UNIVERSITI PUTRA MALAYSIA

SHARP-EDGES STEGANOGRAPHY IN ARABIC CHARACTERS FOR INFORMATION HIDING

NUUR ALIFAH BINTI ROSLAN

FSKTM 2011 5

SHARP-EDGES STEGANOGRAPHY IN ARABIC CHARACTERS FOR INFORMATION HIDING

By

NUUR ALIFAH BINTI ROSLAN

This thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirement for the Degree of Master of Science

June 2011

© COPYRIGHT UPM

DEDICATION

This work is dedicated to my beloved parents and family and also my dearest friends for their endless love, patience and support.

My Parents and family

ZAINAB TAHIR, ROSLAN SARDEN, FIRDAUS, AFRINA

© COPYRIGHT UPM

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

SHARP-EDGES STEGANOGRAPHY IN ARABIC CHARACTERS FOR INFORMATION HIDING

By

NUUR ALIFAH BINTI ROSLAN

June 2011

Supervisor : Ramlan Mahmod, PhD

Faculty : Computer Science and Information Technology

Steganography also known as covered writing creates attention in information hiding field in the past few years in the information security research area. Since the benefit towards this knowledge as the best way of covert communication, many methods and algorithms were implemented through Steganography. Even though many research were concern on image steganography, but in the past two years the text steganography had come with many algorithms and methods. There are two main issues arise in the text steganography: firstly, is a limited redundancy place to hide secret bit which lead to low capacity in hiding secret bits; and the second issue is to have a high invisibility stego-text document at the same time. In order to resolve the problem, sharp-edges stego method focusing in the individual Arabic characters as the redundant data. By using the

© COPYRIGHT UPM

sharp-edges for each Arabic character, each character in the cover text has possibility one to five places of hiding secret bits where, the number of sharp-edges is equals to the number of places to hide the secret bit. As a result, the capacity was increased up to 37.8% compared to the previous works and this method has high invisibility with 1.02 points over 10 points in invisibility ratio. Finally, the sharp-edges stego method had utilized the Arabic text for text steganography and this method also can be implemented to the same area of language such as Jawi, Persian or Urdu.

© COPYRIGHT UPM

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia bagi memenuhi syarat-syarat untuk memperolehi Ijazah Master Sains

STEGANOGRAFI PINGGIR-TAJAM DALAM AKSARA ARAB BAGI PENYEMBUNYIAN MAKLUMAT

Oleh

NUUR ALIFAH BINTI ROSLAN

Jun 2011

Penyelia : Ramlan Mahmod, PhD

Fakulti : Sains Komputer dan Teknologi Maklumat

Bidang kajian penyelidikan steganografi yang juga dikenali sebagai "penulisan yang tersembunyi" mencuri perhatian dalam bidang penyembunyian maklumat kebelakangan ini terutama dalam lapangan keselamatan maklumat. Memandangkan banyak kebaikan steganografi dalam lapangan penyembunyian maklumat ini sebagai komunikasi terlindung, maka terdapat banyak implementasi dari segi algoritma dan kaedah dalam bidang steganografi. Terdapat dua isu utama yang muncul didalam steganografi teks: terbatasnya bit rahsia yang menjurus kepada kurangnya muatan bagi penyembunyian bit rahsia; pada masa yang sama perlu meningkatkan kesamaran dokumen teks-stego. Bagi menyelesaikan masalah tersebut, kaedah pinggir-tajam stego telah memberi tumpuan pada setiap aksara individu bagi set aksara dalam dokumen teks sebagai data yang

© COPYRIGHT UPM

berulang. Dengan menggunakan pinggir-tajam bagi setiap aksara Arab di dalam teks penyembunyi, mereka mempunyai kebarangkalian menyembunyikan satu atau lima bit rahsia dimana, jumlah pinggir-tajam itu adalah bersamaan jumlah tempat untuk menyembunyikan bit rahsia. Sebagai hasilnya, muatan bagi bit rahsia telah meningkat kepada 37.8% berbanding kaedah-kaedah sebelum ini dan kaedah ini juga memiliki kesamaran yang tinggi iaitu 1.02 mata berbanding 10 mata dalam skala kesamaran. Akhir sekali, kaedah pinggir-tajam ini telah memanfaatkan sepenuhnya ruang-rupa aksara Arab untuk teks steganografi dan kaedah ini juga boleh diaplikasikan pada bahasa yang sama jenis seperti Jawi, Parsi atau Urdu.

© COPYRIGHT UPM

ACKNOWLEDGEMENTS

Syukur Alhamdulillah to The Almighty God for His shower of blessing, I am able to complete this study.

I wish to express my sincere and deep gratitude to my Supervisor Assoc. Prof. Dr. Ramlan Mahmod and my co-supervisors, Dr. Nur Izura Udzir for their invaluable ideas, guidance, patience and support which have contributed to the success of this thesis and also to Assoc. Prof. Dr. Adnan Ghutub from King Fard Engineering University, Saudi Arabia for the scientific collaboration in sharing information regarding Arabic Text Steganography.

