AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
COMPUTERS AND SYSTEMS ENGINEERING
DEPARTMENT

DEVELOPMENT AND EVALUATION OF KNOWLEDGE ACQUISITION AND REPRESENTATION SCHEMES FOR DESIGN AUTOMATION

A thesis submitted in partial fulfillment of the requirements for the degree of

Ph.D.

IN

ELECTRICAL ENGINEERING

[Computers And Systems Engineering]

by

SAYED MOHAMED SAYED AL-ARABY

(B.Sc.1976 & M.Sc.1983)

Supervised by

Prof.Dr.M.A.R. GHONAIMY

Faculty of Engineering, Ain Shams University

Prof.Dr. FAIZA A. MOHAMED

Prof.Dr. AMR M.A. OMER

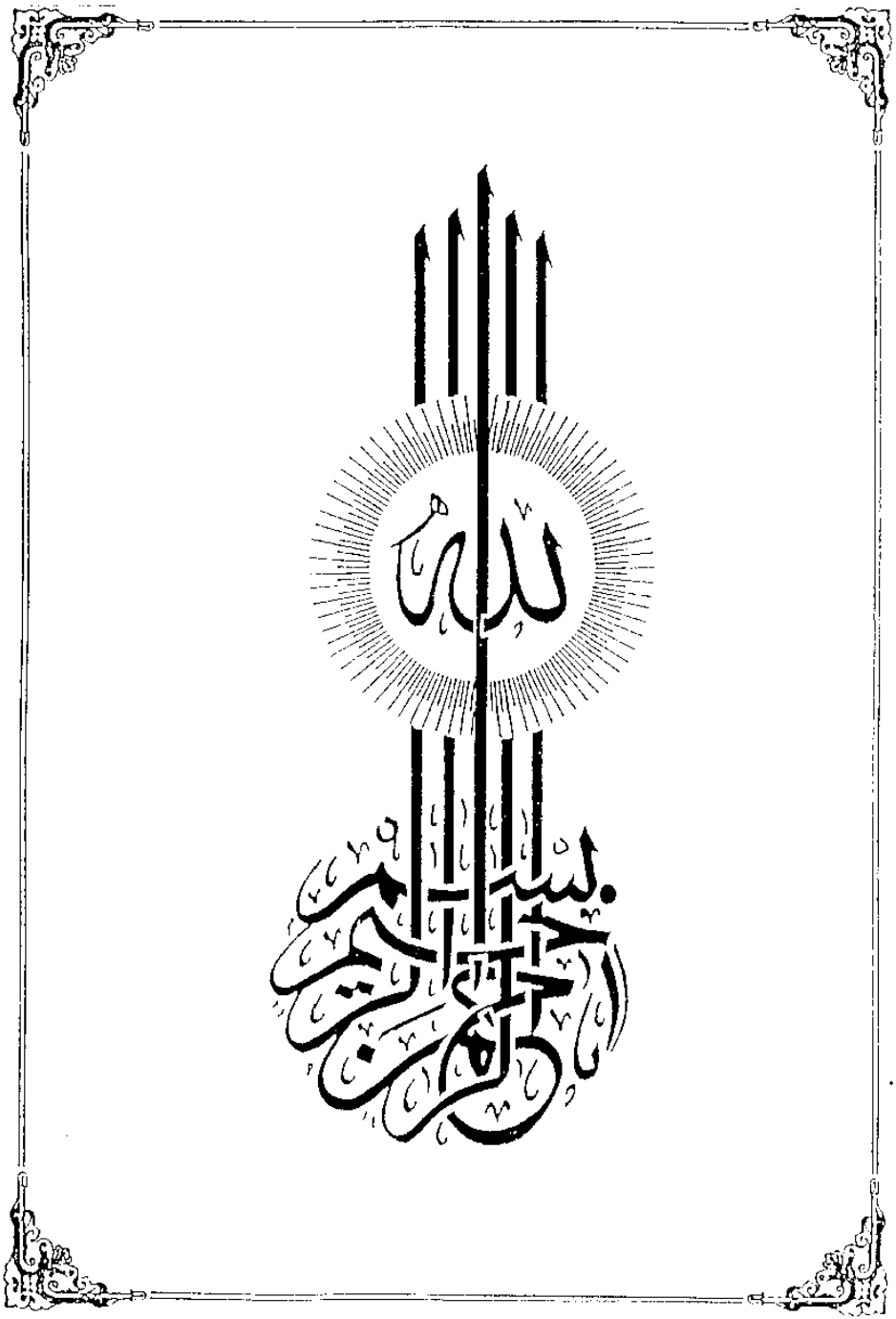
Atomic Energy Authority

CAIRO-1993

EXAMINERS COMMITTEE

Name Title & Affiliation	Signature
1. Prof. Dr. Abd Al-Monem Usef Belal. Cairo University Faculty of Engineering	
2. Prof. Dr. Osman Abd El-Latif Badr. Ain Shams University Faculty of Engineering	
3. Prof. Dr. Mohamed Adib Reyad Ghonaimy. Ain Shams University Faculty of Engineering	

Date : 30/ 3 / 1993



STATEMENT

This dissertation is submitted to Ain Shams University for degree of Ph. D. in Computer Engineering. The work included in this thesis was carried out by the author in Department of Computer and System Engineering, Ain Shams University.

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

Date : 30 / 3 / 1993

Signature : Sayed Al-Araby

Name : Sayed Mohamed Sayed Al-Araby

ACKNOWLEDGEMENT

At various stages of this thesis, a number of people have given me invaluable comments on the management and organization of it. A tremendous team effort has given this thesis its quality. In this regard, I own a deeply grateful to Prof. Dr. M.A.R. Ghonaimy for the point suggestion and for his continuous guidance during the realization of this work.

My thanks and deeply grateful to Prof. Dr. Faiza A. Mohamed for her guidance and encouragement. Also, my thanks and deeply grateful to Prof. Dr. Amr M.A. Omer for his guidance, support and encouragement.

My thanks also to all people who assisted me in doing this thesis especially, Prof. Dr. Osman A. Bader from the staff member of the Computers and Systems Engineering Department, and Prof. Dr. Laila F. Fikry the head of Engineering Department of Nuclear Search Center.

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

COMPUTERS AND SYSTEMS ENGINEERING DEPARTMENT

Summary of the Ph. D. thesis submitted by :

Eng. Sayed Mohamed Sayed Al-Araby.

Title of thesis :

Development and evaluation of knowledge acquisition and representation schemes for design automation.

Supervisors :

Prof. Dr. M. A. R. Ghonaimy

Prof. Dr. Faiza A. Mohamed

Prof. Dr. Amr M. A. Omer

Registration date : 15 / 2 / 1988.

Examination date : 30 / 3 / 1993.

SUMMARY :

