

**DEVELOPING A VOTING SYSTEM IN UUM USING MOBILE
TECHNOLOGY**

A dissertation submitted to the Faculty of Information Technology
in partial fulfillment of the requirements for the degree
Master of Science (Information Technology)
Universiti Utara Malaysia

By

Mohammad Nasri Abdullah Almatarneh

Copyright © Mohammad Nasri Abdullah Almatarneh, 2008.
All rights reserved

TK
6570
M6
A446d
2008



KOLEJ SASTERA DAN SAINS
(College of Arts and Sciences)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Project Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

MOHAMMAD NASRI ABDULLAH ALMATARNEH

calon untuk Ijazah
(candidate for the degree of) **MSc. (Information Technology)**

telah mengemukakan kertas projek yang bertajuk
(has presented his/her project paper of the following title)

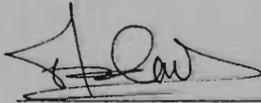
DEVELOPING AVOTING SYSTEM IN UUM
USING MOBILE TECHNOLOGY

seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan
dan meliputi bidang ilmu dengan memuaskan.
*(that the project paper acceptable in form and content, and that a satisfactory
knowledge of the field is covered by the project paper).*

Nama Penyelia Utama
(Name of Main Supervisor): **MR. ABDUL RAZAK RAHMAT**

Tandatangan
(Signature)

: 

Tarikh
(Date)

: 18/5/2008

PERMISSION TO USE

In presenting this thesis in partial fulfilment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or, in their absence by the Dean of Faculty of Information Technology. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Request for permission to copy or to make use of material in thesis in whole or in part should be addressed to:

Dean of Faculty of Information Technology

Universiti Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman

ABSTRACT

In democratic societies, voting is an important issue to reflect people opinions. This study aims to design and develop a mobile voting system for the student council in UUM, to replace the current manual voting system. The system will provide more flexibility and convenience to the students to cast there votes by saving there time and effort, and reduce the cost for the election process. The developed system shows that the objectives of the study were achieved successfully. Finally, the system is tested and the result confirms that the proposed system is capable to record a successful completion of the election process.

ACKNOWLEDGMENT

My praises and thanks to wisdom donator ALLAH, who provide me the will power to complete this thesis. I would like to express my sincere gratitude to my supervisor, **Mr. Abdul Razak bin Rahmat**. He has offered me great freedom on choosing my favorite research topics and developing my research interests, and continuously provided me help and encouragement with extensive knowledge and for his feeling of the responsibility to guide me to the truth approach for completing this work within the required time. I also thank the examining committee, all my colleagues and relatives for their support. I also thank all lecturers, administration and staff of university Utara Malaysia for their help.

Finally, I would like to extend my deepest love to my family especially my parents for their loving, support and trust. I want also to thank my brothers Dr. Abdullah Almatarneh, Eng. Mamoun Almatarneh, Mr. Laith Almatarneh and Ahmad Almatarneh, Thanks for all of you for your support and trust. I wish all of you the best in every thing. I dedicate this work to my parents who gifted me their lives and to my brothers.

TABLE OF CONTENTS

PERMISSION TO USE	ii
ABSTRACT.....	iii
ACKNOWLEDGMENT.....	iv
TABLE OF CONTENTS.....	i
LIST OF FIGURE.....	iv
LIST OF TABLES.....	v
CHAPTER ONE	1
INTRODUCTION	1
1.1 Introduction.....	1
1.2 Problem Statement.....	3
1.3 Research Objective	4
1.4 Scope of the Study	5
1.4.1 Users and Functionality	5
1.4.2 Platform:	5
1.5 Significance of the Study.....	6
1.6 Organization of Study.....	6
1.7 Summary.....	8
CHAPTER TWO	9
LITERATURE REVIEW	9
2.1 Introduction.....	9
2.2 Wireless Technology	9
2.3 Mobile Computing and Mobile Device	10
2.4 WAP Concept and Definition	11
2.5 WAP Architecture.....	13
2.6 WAP Session	15
2.7 Types of Mobile Applications	16
2.4.1 Messaging	17
2.4.2 Browsing.....	17
2.4.3 Interacting	17
2.4.4 Conversing	17
2.8 Common Forms of Electronic Voting.....	18
2.8.1 Kiosk.....	18
2.8.2 Remote (Internet).....	18
2.8.3 Phone.....	18
2.8.4 E-Counting.....	19
2.9 Electronic Voting Application in Malaysia University	19
2.10 M-Government and M-democracy	20
2.6.1 Mobile Democracy in Countries.....	22
2.11 Mobile Voting System Definition.....	22
2.12 Related Work on Mobile Voting Application.....	23
2.13 Summary.....	25

