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[Reddy * *et al.*, 6(8): August, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

AN APPROACH TO MONITOR FETUS GROWTH AND ITS WEIGHT ESTIMATION USING ULTRASOUND

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DOI: 10.5281/zenodo.843930

ABSTRACT

Analysis the growth of a fetus is essential and most important at pregnancy time. For this, we have to consider the fetal biometric measurements. Normally to check the growth of a fetus we used to measure weight of the fetal. The weight estimation is done by using ultrasound image where gynaecologist proper observation required and image quality. And the accuracy of the weight estimation of the fetal during scanning process depends upon fetal biometric parameters like Biparietal diameter (BPD), Head circumference (HC) Crown Rump Length (CRL), Femur length (FL), Humerus Length (HL) and abdominal circumference (AC) have been used. In this paper, we present different stages to monitor the growth of a fetus and weight estimation method using ultrasound images.

KEYWORDS: Ultrasound, Weight Estimation, Fetus growth, segmentation, image processing.

I. INTRODUCTION

Ultrasound image has been widely used for accessing fetus weight estimation parameters and organs such as the heartbeat, kidneys growth and tissues such as the breast, the abdomen, the muscular system, and tissue in the fetus during pregnancy [1]. One indicator for the growth of fetus is the fetal weight. Fetal growth is also very essential to be evaluated as it is linked to the improvement in neonatal and mortality growth. The ultrasound image information it is used to for guessing the fetal weight and estimated date of delivery is been planned. The exactness of the projected value is vital to make the resulting clinical information reliable. Fetal biometric measurements that are obtained from diagnostic medical expert and sonographer Circumference. The equations were generated by using fetal parameters like femur length (FL), Biparietal diameter (BPD), Head circumference (HC) Crown Rump Length (CRL), Humerus Length (HL) and abdominal circumference (AC). By using these biometric measurements we calculate the weight of fetus. So, if ultrasound images are in poor quality that the resulted fetal weight estimation will be less accuracy[2]. The feasible fetal weight is determined based on this subjective measurements will be untrustworthy and the result of the pregnancy's valuation will be high risk. This is a challenge, because the relationship between ultrasound biometric parameters and fetal weight is very complex, which is not a simple linear relationship, so finding a general formula is very difficult.

II. METHODOLOGY

Why ultrasound Scan in Pregnancy

Monitoring of fetus growth is very essential and plays a vital role in pregnancy time. For this purpose we use ultrasound scan which uses high frequency sound waves in the megahertz range that reflected onto 2D and 3D images in varying different degrees. It is also essential to get the ultrasound scan which is associated with imaging the fetus. This ultrasound image check the not only growth of a fetus in pregnant women and also check the abdominal organs like heart, muscles, tendons, arteries and veins [3]. Why ultrasound scan means it is considered to be accurate, inexpensive and safer which does not cause any adverse effects

When though we can get fetus images from different imaging techniques like computed tomography scan (CT), Magnetic Resonance Imaging scan (MRI) and positron emission tomography (PET) scan which are better than ultrasound scan because it has several advantages which make it ideal in different circumstances.

1. It is used to check baby's physical development between 18 to 20 weeks which is useful for nuchal translucency test.

2. It does not harm the baby when in early stage of pregnancy to check whether the baby having the congenital problem.
3. To check the position of the placenta, baby's growth and development.
4. It is very essential during entire course pregnancy and for the antenatal investigations.