Today, there is a growing interest in development and evaluation of knowledge acquisition and representation schemes which are the two important elements of knowledge based systems (K B Ss). The thesis studies a number of different schemes for knowledge representation and knowledge

acquisition techniques with application to design automation.

An overview of design automation systems is presented. ULYSSES system which performs the VLSI design synthesis task of chip and chip layout of CMOS in an automatic fashion uses the rule-based approach for knowledge representation. PI is an algorithmic system for laying out VLSI chips.

This thesis proposes and implements a modular knowledge based system which is very convenient for the layout implementation of either integrated circuits (I Cs) or printed circuit boards (P C Bs) automatically. The modularity of the system facilitates maintenance.

The system overcomes all the layout problems which are usually NP-complete problems : placement, routing and compaction of area. Force-directed placement algorithm is used to select the suitable positions of components with respect to connections among them.

In routing, the thesis presents a new definition for routing channels with convenient rules to facilitate, not only, the routing process but also, the compaction process. Also, each connection net is sorted to either internal net, power ground net or signal net. The nets are executed as internal nets, power-ground nets and signal nets, respectively. But in compaction process, two-dimensional compaction algorithm is used to optimize the area of implemented circuits.

This system is mainly a frame-based which is combined with semantic network and rule-based approaches. Therefore, the system utilizes the advantages of those approaches and their knowledge acquisition techniques. A comparative study is performed between the proposed system and the PI system. This comparative study explains the advantages of the proposed system which overcome PI disadvantages.

The proposed system is tested by several circuits of different densities to verify its capabilities. The results of these circuits are presented with their critical discussion. Also, the description of the proposed system programs are discussed in details. Finally, the proposed future work is presented.

ABSTRACT

This thesis proposes and implements a modular knowledge based system for automated design of either integrated circuits or printed circuit boards. This system proposes solution for placement, routing and compaction of area. This system overcomes PI disadvantages and is tested by several circuits of different densities to verify its capabilities.

CONTENTS

LISTING OF FIGURES :