

INVESTIGATING THE INFLUENCING FACTORS AND ATTITUDES
TOWARDS ONLINE BANKING USING BIOMETRIC TECHNOLOGY

ALA ABDULRAHMAN ABDULQAWI

A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Computer Science (Information Security)

Faculty of Computing
Universiti Teknologi Malaysia

JUNE 2013

Specially dedicated to the soul of my beloved Mother who wished to see me successful person in this stage and my beloved Father who is making prayers for me

I really miss both of you.

Al-Fatihah for the soul of my mother

And To my respected supervisor, Dr. Norafida Binti

Ithnin and my beautiful lady who always stands beside me, thank you everyone for your support, prayers, and advices. I thank to Allah

for guiding throughout this life

ACKNOWLEDGEMENT

IN THE NAME OF ALLAH, MOST GRACIOUS, MOST COMPASSIONATE,
MOST MERCIFUL.

Firstly, I would like to be thankful to the Almighty Allah who is the creator, protector of the whole universe and who gave me the strength to do this thesis work.

Secondly, I would like to thank my supervisor **Dr. Norafida Binti Ithnin**, for her patience, support and for allowing me to work in my own way.

I would like to give my gratitude to all my friends and classmates in University Technology Malaysia and for my beautiful lady who supports me all the time. Finally, I would like to express my deep respect and appreciation for my parents and my brothers & sisters.

ABSTRACT

Over the past several years, the online banking has tremendously grown up and offered several financial services to the customers but plagued by internet criminals and fraudsters attempted to steal customer information. Malware attacks, phishing fraudsters and other types of attacks have become well known and widely used as a means to obtain information from customers. As a result, security and privacy of personal information became major concerns of the online users. Nonetheless, the customer attitudes towards online banking using strong authentication technique such as, the biometric technology, must be studied and not to forget customer security and privacy of information. This study presents the main security concerns and it aims to provide a clear picture of the need for strong authentication means in online banking using biometric technologies. The findings of this study showed that participants have expressed their opinions and attitudes regarding the issues of security, privacy concerns, biometrics convenience towards online banking using biometric technology.

ABSTRAK

Sejak beberapa tahun yang lalu, perbankan dalam talian telah pesat berkembang dan menawarkan beberapa perkhidmatan kewangan kepada pelanggan tetapi dibelenggu oleh penjenayah internet dan penipu cuba untuk mencuri maklumat pelanggan. Serangan malware, phishing penipu dan lain-lain jenis serangan telah menjadi terkenal dan digunakan secara meluas sebagai satu cara untuk mendapatkan maklumat daripada pelanggan. Akibatnya, keselamatan dan privasi maklumat peribadi yang menjadi kebimbangan utama bagi pengguna dalam talian. Walau bagaimanapun, sikap pelanggan terhadap perbankan online menggunakan teknik pengesahan yang kukuh seperti teknologi biometrik, mesti dikaji dan tidak lupa keselamatan dan privasi maklumat pelanggan. Kajian ini membentangkan masalah keselamatan utama dan ia bertujuan untuk memberikan gambaran yang jelas tentang keperluan untuk cara pengesahan yang kukuh dalam perbankan online menggunakan teknologi biometrik. Hasil kajian ini menunjukkan bahawa peserta telah menyatakan pendapat mereka dan sikap mengenai isu-isu keselamatan, kebimbangan privasi, kemudahan biometrik ke arah perbankan online menggunakan teknologi biometrik.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF APPENDICES	xiii
1	INTRODUCTION	
	1.1 Introduction	1
	1.2 Problem Background	2
	1.3 Problem Statement	3
	1.4 Research Questions	4
	1.5 Project Aim	4
	1.6 Objectives	4
	1.7 Scope of Project	5
	1.8 Significance of Study	5
	1.9 Summary	5
2	LITERATURE REVIEW	
	2.1 Introduction	7
	2.3 Internet Banking Risks and Identity Fraud	10