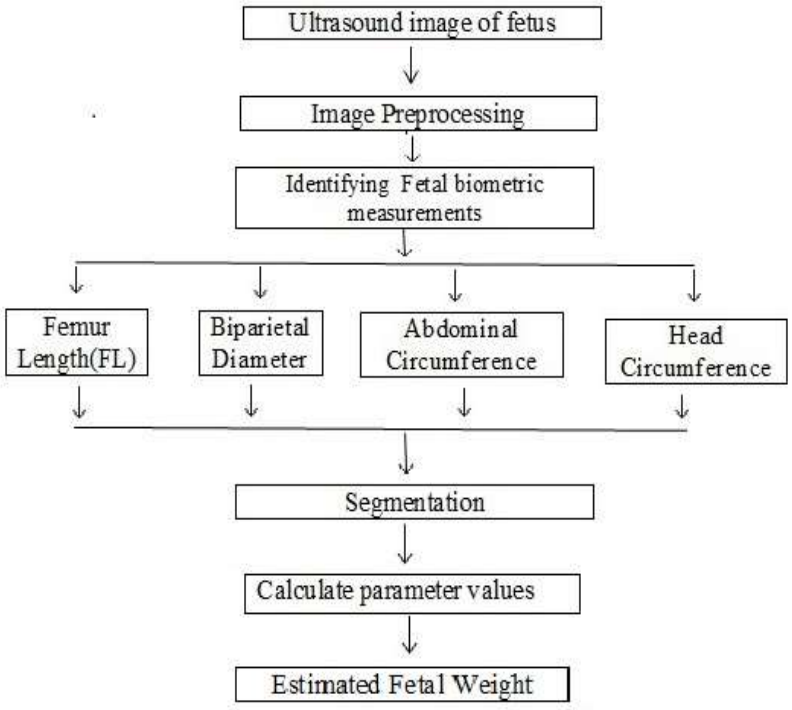

Figure 1. The proposed model for estimating fetal weight

Noises and pre-processing

Image degradation is due to noise involved in the image caused by external disturbance. Noise gets introduced during acquisition, communication, reception, storing & retrieval of an image. Usually Noise are added to image while doing above mention processes, hence we investigate the type of the standard noise. Pre-processing techniques are used for eliminating or reducing noise in image [4]. Type of noise the occurs in images are

- Amplifier noise
- Impulsenoise
- Poisson Noise
- Speckle Noise

Mean Filter

This is the straight forwarded filter to remove noise from image. In this technique, each pixel is replaced by mathematical mean of neighbouring pixels.

Median Filter

One of the non-linear filters is median filter. It removes noise effectively when compare to other filters as well as conserve sharpness of edges. It just substitutes each pixel value by the median of the intensity values of its neighbouring pixels.

Weiner filter

Wiener filter is to reduce the amount of noise present in a signal by evaluation with an estimation of the desired noiseless signal. It fellows statistical method.

Speckle noise is observed in ultrasound image which affects edges and fine details of objects in images. By applying the Weiner filter noise and get edge detection of an image.

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Fetal anatomical parameters

To know the growth of fetus by using ultrasound imaging system involves many fetal anatomical parameters are used. On which the Biparietal Diameter(BPD),Femur Length(FL),Abdominal Circumference(AC), Head Circumference(HC),Crown Rump Length(CRL) and Humerus Length(HL) are present[5].

Biparietal Diameter (BPD): It is measured from the starting of the fetal skull to distal skull as represented in Table 1.

Abdominal Circumference (AC): It is a transverse or coronal section through the fetal abdomen at the level where the umbilical vein enters the liver as shown in Figure 1.

Femur Length (FL): it is used as a maker for fetal malformation and longitudinal growth of the fetus. It will be found about a 45^{o} angle away from spine of fetal.

Head Circumference (HC): It is the measurement the fore head region that is the eyebrows and ears that delivers the head circumference as shown in the Figure 1

Crown Rump Length (CRL): The length of human embryos from the top of the head to bottom of the buttocks of fetus.

Humerus Length (HL): It is measured in Down syndrome assessment methodsof fetal [6].

Table 1. Ultrasound images of different biometric measurements.

