynecol 2011; 37: 335–340.