Ain Shams University
Faculty of Engineering

MICROCOMPUTER ULTRASONIC DATA ACQUISITION AND PROCESSING FOR EVALUATING ABNORMAL FETAL GROWTH

By

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(B.Sc., M.Sc.)

A Thesis

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[Computer and Systems Engineering]

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M.A

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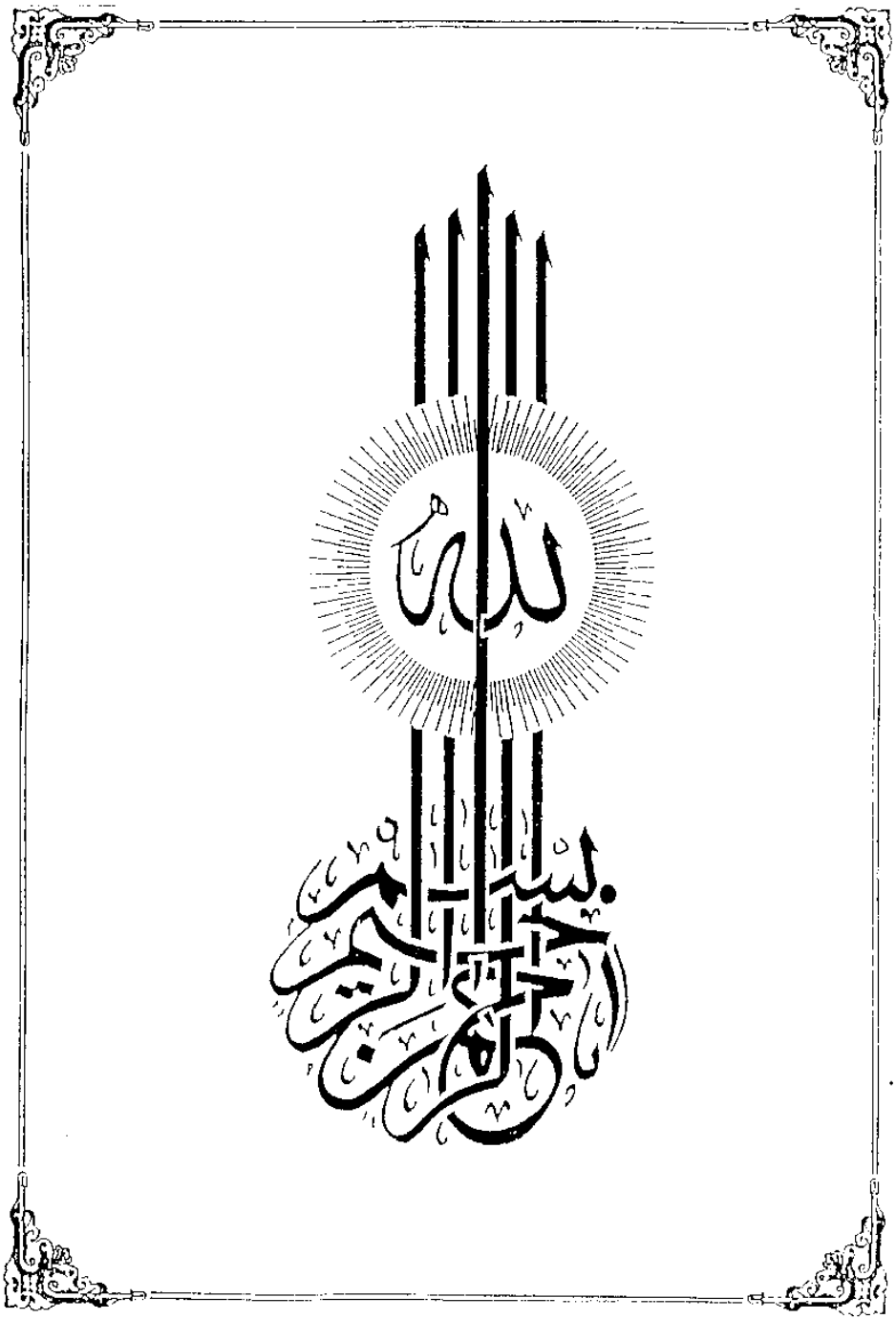

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STATEMENT

This dissertation is submitted to Ain Shams University for degree of PH. D. in Electrical Engineering.

The work included in this thesis was carried out by the auther in the Department of Computer and Systems Engineering, Ain Shams University, ICL lab., and Talat unit for Diagnostic Ultrasound, from

No part of this thesis has been submitted for a degree or qualification at any other University or Institution.

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quality and quantity, data acquisition processing is one of these analytical tools.

The method is based on an analysis of the echo amplitude distribution. The distribution in magnitude can be described by the coefficient of variation which is defined as the standard deviation divided by the mean of the distribution. this parameter correlates with the proportion of echo-dense regions visualized within the tissue sampled

The echo-peak amplitude distributions obtained from placental images may be of clinical value.

TIUV, fetal head volume, fetal abdominal cross sectional area, and placental coefficient of variation, digitization have been introduced with a new technique to evaluate IUGR.

Thesis organization

The thesis contains four chapters. The first one concerned with the review of fetal growth characteristics and ultrasonic visualization of fetal anatomy. The second chapter represents the expermental techniques, shows the ultrasonic estimation of the volume of organs, placental digitization and implementation of data processor using standard TTL chips. The third chapter includes the results and the programs for evaluation of IUGR. While the fourth chapter represents the VLSI design of a multiplier with two 5-bit words to use as a part of the data processor. The thesis is ended by conclusive remarks about the technique studied and the future remarks.