CHAPTER THREE	26
RESEARCH METHODOLOGY	26
3.1 Introduction.....	26
3.2 Process Steps.....	29
3.2.1 Awareness of the Problem Phase.....	29
3.2.2 Suggestion Phase	30
3.2.3 Development phase.....	30
3.2.4 Evaluation and Conclusion phase.....	30
3.3 Summary	31
CHAPTER FOUR	32
ANALYSIS AND DESIGN	32
4.1 Introduction.....	32
4.2 Analysis.....	32
4.2.1 Requirements Determination	33
4.2.2 System Requirements.....	34
4.3 Design	36
4.3.1 Logical Design.....	37
4.3.2 Physical Design.....	54
4.4 Summary	55
CHAPTER FIVE	57
FINDING AND RESULT	57
5.1 Introduction.....	57
5.2 System Architecture.....	57
5.3 System Privacy and Security	61
5.4 M-voting Prototype Design (System Interfaces)	61
5.3.1 Register to Vote	61
5.3.2 Student Login.....	62
5.3.3 Voting For Candidate.....	64
5.3.4 Candidate Login.....	65
5.3.5 Create Candidate Profile	66
5.3.6 View Candidate Profile.....	67
5.3.7 Administrator Login.....	69
5.3.8 Manage Faculty.....	71
5.3.9 Manage Candidates	73
5.3.10 Manage Duration	75
5.3.11 Election Result.....	77
5.5 Summary	78
CHAPTER SIX	79
TESTING AND EVALUATION	79
6.1 Introduction.....	79
6.2 Usability Testing Questionnaire	79
6.2.1 Respondents	80
6.2.2 Structure of the questionnaire	80
6.2.3 Conducting the Test	81
6.2.4 Analysis of the demographic questions	81
6.2.5 Analysis of the Usability Testing Questionnaire:	82

6.3	Summary	87
CHAPTER SEVEN.....		88
CONCLUSION AND RECCOMNDATION		88
7.1	Introduction.....	88
7.2	Conclusion of the Study.....	88
7.3	Problems and Limitations	89
7.4	Contribution of Study	90
7.5	Recommendation and Future Work	91
7.6	Summary	91
References		93
APPENDICES		99
Appendix A: Use Case Specification.....		99
Appendix B: Questionnaire for M-voting system in UUM		110

LIST OF FIGURE

Figure 2.1: WAP Protocol Stack.....	14
Figure 3.1: The General Methodology of Design Research	27
Figure 4.1: M-Voting System Use Case Diagram	38
Figure 4.2: Register to vote Sequence Diagram	40
Figure 4.3: Student Login Sequence Diagram	41
Figure 4.4: Vote for Candidate Sequence Diagram	42
Figure 4.5: View Candidate profile Sequence Diagram	43
Figure 4.6: Candidate Login Sequence Diagram	44
Figure 4.7: Create Candidate profile Sequence Diagram	45
Figure 4.8: Administrator Login Sequence Diagram.....	46
Figure 4.9: Manage Faculty Sequence Diagram.....	47
Figure 4.10: Manage Candidate Sequence Diagram.....	48
Figure 4.11: Manage Duration Sequence Diagram.....	49
Figure 4.12: Election Result Sequence Diagram	50
Figure 4.13: Class Diagram	52
Figure 4.14: ER Diagram.....	53
Figure 5.1: System Architectures.....	60
Figure 5.2: Home Page and Register to Vote Page.....	62
Figure 5.3: Home Page and Login Student Page	63
Figure 5.4: Voting For Candidate Page	64
Figure 5.5: University Home Page.....	65
Figure 5.6: Candidate Login Page	66
Figure 5.7: Create Candidate Profile Page.....	67
Figure 5.8: View Candidate Profile Page	68
Figure 5.9: Candidate Profile Page	69
Figure 5.10: Administrator Login Page	70
Figure 5.11: Administrator Main Page	71
Figure 5.12: Manage Faculty Page	72
Figure 5.13: Add Faculty Page	72
Figure 5.14: Delete Faculty Page.....	73
Figure 5.15: Manage Candidate Page	74
Figure 5.16: Add Candidate Page	74
Figure 5.17: Delete Candidate Page.....	75
Figure 5.18: Manage Duration Page	76
Figure 5.19: Faculty Election Time Page	76
Figure 5.20: Update Faculty Time Page	77
Figure 5.21: Election Result Page.....	78

