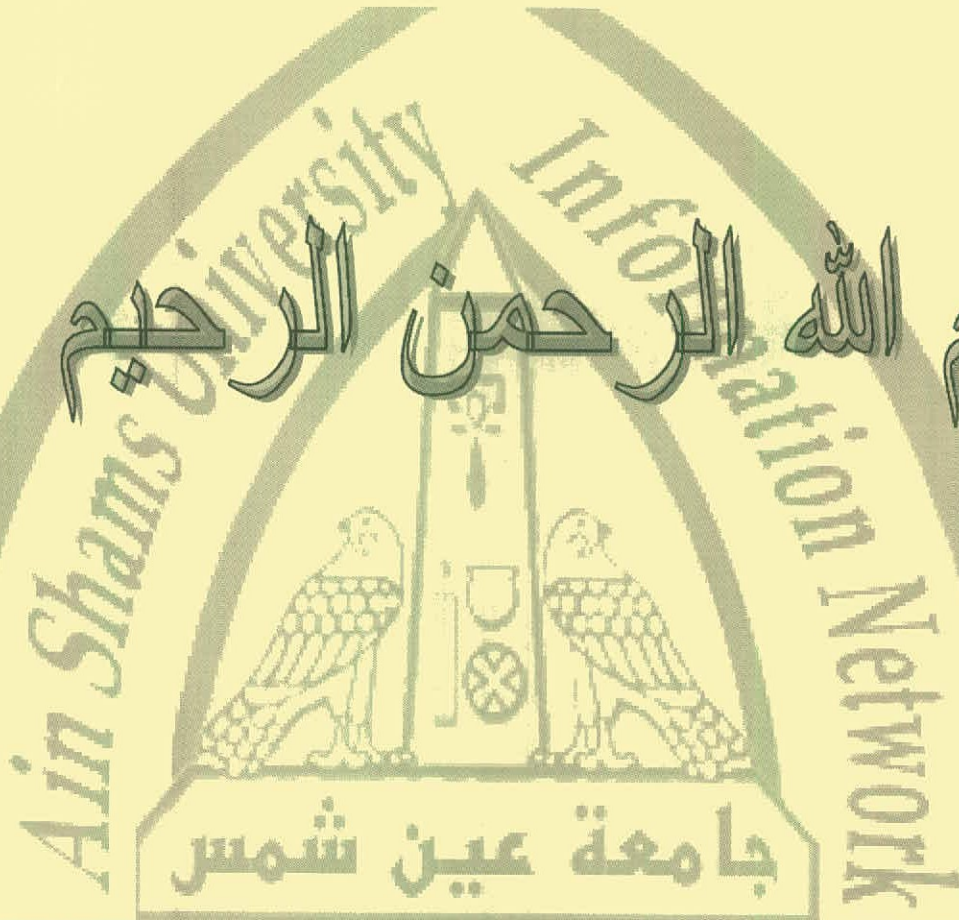




شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



شبكة المعلومات الجامعية
@ ASUNET



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of
15-25- c and relative humidity 20-40%

بعض الوثائق الأصلية تالفة

بالرسالة صفحات لم ترد بالاصل

5915
CP

DEVELOPING A COMPLETE AUTOMATIC 2D AND 3D CEPHALOMETRIC ANALYSIS SYSTEM

By

Eng. Ahmed Aly Saad Ahmed

Systems and Biomedical Engineering Department

Faculty of Engineering, Cairo University

610928

A Thesis Submitted to the

Faculty of Engineering at Cairo University

in Partial Fulfillment of the

Requirement for the Degree of

MASTER OF SCIENCE

In

SYSTEMS AND BIOMEDICAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

March 2005

DEVELOPING A COMPLETE AUTOMATIC 2D AND 3D CEPHALOMETRIC ANALYSIS SYSTEM

By

Eng. Ahmed Aly Saad Ahmed

Systems and Biomedical Engineering Department

Faculty of Engineering, Cairo University

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the

Requirement for the Degree of

MASTER OF SCIENCE

In

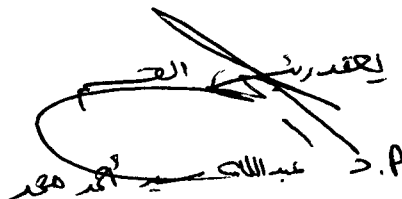
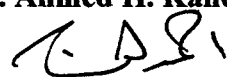
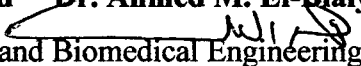
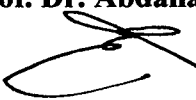
SYSTEMS AND BIOMEDICAL ENGINEERING

Under the Supervision of

Prof. Dr. Abdallah S. Ahmed Dr. Ahmed M. El-Bialy Dr. Ahmed H. Kandil

Systems and Biomedical Engineering Dept.