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image of the fetal head and abdomen may, however vary due to non uniform pressure applied to the trunk in various ways.

Such change in shape involve a movement of mass would be expected to be toward the regions of least resistance, the shape changes induced by these mass movements can change diameter and circumference measurements but will not decrease or increase the profile area and volume.

Quantitative characterization of fetal growth requires the selection of measurement parameters and a growth curve model. These parameters are relatively insensitive to shape changes and are related to three-dimensional parameters.

Since the head and trunk are three-dimensional objects, the most appropriate growth parameters would be area and volume (Deter, et al, 1981).

However, ultrasound images do not provide a simple means for measuring these parameters as the images are two dimensional in character.

By means of a digital light pen measuring system coupled with a microprocessor, a measure of volume and surface area can be obtained by ultrasound scan sets.

A measure of Total Intrauterine Volume (TIUV) would theoritically be useful to detect the Intra-uterine Growth Retardation (IUGR).

By definition, fetal mass is reduced in IUGR (Deter et al,

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1981). In addition, placental volume and amniotic fluid are often diminshed.

Placental insufficiency is usually associated with IUGR (Carroll, 1980).

Amniotic fluid volume plays a major part in determining TIUV, and reflects both fetal and placental function **(Carrol et al, 1980)**.

Amniocentesis, which is the percutaneous passage of a needle into amniotic cavity, for the determination of fetal biologic maturation is associated with some morbidity, including fetal trauma and fetal death,so the prediction of a mature fetus by noninvasive means would be useful in managing certain high-risk patients and IUGR. Fig. 1.

There is a strong correlation between fetal lung maturity and placental maturity (texture) (Grannume, et al,1979), ultrasound can be used to quantitate the B-scan appearance of the placenta, the shape of the amplitude distribution of echo peaks detected within the placental sample volume can be described by the coefficint of variation, which is defined as standard deviation divided by the mean of the distribution. This parameter correlates with the proportion of echo-dense regions visualized within the tissue sampled.

Examining the placenta for signs of premature aging using a quantitative assessment, placental digitization and signal

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processing, could be used to evaluate the maturation of the placenta and fetal biologic maturation instead of amniocentesis to develop safe and noninvasive ultrasonographic technique.

The equations used to predict IUGR from the estimated fetal parameters were derived using a more general program: Lotus 1-2-3, which is a spread-sheet software. This software runs on an IBM-compatible P.C. for processing obstetric ultrasound data.

Calculation of fetal parameters was performed by the Ti-59 microcomputer with program for the different parameters calculations and hard copy printout of calculated data and evaluation of IUGR.

Aim of the work.

The aim of the present work is to study by ultrasound measurements the different fetal parameters which are relatively insensitive to shape changes **(Abd. area, HV, and TIUV)** The correlation between these measurements and fetal gestational age, and the expression of these relationships in mathematical models, is the aim of this work for evaluation of IUGR .

Also, the target of this work is to develop a safe and noninvasive technique to examine the placenta for signs

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of IUGR using ultrasonic data acquisition, processing, and circuit techniques.

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[1]

Definition for small/gestation age: SGA:

Infants with less

than two standard deviation for gestational age, clinically, those less than the tenth percentile are also included, as they share similar complication.

Types of IUGR.

1- Symmetric 20%: An early gestation insult with overall decreased cell number and a proportionate decrease in organ size Causes: Infection and cromosomal.

2- Asymmetric 80%: occur later in gestation with decreased subcutaneous fat and decreased in abdominal circumference with preservation of head and femur growth, Causes: Maternal hypertension, Mal nutrition and renal disease.

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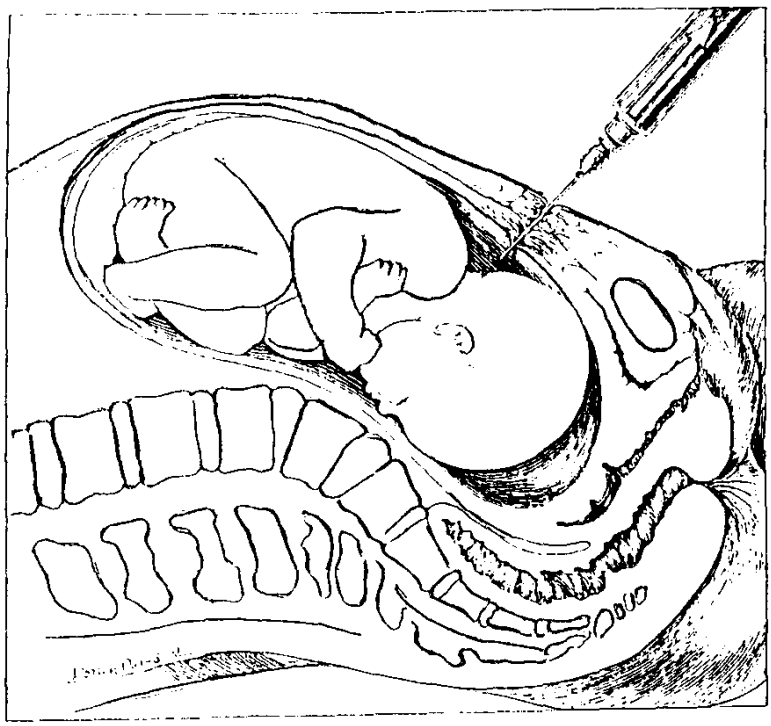

Technique of amniocenlesis.

Fig. 1 Percutaneous passage of a needle into the amniotic cavity.

(Sandberg 1978)

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CHAPTER 1

REVIEW

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