2.4	Biometrics Authentication and Internet Banking Security	12
2.5	Biometrics Technologies	15
2.6	The Need for Biometrics Authentication	18
2.7	Different Authentication Methods	20
2.8	Biometrics Implementation in Malaysian Context	24
2.9	Biometrics Authentication Challenges	24
2.10	Technology Acceptance Frameworks	26
2.11	Existing Frameworks for Biometrics Technology Adoption	29
2.12	Conceptual Framework for Biometrics Technology Acceptance	36
2.13	Gaps in the Literature	37
2.14	Framework Factors	41
2.15	Summary	44
3	RESEARCH METHODOLOGY	
3.1	Introduction	45
3.2	Research Methodology	45
3.3	Operational Framework	46
3.4	Design Survey and Data Analysis	47
3.5	Questionnaire Method	51
3.6	Distributing the Questionnaire	52
3.7	Design and Evaluate the Research Framework	52
3.8	Summary	53
4	FRAMEWORK IMPLEMENTATION	
4.1	Introduction	54
4.2	Conceptual Framework for Online Banking Using Biometrics Authentication	54

5	ANALYSIS AND RESULT	
5.1	Introduction	60
5.2	Questionnaire	60
5.3	Population and Sample	61
5.4	Objectives of the Questionnaire	61
5.5	Analysis of the Questionnaire	61
5.7	Investigating the Influencing Factors and Attitudes towards Online Banking	74
5.8	Summary	75
6	DISCUSSION AND CONCLUSSION	
6.1	Introduction	77
6.2	Project Acheivements	77
6.3	Project Contribution	78
6.4	Project Constraints	79
6.5	Future Work	80
6.5	Summary	81
	REFERENCES	82
	APPENDIX	84

LIST OF TABLES

Table NO	TITLE	PAGE
Table 2.1	Biometrics Technologies	14
Table 2.2	Comparison of several Biometric Identification Procedures	18
Table2.3	Proportion of used biometric technologies over the worlds' banks	22
Table 2.4	World's bank using biometrics for online banking	24
Table 2.5	Conceptual Biometrics security Authentication adoption Frameworks	39
Table 2.6	Selected Constructs from Biometric Security Models Acceptance	41
Table 2.7	Framework Components	42
Table 3.1	Details of Research Methodology	53
Table 4.1	Proposed Research components	58
Table 5.1	Demographic data from questionnaire participants	63

LIST OF FIGURES

Figure No	TITLE	PAGE
Figure 2.1	Literature Review Framework	8
Figure 2.2	E-banking Types	10
Figure 2.3	Biometrics types	13
Figure 2.4	Authentication Techniques	21
Figure 2.5	The proportions of biometrics technology in the world	23
Figure 2.6	Theory of planned behavior (TPB)	28
Figure 2.7	Technology Acceptance Model	30
Figure 2.8	Adoption of Biometric Technology: Information Privacy in TAM	31
Figure 2.9	Consumer acceptance of biometrics for identity verification in financial transactions	31
Figure 2.10	Improving e-banking security with biometrics: modelling user attitudes and acceptance	33
Figure 2.11	Adoption of Biometric Technology in Online Applications	34
Figure 2.12	Users' Acceptance of Secure Biometrics Authentication System: Reliability and Validate of an Extended UTAUT Model	36
Figure 3.1	Operational Framework	50
Figure 4.1	Influencing Factors and Attitudes towards Online Banking Using Biometric Technology	60
Figure 5.1	Online Banking Background	64
Figure 5.2	Online Banking Service Provider	64
Figure 5.3	Biometrics Knowledge	65
Figure 5.4	Biometrics Used and the Importance for the User	66
Figure 5.5	Privacy Concerns	67
Figure 5.6	Security Benefits	68

Figure 5.7	Intrusiveness Aspect of Biometrics	69
Figure 5.8	Convenience of Biometrics	70
Figure 5.9	Actual Usage Experience of Biometrics	71
Figure 5.10	Social Factor Responses	72
Figure 5.11	Attitudes towards Biometric Technology	73
Figure 5.12	Influencing Factors and Attitudes towards Online Banking Using Biometrics Technology	74