Faculty of Engineering, Cairo University



د. أحمد علي سعد أحمد

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

March 2005

DEVELOPING A COMPLETE AUTOMATIC 2D AND 3D CEPHALOMETRIC ANALYSIS SYSTEM

By

Eng. Ahmed Aly Saad Ahmed

Systems and Biomedical Engineering Department

Faculty of Engineering, Cairo University

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the

Requirement for the Degree of

MASTER OF SCIENCE

In

SYSTEMS AND BIOMEDICAL ENGINEERING

Approved by the

Examining Committee

Prof. Dr. Abdallah S. Ahmed, Thesis Main Advisor

Prof. Dr. Mohamed Emad M. Rasmy, Member

Prof. Dr. Yahia Ahmed Mostafa, Member

Dr. Ahmed M. El-Bialy, Thesis Advisor

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

GIZA, EGYPT

March 2005

بسم الله الرحمن الرحيم
"و قل ربي زدني علماً"
صدق الله العظيم

CONTENTS

CONTENTS.....	V
LIST OF TABLES.....	VIII
LIST OF FIGURES.....	IX
DEDICATION.....	XIII
ACKNOWLEDGEMENTS.....	XIV
ABSTRACT.....	XV
CHAPTER 1 INTRODUCTION.....	1
1.1 PROBLEM DEFINITION AND MOTIVATION.....	1
1.2 THESIS OBJECTIVES.....	5
1.3 THESIS ORGANIZATION.....	6
CHAPTER 2 BACKGROUND.....	7
2.1 MANUAL CEPHALOMETRIC ANALYSIS.....	7
2.2 SEMI-AUTOMATIC CEPHALOMETRIC ANALYSIS.....	8
2.3 FULLY AUTOMATIC CEPHALOMETRIC ANALYSIS.....	9
2.3.1 <i>Priori-knowledge image processing techniques (bottom-up techniques)</i>	9
2.3.2 <i>Model-based techniques (Top-down techniques)</i>	11
CHAPTER 3 ACTIVE APPEARANCE MODEL (AAM).....	16
3.1 BACKGROUND OF ACTIVE APPEARANCE MODEL.....	16
3.1.1 <i>Benefits of Active Appearance Model</i>	17
3.1.2 <i>Definition of the Active Appearance Model</i>	18
3.2 BUILDING SHAPE MODEL.....	19
3.2.1 <i>Obtaining Shape Representation</i>	19
3.2.2 <i>Shape Alignment</i>	20
3.2.3 <i>Modeling Shape Variations using Principal Component Analysis (PCA)</i>	24
3.3 BUILDING TEXTURE MODEL.....	27
3.3.1 <i>Delaunay Triangulation of the Mean Shape</i>	28
3.3.2 <i>Calculating the mask image</i>	29
3.3.3 <i>Piece-wise affine Transformation</i>	29
3.3.4 <i>Bilinear Interpolation</i>	30

3.3.5 Photometric Normalization.....	31
3.3.6 Modeling Texture Variations using Principal Component Analysis (PCA)	33
3.4 BUILDING COMBINED APPEARANCE MODEL	34
3.5 SEARCHING ACTIVE APPEARANCE MODEL FOR NEW IMAGES	38
3.6 AUTOMATIC INITIALIZATION OF ACTIVE APPEARANCE MODEL	41
CHAPTER 4 EXPERIMENTAL RESULTS.....	46
4.1 THE APPLICATION OF BASIC ACTIVE APPEARANCE MODEL.....	46
4.2 THE APPLICATION OF ACTIVE APPEARANCE MODEL (AAM) + SIMULATED ANNEALING (SA)	56
4.3 THE UNIFICATION BETWEEN ACTIVE APPEARANCE MODEL AND ACTIVE SHAPE MODEL IN A MULTI-RESOLUTION FRAMEWORK USING LEAVE-ONE-OUT EXPERIMENT	62
4.4 THE UNIFICATION BETWEEN ACTIVE APPEARANCE MODEL AND ACTIVE SHAPE MODEL IN A MULTI-RESOLUTION FRAMEWORK USING LEAVE-ONE-OUT EXPERIMENT WITH SKULL SUB- MODELS	74
4.5 COMPARISON BETWEEN THE USED METHODS.....	82
4.5.1 Comparison between the used methods in terms of accuracy of automatic identification of cephalometric landmarks as in Table 4.12.....	83
4.5.2 Comparison between the used methods in terms of Time of automatic identification of cephalometric landmarks as in Table 5.12.....	84
4.6 COMPARISON WITH OTHER PUBLISHED RESEARCH RESULTS.....	85
4.6.1 Comparison With Respect To the Number of Cephalometric Landmarks as shown in Table 4.14.....	85
4.6.2 Comparison with respect to average error wherever possible. as shown in Table 4.15....	86
CHAPTER 5 AUTOMATIC CEPHALOMETRIC ANALYSIS	88
5.1 GRAPHICAL REPRESENTATION OF CEPHALOMETRIC ANALYSIS	89
5.1.1 Skeletal Profile Analysis.....	89
5.1.2 Growth Pattern Analysis	90
5.1.3 Maxilla Analysis.....	90
5.1.4 Mandible Analysis.....	91
5.1.5 Maxillary Dentition Analysis	92
5.1.6 Mandibular Dentition Analysis	93
5.1.7 Maxillary / Mandibular Dentition Analysis	94
5.1.8 Soft-tissue Analysis.....	95
5.2 STANDARD REPORT FORMAT OF CEPHALOMETRIC ANALYSIS.....	97
CHAPTER 6 3D CEPHALOMETRIC ANALYSIS	98
6.1 OBJECTIVES.....	99