LIST OF TABLES

Table 4.1: Functional Requirement.....	34
Table 4.2: Non Functional Requirement.....	35
Table 4.3: H/W.S/W Specifications.....	54
Table 5.1: Prototype Development Environment.	58
Table 6.1: Evaluation Dimensions for Mobile Voting System.....	80
Table 6.2: Gender.....	81
Table 6.3: Faculties.....	81
Table 6.4: Descriptive Statistics for M-voting Screen.....	83
Table 6.5: Descriptive Statistics: for Terminology Used in M-voting	83
Table 6.6: Descriptive Statistics for M-voting System Capabilities.....	84
Table 6.7: Descriptive Statistics for Perceived Usefulness	85
Table 6.8: Descriptive Statistics for Perceived Ease Use	85
Table 6.9: Descriptive Statistics for Attributes of Usability.....	86
Table 6.10: Descriptive Statistics for all Dimensions.....	86

CHAPTER ONE

INTRODUCTION

1.1 Introduction

In democratic societies, voting is an important tool to collect and reflect people's opinions. Having witnessed the twenty first stage renaissance of major technological and acceleration countries in the acquisition and application of this technology, the electronic voting (E-Voting) is expected to replace the traditional or the manual voting way to do the election for selection operation that is conducted in centralized or distributed places called voting booths. Voters should go to these voting booths and cast their votes under the supervision of authorized parties, the votes then counted manually once the election has finished (Feng, Ng & Schwiderski-Grosche, 2006).

The Constitution of Malaysia requires that a general election must be held at least once every five years. Nomination centers are set up in various locations by the Election Commission to allow candidates to register themselves. On Election Day, these centers are open for a set time period and the registered voters may cast their ballot for their chosen candidate in a designated voting centre. Each candidate is allowed one agent per

The contents of
the thesis is for
internal user
only

References

- Abanumy, A., & Mayhew, P. (2005). M-government Implications For E-Government In Developing Countries: The Case Of Saudi Arabia'. *Proceedings of EURO mGOV 2005: The First European Mobile Government Conference*, 6. Retrieved: March 17, 2008. From:
http://www.mgovernment.org/resurces/euromgov2005/PDF/1_R351AA.pdf
- Antovski, L., & Gusev, M. (2003). M-payments. Information Technology Interfaces, 2003. ITI 2003. *Proceedings of the 25th International Conference on*, 95-100. IEEE.
- Bahrami, A. (1999). *Object Oriented System Development*, McGraw-Hill, United States of America.
- Barikmo, T. (2000). Wireless Application Protocol. Retrieved: March 16, 2008. From:
<http://eplu.plu.edu/portfolio/courses/2000/fall/578/waps.pdf>
- Barry, C., Dacey, P., Pickering, T., & Evans, T. (2002). eVolution not revolution. *Electronic Voting Status Report 2: Victorian Electronic Commission (VEC)*. Retrieved: April 5, 2008. From:
http://www.aec.gov.au/pdf/voting/e-voting_report.pdf
- Beaulieu, M. (2001). *Wireless Internet Applications and Architecture: Building Professional Wireless Applications Worldwide*: Addison-Wesley Professional.
- Brucher, H., & Baumberger, P. (2003). Using mobile technology to support eDemocracy. *System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on*, 8. IEEE.
- Cervera, A. (2002). Analysis of J2ME for developing Mobile Payment Systems. IT University of Copenhagen. Retrieved: March 11, 2008. From:
<http://whitepapers.silicon.com/0,39024759,60107906p,00.htm>
- Collard, R. (1999). *Test Design. Stqemagazine: Software Testing & Quality Engineering*. Retrieved: January 26, 2008. From:
www.stickyminds.com/getfile.asp?ot=XML&id=5081&fn=Smzr1XDD2867filelistfilename1.pdf
- Dayal, A. (2005). Developing A Mobile Website. Retrieved: March 20, 2008. From:
<http://tools.cottoncrc.org.au/cl2/ScoutingTools/Reports/CDD%203.2%20-%20MobileWebsiteDevlp.pdf>

