



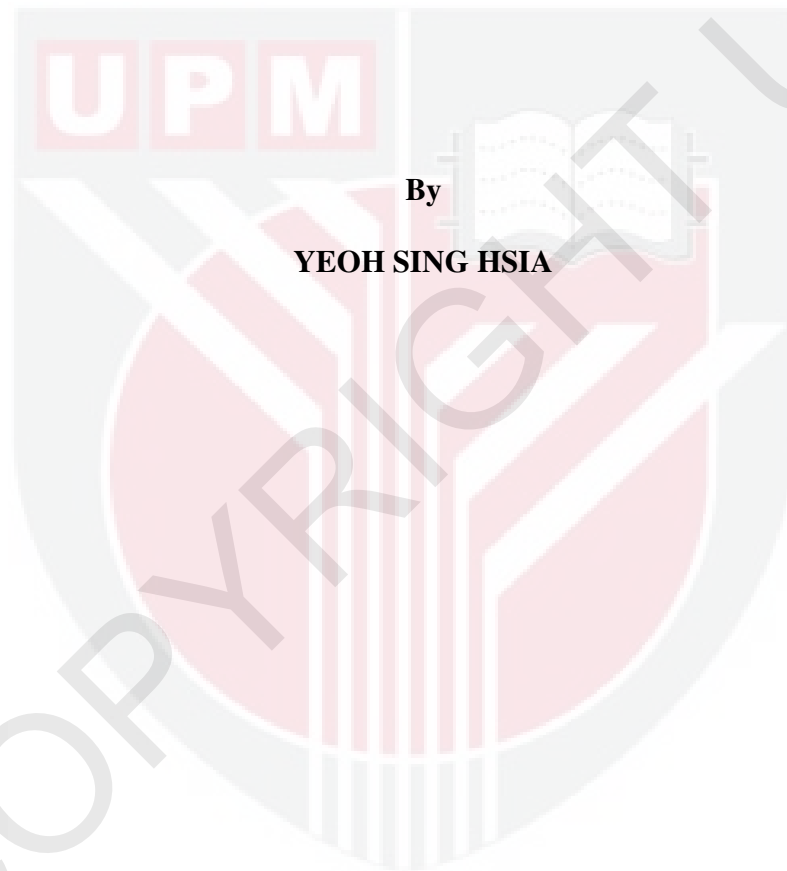
UNIVERSITI PUTRA MALAYSIA

***DESIGN OF ARTIFICIAL INTELLIGENCE-BASED ELECTRONIC MALAY
LANGUAGE LEARNING TOOL FOR VISUALLY IMPAIRED CHILDREN***

YEOH SING HSIA

FK 2011 138

**DESIGN OF ARTIFICIAL INTELLIGENCE-BASED ELECTRONIC MALAY
LANGUAGE LEARNING TOOL FOR VISUALLY IMPAIRED CHILDREN**



By

YEOH SING HSIA

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfilment of the Requirement for the Degree of Master Science**

December 2011

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master Science

DESIGN OF ARTIFICIAL INTELLIGENCE-BASED ELECTRONIC MALAY LANGUAGE LEARNING TOOL FOR VISUALLY IMPAIRED CHILDREN

By

YEOH SING HSIA

December 2011

Chairman: Professor Ishak bin Aris, PhD

Faculty: Engineering

For many years, the application of assistive technologies for the disabled has been given little attention, despite the undoubted need for more. Disable people especially for those who are blind, always face a lot of difficulties in their learning process. Personal teachers have to guide them patiently with the aid of limited learning devices. The advancement of technology in twenty-first century should provide more design of great learning devices. However in developing countries like Malaysia, there are limited locally made assistive devices to suit the language used and the local culture. There are more than 20,000 people who are categorized under vision disability in Malaysia. The percentage of visually impaired people who master Malay language, as the national language in Malaysia, is low.

The main purpose for this research is to develop a Malay language learning tool for blind children. This research work involves the implementation of Hamming Distance

Technique (HDT) and simple Genetic Algorithm (GA) in spell checking and word suggestion mechanism. Besides spell checking, this system has a complete, step by step learning method with audio output. The learning contents are built using MATLAB. Moreover, it is linked with a tactile feedback module that is built using C language and microcontroller, to provide Braille display functionality. Also, this research involves developing a database for 10,000 Malay root words. This number of words is more than enough for kindergarten level. The simulation results indicate that the algorithm is able to suggest a word, based on the design settings. It depends on the size of word. The longest word, which is 6 ALP, has the slowest word suggestion time, at around 10 seconds for the worst case scenario. The feedback from two surveys is positive with 100% satisfaction on the overall performance of the prototype.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**REKA CIPTA ALAT ELEKTRONIK PINTAR DALAM PEMBELAJARAN
BAHASA MELAYU UNTUK KANAK-KANAK BERMASALAH
PENGLIHATAN**

