بسم الله الرحمن الرحيم

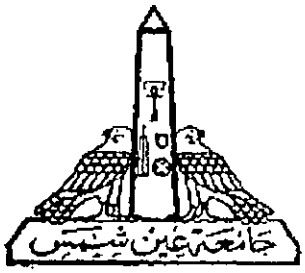
∞∞∞

تم عمل المسح الضوئي لهذة الرسالة بواسطة / سامية زكى يوسف

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات:

- بالرسالة صفحات لم ترد بالأصل
- بعض الصفحات الأصلية تالفة
- بالرسالة صفحات قد تكون مكررة
- بالرسالة صفحات قد يكون بها خطأ ترقيم



Ain Shams University
Faculty Of Engineering
Computers & Systems Engineering Department

Online Handwriting Recognition of Arabic Characters Using Fuzzy Rules

A Thesis submitted in Partial fulfillment of the requirements of the degree of Master of Science in Computers and Systems Engineering

Submitted by
Amr Adel Hassan
B.Sc. of Computers and Systems Engineering 1993
Computers and Systems Engineering Department
Faculty of Engineering – Ain Shams University

Under supervision of
***Dr.* Hassan Shehata Bedor**
Ass. Prof. in Computers and Systems Engineering Department

Cairo 1998

AIN SHAMS UNIVERSITY
Faculty Of Engineering
Computer and Systems
Engineering Department

Approval Sheet

Thesis Title

Online Handwriting Recognition of Arabic Characters Using Fuzzy Rules

Submitted by

Amr Adel Hassan

For the degree of

Master of Science in
Computers and Systems Engineering

Discussion Committee

Signature

Prof. Dr. Mohamed Abdel Moneim Hashish
Professor of Computers & Systems Eng.
Cairo University

Prof. Dr. Hussein Isamail Shahein
Professor of Computers & Systems Eng.
Ain Shams University

Dr. Hassan Shehata Bedor
Ass. Professor of Computers & Systems Eng.
Ain Shams University

Date: *December 31, 1998*

Statement

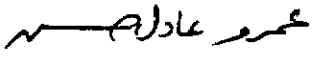
This thesis is submitted to Ain Shams University in partial fulfillment of the requirements for the degree of Master of Science in Computers and Systems Engineering.

The research included in this thesis was carried out by the author at the Computers and Systems Engineering department, Ain Shams University.

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

Date : 31 / 12 / 1998

Name : Amr Adel Hassan

Signature : 

Student Profile

Name : **Amr Adel Hassan**

Birth Date : 30 / 10 / 1971 Cairo

Degree

B.Sc. of Computers and Systems Engineering
Computers and Systems Engineering Department
Faculty of Engineering
Ain Shams University
June, 1993

Profession

Demonstrator in Suez Canal University
Electrical Engineering Department
Faculty of Industrial Education

AIN SHAMS UNIVERSITY
Faculty Of Engineering
Computer and Systems
Engineering Department

Online Handwriting Recognition of Arabic Characters Using Fuzzy Rules

Submitted by
Eng. **Amr Adel Hassan**

Abstract: The objective of this thesis is to discuss the problem of Arabic online handwriting recognition and finding techniques to be applied in a system for recognizing Arabic characters and words. At first, the research was focused on the recognition of handwritten isolated Arabic characters and Hindi numerals which are used in our daily life as Arabic numerals. Later on, a preliminary study is carried on the recognition of handwritten Arabic words (which is cursive by its nature). This study results on developing a word segmentation module to be used in word recognition system. The study also discussed the needed modifications on the other modules of the word recognition system to be compatible with the output from the developed word segmentation module. Most of the described techniques are implemented in the developed programs within this thesis.

The major stages of the introduced handwriting recognition system are as follows:

- Pre-processing.
- External (Character) Segmentation.
- Inner Segmentation.
- Segment Classification.
- Character Classification.

The classification (Segment or character) is done with the aid of fuzzy rules. The fuzzy rules simplify the design and provide the ability to extend the rule base easily, which provides the system the ability to extend the set of defined characters to be recognized.

Many ambiguities that exists in handwritten characters can be reduced by the techniques discussed in this thesis. These techniques are flexible enough to overcome the variations of handwriting modes. The flexibility of these techniques permits the recognition system to be able to recognize characters from a new writers.

Keywords: *Handwriting Recognition, Fuzzy Logic, Fuzzy-Rule based System*

This thesis is submitted in partial fulfillment of the requirements of the degree of Master of Science in Computer and Systems Engineering under supervision of

_Dr._ Hassan Shehata Bedor

Ass. Prof. **in Computer and Systems Engineering Dept.**
Faculty Of Engineering
Ain Shams University

Acknowledgment

I would like to express my thanks to :

- *Dr.* **Hassan Shehata** for his supervision and advice during the course of this accomplishment.
- *Prof. Dr.* **Osman Badr** for his advice and support.
- *Prof. Dr.* **Ahmed Easa**, dean of Industrial Education Faculty, Suez Canal University and all my colleagues for their support during the course of this accomplishment.

I would like to express my gratitude to the **ECG Engineering Consultant Group S.A.** for all kinds of support during the course of this accomplishment. Especially, I would like to thank my friends in **ECG Systems Division** for providing the excellent research environment.

I would like to thank **all my friends** for their cooperation and remarks. Especially, I would like to thank ***Eng. Amr Ibrahim*** and ***Eng. Mohamed El-Zemaity*** for their help and technical support.

Table Of Contents

Chapter 1: Introduction And Overview

Chapter 2: Overview On Fuzzy Logic

Chapter 3: Survey On Handwriting Recognition

Chapter 4: Character Recognition System Design And Implementation