- Dennis, A., Wixon, B.H., Tegarden, D. (2002). *System Analysis & Design: An Object Oriented Approach Using UML*. New York: John Wiley & Sons, Inc
- DiMicco, J. M. (2002). Mobile Ad Hoc Voting. *Proc. of CHI Workshop on Mobile Ad-Hoc Collaboration*. Retrieved: March 25, 2008. From: <http://web.media.mit.edu/~joanie/voting/mobile-adhoc-voting.pdf>
- Election Process in Malaysia (2008). Election Commission of Malaysia. Retrieved: March 20, 2008. From: <http://www.spr.gov.my/index/process.htm>
- El Kiki, T., & Lawrence, E. (2006). Government as a Mobile Enterprise: Real-time, Ubiquitous Government. *Proceedings of the Third International Conference on Information Technology: New Generations (ITNG'06)-Volume 00*, 320-327.IEEE.
- Elliott, G., & Phillips, N. (2004). *Mobile Commerce & Wireless Computing Systems*. New York: Pearson/Addison Wesley
- Erlanson, C., & Ocklind, P. (1998). WAP- the wireless application protocol. *Ericsson REV(ENGL ED)*, 75(4), 150-153. Retrieved: March 2, 2008. From: <http://cnscenter.future.co.kr/resource/rsc-center/vendor-wp/ericsson/1998041.pdf>
- Ermel, C., Holscher, K., Kuske, S. & Ziemann, P. (2005). Animated Simulation of Integrated UML Behavioral Models based on Graph Transformation. *Proceedings of the 2005 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC'05) September 2005*. 125- 133. IEEE.
- European commission , (2003) CYBERVOTE - An innovative cyber voting system for Internet terminals and mobile phones. Retrieved: March 3, 2008. From: http://ec.europa.eu/information_society/activities/egovernment/docs/project_synopsis/syn_cybervote.pdf
- Feng, Y., Ng, S.-L., & Schwiderski-Grosche, S. (2006). An Electronic Voting System Using GSM Mobile Technology. *Royal Holloway, University of London*. Retrieved: April 9, 2008. From: <http://www.ma.rhul.ac.uk/static/techrep/2006/RHUL-MA-2006-5.pdf>
- Foo, S. M., Hoover, C. & Lee, W.M. (2001). *Dynamic WAP application development*. Greenwich: Manning Publication Co.
- George, J., Valacich, J. S., Hoffer, J. A. & Batra, D. (2006). *Object-oriented Systems Analysis and Design*. (2nd Ed), Prentice Hall. ISBN: 9780132279000. pp. 221-229
- Griffin, E. (2001). .NET Mobile Web SDK: Build and Test Wireless Web Applications for Phones and PDAs. MSDN Magazine 16. Retrieved: April 10, 2008. From: <http://msdn2.microsoft.com/en-us/magazine/cc301785.aspx>