Oleh

YEOH SING HSIA

Disember 2011

Pengerusi: Profesor Ishak bin Aris, PhD

Fakulti: Kejuruteraan

Selama bertahun-tahun, teknologi bantuan dalam merekacipta peralatan untuk orang kurang berupaya kurang dititikberatkan walaupun mempunyai keperluan ini. Orang kurang berupaya, terutamanya orang yang menghadapi masalah penglihatan, selalu menghadapi cabaran yang besar dalam proses pembelajaran mereka. Dalam keadaan alat bantuan yang terhad, guru peribadi mereka perlu mengajar mereka dengan sabar. Pada abad ke-21 ini, teknologi yang canggih sepatutnya berupaya merekacipta lebih banyak alat bantuan pembelajaran yang hebat. Namun, di negara-negara yang sedang membangun seperti Malaysia, alat ciptaan tempatan yang dapat memenuhi kehendak tempatan adalah amat terhad. Di Malaysia, terdapat lebih daripada 20 ribu orang yang mempunyai masalah penglihatan. Daripada angka ini, peratusan orang yang menguasai Bahasa Melayu, iaitu bahasa kebangsaan di Malaysia, adalah amat rendah.

Penyelidikan ini bertujuan untuk merekacipta alat bantuan pembelajaran Bahasa Melayu untuk kanak-kanak yang menghadapi masalah penglihatan. Kerja penyelidikan ini merangkumi penggunaan algoritma genetik dan teknik jarak *Hamming* dalam mengesan kesalahan ejaan dan mencadang perkataan yang terdekat. Selain daripada semakan ejaan, sistem ini mempunyai teknik pembelajaran yang lengkap dan bersistematik dengan hasil keluaran audio. Isi kandungan pembelajaran dibangunkan dengan menggunakan MATLAB. Selain itu, program komputer ini juga boleh menyambung dengan satu alat yang dapat menunjukkan perkataan dalam Braille. Alat tersebut dibangunkan dengan menggunakan bahasa C dan mikro pengawal. Penyelidikan ini juga telah membina satu set data yang mempunyai 10 ribu perkataan dasar Bahasa Melayu. Ini adalah bersesuaian dengan tahap pra-sekolah. Keputusan perbandingan untuk pelbagai parameter untuk algoritma genetik telah dijalankan dan kecekapan algoritma telah ditunjukkan. Keputusan daripada simulasi menunjukkan sistem ini mampu mencadang satu perkataan yang terdekat berdasarkan apa yang ditetapkan. Keputusan bergantung kepada saiz perkataan yang disemak. Perkataan yang paling panjang iaitu 6 abjak mempunyai masa mencadang perkataan yang paling lama. Untuk situasi yang paling teruk, masa tersebut adalah lebih kurang 10 saat. Sambutan yang baik diterima apabila prototaip ini diuji oleh kanak-kanak bermasalah penglihatan.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Professor Ishak bin Aris, for guiding me patiently throughout the research period. He has given me a lot of useful ideas and comments which help me to manage to complete the research. Besides that, I am also grateful to my project co-supervisor Dr. Fakhrul Zaman for his invaluable encouragement in the development of this project.

In addition, thanks to my lovely family members for their encouragement and support throughout my research work. And a heartfelt gratitude to all my friends who has given me endless helps.

Special thanks to MOSTI for providing National Science Fellowship to support my expenses during my master program. A word of thanks to Pn. Rosnah Alimuda for her contribution of idea and follow-up of the project development. Finally, sincere thanks to *Pemulihan Dalam Komuniti (PDK) Permata* and *Jalan Batu* special education primary school which gave permissions for us to conduct the surveys.

I certify that a Thesis Examination Committee has met on 28 December 2011 to conduct the final examination of Yeoh Sing Hsia on his (or her) thesis entitled "**Design of Artificial Intelligence-based Electronic Malay Language Learning Tool for Visually Impaired Children**" 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 Degree of Master Science.

Members of the Thesis Examination Committee were as follows:

Izhal bin Abdul Halin, PhD

Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Nasri bin Sulaiman, PhD

Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Suhaidi bin Shafie, PhD

Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Umi Kalthum binti Ngah, PhD

Associate Professor
Faculty of Engineering
Universiti Sains Malaysia
Malaysia
(External Examiner)

SEOW HENG FONG, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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

Ishak bin Aris, PhD

Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Fakhrul Zaman bin Rokhani, PhD

Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Member)



BUJANG BIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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.