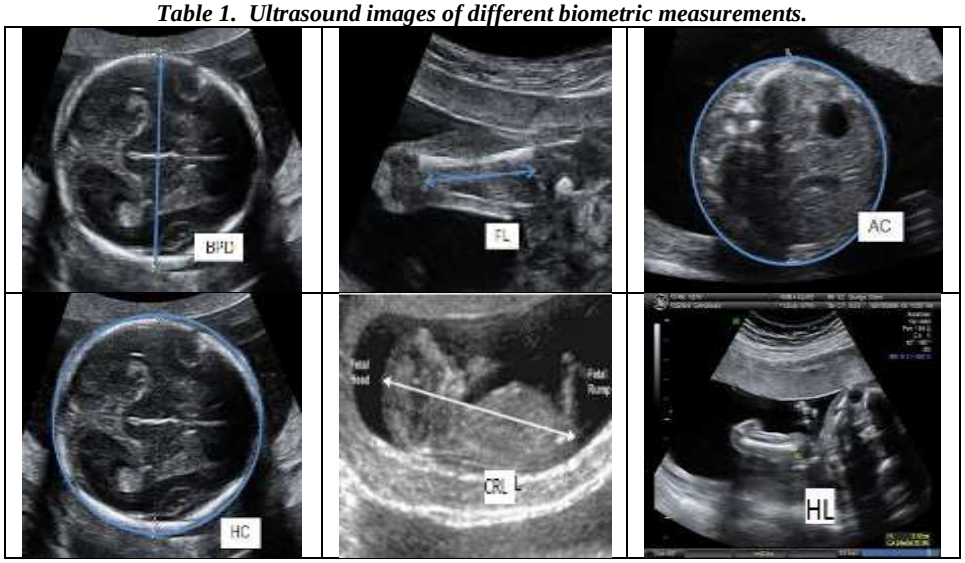

Image segmentation

Image segmentation is an important phase in image processing applications and emerged to separating image into different sections. Segmentation is a procedure of separating a digital image in to distinct regions based upon the dissimilarities in their pixel intensity and getting a meaningful region known as the Region of Interest (ROI). Image segmentation algorithms are based on the principle of discontinuity or similarity of intensity. The concept under the discontinuity and similarity is to get a region that differs in properties such as grey level, color intensity, grain, or any other image statistics and group pixels based on common property[7].

- Thresholds
- Edge Detection Technique
- Region Based Segmentation Methods
- Artificial Neural Network

Estimation of Fetus Weight and formulas

Many different formulas have been published in different literature for calculating EFW (Estimated Fetus Weight), and various studies have been done to evaluate the accuracy a mong these formulas. The Shepard and

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Hadlock formulas compare well with fetal weight calculation to get the nearest results but not exact. From various studies it is came through that the Hadlock III and Hadlock IV are approximate to actual mass of the fetus[8].

Table 2. Formulas of calculate the fetus weight

Formula	Regression equation for EFW(Estimation Fetus Weight)
Combs [HC, AC, FL]	$EFW = 0.23718 * AC^2 * FL + 0.03312 * HC^3$
Hadlock III [BPD, AC, FL]	$EFW = \log_{10}(1.335 - 0.0034 * AC * FL + 0.0316 * BPD + 0.0457 * AC + 0.1623 * FL)$
Shepard [BPD, AC]	$EFW = 10^{(-1.7492 + 0.166 * BPD + 0.046 * AC - 0.002546 * AC * BPD)}$
Scott [HC, AC, FL]	$EFW = \text{Log}_{10}(0.66 * \log(HC) + 1.04 * \log(AC) + 0.985 * \log(FL))$
Hadlock IV [HC, AC, FL]	$EFW = \text{Log}_{10}\ 1.326 + 0.0107\ HC + 0.0438\ AC + 0.158\ FL - 0.00326\ AC \times FL$
Shinozuka [BPD, AC, FL]	$EFW = 1.07 * BPD^3 + 0.3 * AC^2 * FL$

III. CONCLUSION

To check the growth of a fetus we used to calculate weight of the fetal. Fetus weight calculating is a challenge, because the relationship between ultrasound biometric parameters and fetal weight is very complex, which is not a simple linear relationship, so finding a general formula is very difficult. In this paper, a model is presented how to check growth of fetus by apply the fetal biometric measurements on different formulas. Analysis the growth of a fetus is essential and most important in pregnancy

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CITE AN ARTICLE

Reddy, R. K., Babu, U. R., Dr, & Raju, K. P. (2017). AN APPROACH TO MONITOR FETUS GROWTH AND ITS WEIGHT ESTIMATION USING ULTRASOUND. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, 6*(8), 263-566. Retrieved August 16, 2017.