- Gsmworld.com (2000). Business applications of WAP. Retrieved: February 16, 2008. From: http://www.gsmworld.com/technology/wap_04.html
- GTI Specialist Publishers (M) Sdn Bhd (2005). E-Voting Practiced For Student Council Elections In 2005. Retrieved: April 16, 2008. From: http://doctorjob.com.my/undergrad_news/printerfriendly.asp?ID=2984
- Hamzah, N.M. (January 23, 2008). the student election supervisor of the student affairs department in UUM on topic of the voting system in UUM. (Malaysia, UUM).
- Her, Y. S., & Sakurai, K. (2000). The Analysis of Current State and Future on the E-voting System. 6. Retrieved: April 12, 2008. From: http://www.c.csce.kyushu-u.ac.jp/lab_db/papers/paper/pdf/2001/yong01_1.pdf
- Hevner, A., March, S., Park, J. & Ram, S. (2004). "Design Science in Information Systems Research." MIS Quarterly 28(1): 75-105. Retrieved: March 11, 2008. From: http://www.idi.ntnu.no/mner/empse/papers/hevner_etal_2004.pdf
- Hoffer, J.A., George, J.M. and Valacich, J.S. (2004). Essentials of Systems Analysis and Design, Prentice Hall, Upper Sadder River, NJ.
- Kalliola, M. (2005). Mobile Payments. Towards the Next Wave of Mobile Communication, 51-55. Retrieved: January 15, 2008. From: <http://www.tml.tkk.fi/Studies/T-109.551/2005/Proceedings.pdf#page=51>
- Kargl, F., Illmann, T., Raschke, A., Schlott, H., & Weber, M. (2001). WAPcam - using a WAP application in student education, ACM SIGGROUP Bulletin, 22(1) pp. 12-15. ACM.
- Kim, K & Hong, D. (2005). Electronic Voting System using Mobile Terminal. *International Journal of Computer Science and Engineering*, Vol. 1 No. 4, 217 - 221. Retrieved: February 15, 2008. From: <http://www.waset.org/ijcse/v1/v1-4-31.pdf>
- Kitcat, J. (2004). Voting, E-Voting and E-Democracy > Electronic Voting: I Want to Understand the Issues. Retrieved: February 26, 2008. From: <http://www.jasonkitcat.com/h/n/WRITING/evoting/ALL/50/>
- Kitcat, J. (2007). Electronic Voting: A challenge to democracy? *Open Rights Group*. Retrieved: February 13, 2008. From: <http://www.openrightsgroup.org/wp-content/uploads/org-evoting-briefing-pack-final.pdf>
- Kothari, C. R. (1990). *Research Methodology, Methods and Techniques*. Delhi: (2nd Ed), Wiley Eastern Limited.

- Lallana, E. C. (2008). E-Government for Development M-Government Applications and Purposes Page. Retrieved: Feb 12, 2008. From: <http://www.egov4dev.org/mgovapplic.htm>
- Lee, W. M., Foo, S. M., Watson, K., & Wugofski, T. (2000). *Beginning WAP WML & WMLScript*: Wrox Press Ltd.
- Malaysia Elections. (2008). The Malaysia Page Blog » Blog Archive » Malaysia Elections 2008. Retrieved: February 12, 2008. From: <http://www.themalaysiapage.com/blog/?p=29>
- Mcmc.gov (2005) Facts & Figures, Statistics & Records. Retrieved: January 30, 2008. From: http://mcmc.gov.my/facts_figures/stats/index.asp
- Mercuri, R. (2002). A better ballot box? *IEEE Spectrum*, 39(10), 46-50. IEEE.
- Micheli, A. D., Vare, J., Tucholke, U., Levy, S., & Ohlin, T. (2002). An Innovative Cyber Voting System, Cybervote for Internet Terminals and Mobile Phones. *Stéphan BRUNESSAUX*, 34. Retrieved: March 10, 2008. From: <http://www.eucybervote.org/MSI-WP6-D21-v1.0.pdf>
- Nielsen's, J. (2006). Quantitative Studies: How Many Users to Test?. Retrieved: April 20, 2008. From: http://www.useit.com/alertbox/quantitative_testing.html
- Nunnally, J. C. (1978). *Psychometric theory* (2nd Ed), New York: McGraw-Hill.
- O'Docherty, M. (2005). *Object-Oriented Analysis and Design Understanding System Development with UML 2.0*. John Wiley & Sons, Ltd.
- Oovstreen, A (2004). Meeting the challenges of e-voting. Retrieved: January 23, 2008. From Department of Social Sciences Netherlands Institute of Scientific Information Website <http://istresults.cordis.lu/index.cfm/section/news/Tpl/article/BrowsingType/Short%20Feature/ID/62740>
- Rannu, R., & Semevsky, M. (2005). Mobile Services in Tartu: Mobi Solutions Ltd, Available http://www.ega.ee/public/Mobile_services_in_Tartu_FINAL. Retrieved: February 5, 2008. From: <http://www.ega.ee/files/Mobile%20services%20in%20Tartu%20FINAL1.pdf>
- Rivest, R. L. (1991). Electronic Voting. *Financial Cryptography*, 91. Retrieved: April 12, 2008. From: <http://www.vote.caltech.edu/Rivest-ElectronicVoting.pdf>
- Rubin, A. D. (2002). Security Considerations for Remote Electronic Voting. *Communications of the ACM*. 45, 12, 39-44. ACM.