YEOH SING HSIA

Date: 28 December 2011

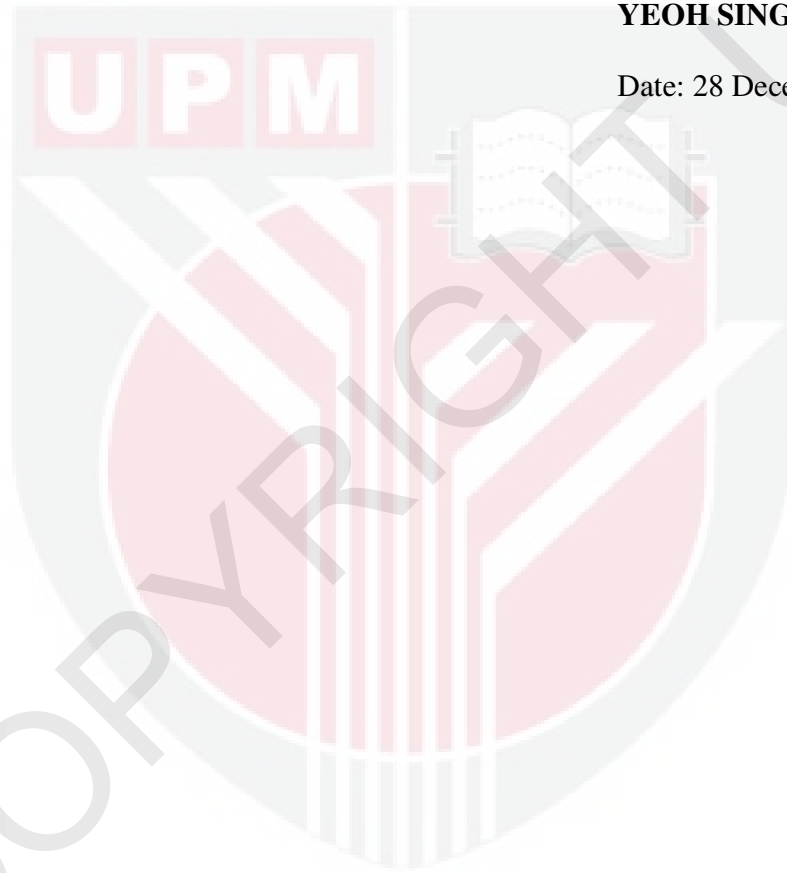


TABLE OF CONTENTS

	Page
ABSTRACT	ii
ABSTRAK	iv
ACKNOWLEDGEMENTS	vi
APPROVAL	vii
DECLARATION	ix
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS	xvii
CHAPTER	
1 INTRODUCTION	
1.1 Introduction	1
1.2 Problem Statement	3
1.3 Objectives of the Research	6
1.4 Research Scope	7
1.5 Overview of the Project	8
1.6 Thesis Layout	9
2 LITERATURE REVIEW	
2.1 Introduction to Artificial Intelligence (AI)	10
2.2 Development in Genetic Algorithms	11
2.2.1 Biomedical	12
2.2.2 Information Technology and Engineering	12
2.2.3 Data Mining	13
2.2.4 Scheduling	13
2.3 Single Objective Genetic Algorithm	14
2.3.1 Initial Population Generation	16
2.3.2 Fitness Function	16
2.3.3 The Selection Operator	17
2.3.4 Crossover	18
2.3.5 Mutation	19
2.4 Natural Language Processing (NLP)	20
2.4.1 GA in NLP	21
2.4.2 Spelling Checker	23
2.4.3 Development in Spelling Checker	24
2.5 Assistive Technology for Disabled People	27

2.6	Pedagogies for Visually Impaired Children	29
2.7	Malay Language	31
	2.7.1 Phonemes	31
	2.7.2 Morphology	32
	2.7.3 Malay Language based Research	33
2.8	Summary of Literature Review	36

3 METHODOLOGY

3.1	Introduction	37
3.2	Design Overview	37
3.3	Genetic Algorithm Optimization Method	40
	3.3.1 Genetic Operation	42
	3.3.2 Generation of Initial Population	45
	3.3.3 Selection Process	46
	3.3.4 Crossover Operation	46
	3.3.5 Mutation Operation	48
	3.3.6 Fitness Function	49
	3.3.7 Summary of GA Parameters	50
3.4	MATLAB Software	51
	3.4.1 Genetic Algorithm in MATLAB	51
	3.4.2 Hamming Distance Technique in MATLAB	53
	3.4.3 Opening Audio File in MATLAB	54
	3.4.4 Serial Interface in MATALB	56
	3.4.5 Graphical User Interface in MATLAB	59
3.5	Hardware Design	64
	3.5.1 System Overview	64
	3.5.2 Design Architecture	65
	3.5.3 Schematic	67
	3.5.4 Software Design for Microcontroller	69
	3.5.5 Mechanical Design	70
3.6	Summary of Methodology	74

4 RESULTS AND DISCUSSION

4.1	Introduction	76
4.2	Display of Learning Content	76
4.3	Efficiency of GA Control Parameters	82
	4.3.1 Effect of Number of Population Generation	83
	4.3.2 Effect of Population Size	85
	4.3.3 Effect of Crossover Rate	88
	4.3.4 Effect of Mutation Rate	90

4.3.5	Effect of Filtering System	90
4.4	Effect of Algorithms	92
4.4.1	The Need for GA	92
4.4.2	The Need for HDT	93
4.5	Database Analysis	95
4.6	Hardware Result	98
4.6.1	Electrical Aspect	99
4.6.2	Electronic Aspect	99
4.6.3	Mechanical Aspect	101
4.7	Products Comparison	102
4.8	Prototype Testing and Surveys	103
4.9	Summary of Results and Discussion	106
5	CONCLUSIONS	
5.1	Conclusions	108
5.2	Recommendations for Future Work	109
5.3	Project Contribution	110
	REFERENCES	111
	APPENDICES	119
	BIODATA OF STUDENT	139
	LIST OF PUBLICATIONS	140