My special appreciation goes to my family and my friends Kak Shamima, Zalinda, Huda, Wan Atiqah and Kauthar, for their encouragement through this research work and also to my foreign friends, Dhuha (Sudan) and Salwa (Iraq) for helping me in understanding the Arabic language, Arabic character and Arabic Unicode ; Roya (Iran), very helpful in my data preparation.

Last but not least, I would like to thank all the professors and lecturers from Faculty of Science Computer and Information Technology and those who had helped me directly and indirectly in order to improve and complete this thesis.

© COPYRIGHT UPM

I certify that the Examination Committee has met on 20 Jun 2011 to conduct the final examination of Nuur Alifah binti Roslan on her thesis entitled "Sharp-Edges Stego Method in Arabic Character for Information Hiding" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

Rusli bin Hj Abdullah, PhD
Associate Professor
Faculty of Science Computer and Information Technology
Universiti Putra Malaysia
(Chairman)

Md Nasir bin Sulaiman, PhD
Associate Professor
Faculty of Science Computer and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

Muhamad Taufik bin Abdullah, PhD
Lecturer
Faculty of Science Computer and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

Azizah binti Abdul Manaf, PhD
Professor
Advanced Informatics Schools (Ais)
University Technology Malaysia
(External Examiner)

_____

BUJANG KIM HUAT, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 20 Jun 2011

© COPYRIGHT UPM

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of requirement for the degree of Master of Science. The members of supervisory Committee were as follows:

Ramlan Mahmod, PhD
Professor
Faculty of Computer Science
Universiti Putra Malaysia
(Chairman)

Nur Izura Udzir, PhD
Faculty of Computer Science
Universiti Putra Malaysia
(Member)

_____
HASANAH MOHD. GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

© COPYRIGHT UPM

DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

NUUR ALIFAH BINTI ROSLAN
Date: 20 June 2011

© COPYRIGHT UPM

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	vii
APPROVAL	viii
DECLARATION	x
LIST OF TABLES	xiv
LIST OF FIGURES	xv
LIST OF ABBREVIATION	xvii
CHAPTER	
1 INTRODUCTION	
1.1 Introduction	1
1.2 Problems Statement	4
1.3 Research Objective	5
1.4 Research Scope	6
1.5 Research Contribution	6
1.6 Research Methodology	**7**
1.6.1 Problem Identification	7
1.6.2 Method Design	8
1.6.3 Method Implementation	8
1.6.4 Analysis	9
1.7 Thesis Organization	10
2 LITERATURE REVIEW	
2.1 Introduction	12
2.2 Classification of Steganography in Information Hiding	13
2.3 Fundamental of Steganography Concept	15
2.3.1 Capacity, Invisibility and Robustness	16
2.4 Steganography in various digital media	17
2.4.1 Steganography in Images	18
2.4.2 Steganography in Audio	19
2.4.3 Steganography in Video	20
2.4.4 Steganography in Documents	20

© COPYRIGHT UPM

2.5 Text Steganography 21
2.5.1 Linguistic Text Steganography 23
2.5.2 Non-Linguistic Text Steganography 24
2.5.3 Feature Based 25
2.6 Arabic Script Steganography 32
2.6.1 Pointed Character Approach 33
2.6.2 Letters Points and Extention 34
2.6.3 La Steganography Method 36
2.6.4 Multiple Diacratics in Arabic Script Method 36
2.6.5 Pseudo-Space and Pseudo-Connection Character Method 37
2.7 Underlying the Sharp-Edges Stego Method 38
2.8 Summary 39

3 THE DESIGN OF SHARP-EDGES STEGO METHOD IN ARABIC CHARACTER
3.1 Introduction 41
3.2 Sharp-Edges Stego Method System Architecture 41
3.3 Hiding Module 43
3.3.1 Stego Key 45
3.3.2 Input Key Type Identification 45
3.3.3 Identification of Arabic Character Features 46
3.3.4 Hiding Place Capacity Calculation 48
3.3.5 Secret Bit Capacity Calculation 51
3.3.6 Hiding Validation 52
3.3.7 Bit Hiding Process 53
3.4 Retrieving Module 56
3.4.1 Conceal Secret Message 57
3.5 System Development Requirement (Hardware & Software) 60
3.6 Summary 60

4 RESULT AND DISCUSSION
4.1 Introduction 61
4.2 Experimental Design 61
4.2.1 Data Preparation 62
4.2.2 Performance Measurement 66
4.3 Text Steganography 69
4.3.1 Hiding Module Implementation 69
4.3.2 Retrieving Module Implementation 73
74

© COPYRIGHT UPM

4.4 Experimental Results and Analysis
4.4.1 Capacity Test Result and Analysis 75
4.4.2 Invisibility Test Result and Analysis 87
4.5 Summary 90

5 CONCLUSION AND FUTURE WORKS
5.2 Conclusion 91
5.3 Future Works 93

REFERENCES 94
APPENDICES 99
BIODATA OF STUDENT 133

© COPYRIGHT UPM