- Sanna, S., Vita, D. E., Piras, A., & Melchiorre, C. (2005). Lightweight Client-Pull Protocol For Mobile Communication. Retrieved: February 23, 2008. From: http://www.crs4.it/Publications/cgi-bin/tr/repository/crs4_1009.pdf
- Sasidhar, B., & Kumar, B. V. D. (2005). The Effects of Mobile Devices and Wireless Technology on E-Learning. *Sunway Academic Journal*, 2, 45-53. Retrieved: January 23, 2008. From: <http://www.sunway.edu.my/others/vol2/sasidhar45.pdf>
- Sayer, P.(2005). Mobile phone sales reached new records in first quarter. Retrieved: February 10,2008. From: <http://www.computerworld.com.my/ShowPage.aspx?pagetype=2&articleid=1301&pubid=3&issuedid=49>.
- Shen, K. H. W., & Lee, D. C. H. (2000). WAP Mail Service and Short Message Service for Mobile CRM. *Proceedings of the 2000 International Conference on Microelectronic Systems Education*, 201 - 207. IEEE.
- Simon, S. (2004) What's a good value for Cronbach's Alpha?. Retrieved: March 28, 2008. From: <http://www.childrens-mercy.org/stats/weblog2004/CronbachAlpha.asp>
- SmartDraw. (2008). SmartDraw 2008 Reviewer's Guide. *The World's Most Popular Business Graphics Software*. Retrieved: March 12, 2008. From: <http://www.smartdraw.com/about/ReviewersGuide.pdf>
- Smmmsia (2005) . Solidarity Mahasiswa Malaysia. Solidariti Mahasiswa Malaysia (SMM). Retrieved: April 16, 2008. From: <http://www.savethecampus.blogspot.com/>
- Tang, M. J., & Cao, J. (2006). A dynamic mechanism for handling mobile computing environmental changes. *Proceedings of the 1st international conference on Scalable information systems*. ACM.
- Tewari, R., & Grillo, P. (1995). Data management for mobile computing on the Internet. Paper presented at the Proceedings of the 1995 ACM 23rd annual conference on Computer science, Nashville, Tennessee, United States. ACM.
- Thestaronline (2006). Campus elections: UPM e-voting system breaks down, polling time extended. Retrieved: April 16, 2008. From: <http://thestar.com.my/news/story.asp?file=/2006/9/21/nation/20060921124336&sec=nation>
- The Wap Protocol. (2000). *The Wap Protocol*. Retrieved: January 10, 2008. From: <http://194.51.152.252/WML/wapdocangl.htm>

- Vaishnavi, V. & Kuechler, B. (2007), Design research in Information Systems. Retrieved: March 9, 2008. From: <http://www.isworld.org/Researchdesign/drisISworld.htm>
- WAP Forum (2002a). WAP 2.0. Technical White Paper. Retrieved: April 16, 2008. From: http://www.wapforum.org/what/WAPWhite_Paper1.pdf
- WAP Forum (2002b). What is WAP. Retrieved January 10, 2008. From: <http://www.wapforum.org/faqs/index.htm>
- Wortzet, R. (1979). New Life Style Determinants of Women's Food Shopping Behavior. *Journal of Marketing*, 43, 28-39.
- Yacoub, M. D. (2002). *Wireless Technology: Protocols, Standards, and Techniques*: CRC Press.
- Yusoff, H. B. H., Bakar, A. Z. A., & Alias, R. A. (2006). Polygraphic Counterproductive Behavior Index Profiling System. *Proceedings of the Postgraduate Annual Research Seminar 2006*, 308 - 313. Retrieved: January 4, 2008. From: http://eprints.utm.my/3349/1/POLYGRAPHIC_COUNTERPRODUCTIVE.pdf