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Questionnaire Form	85

CHAPTER 1

INTRODUCTION

1.1 Introduction

With the growing popularity of the internet, the relaying on the web have become a paramount of importance for the organizations today than ever before. They are trying to reach their customers through a more easier and secure way of accessing services and performing online transactions at anywhere and anytime (Voice, 2005). Moreover, the dynamic nature of Internet with millions of computers linked to each other makes it hard to control and secure the Internet environment. Due to this huge and complex nature, it is not surprising that the Internet has given the fraudster a new and unprecedented opportunity and means of committing financial crime against businesses (Soh et al., 2010).

Regarding to consumer attitudes and acceptance towards Internet banking, organizations are concerned with providing a level of satisfaction to their customers while doing their financial transactions. Besides, many research attempts have been conducted to address the factors that influence the user acceptance of internet banking services. Consequently, many security measures, such as using passwords and traditional means, have been applied to protect the customer information and their private data. However, the biometric technology is seen as a potential solution which could achieve, alongside with traditional measures, a satisfied level of comfort

and security while reducing the need to remember multiple passwords and Ids (Frye, 2001).

1.2 Problem Background

Today, there are more and more online applications that enable users to do various things anywhere and anytime via the Internet. With the current rapid changes and developments in information technology networks, we can search for information; perform online services; do financial transactions like pay bills via internet banking (Soh et al., 2010). Furthermore, banks are undergoing unprecedented and global achievements. Therefore, the business people have been revolutionized with a great change which has been occurring in developing countries (Hassanuddin et al., 2012).

The advantages of Internet banking are manifest. Instead of going a trip to the bank, the customers can access their personal and business account information. Although the bank is closed, the customers can check their balance whenever they want. In addition, the most attractive service that offered by internet banking is that they can pay the bills online, which saves both time and money on postage (Hassanuddin et al., 2012).

However, threats of spyware and viruses, which allow usernames and passwords to be stolen for unauthorized access, are hampering the adoption of online Banking especially those involving sensitive data and money like financial transactions. Due to the need to protect customers from online fraud, extra security measures are implemented like the usage of security devices that generate a different PIN for each minute and digital certificate/signature or using smart cards (Soh et al., 2010).

Regarding to growing up in technologies changes which offered the easy way to adopt internet banking, new security measures have emerged such as biometric technology which can be used to validate access to the online banking. Since biometric technology utilizes certain physical and behavioral traits that are unique to an individual to identify and verify a person, it may therefore provide a better and an attractive method to implement by organizations for identification as compared to other security measures. However, the influencing factors related to customer's behavior have raised several concerns on user acceptance such as user's privacy and data security (Ahmad and Hariri, 2012; Chan, 2008).

1.3 Problem Statement

The rise of phishing, data compromises and other attacks against online banking systems have impacted the use of online banking and thus the consumer's ability to adopt online services has been negatively affected. There are some studies have been done to investigate the influential factors and attitude related to online banking using biometric techniques. Therefore, the need for further investigation to fill this gap and identify the factors impacting a user's attitude to use or resist online banking through the use of the biometric technology is a paramount of importance. The current study investigates the effects of security and privacy concerns on the user attitude towards online banking using biometrics technology authentication. Furthermore, the study explores the other influencing factors such as technology convenience, technology usage experience and familiarity with the new technology. All these are done through proposing a conceptual framework.

1.4 Research Questions

To investigate these questions, the project considers the following questions to answer the above hypotheses:

1. What are the main factors influencing biometrics implementation in Internet banking system?
2. What are the roles of security and privacy concerns on the user attitude towards online banking using biometrics technology authentication.
3. What are the roles of other constructs such as Technology Usage experience, and technology convenience on the users' attitude towards online banking through the use of biometrics?

1.5 Project Aim

The project has general objective which is to propose a framework takes different factors as an input to measure users' attitude towards online banking using the biometrics technology. This research will achieve its goal by using the conceptual framework through the review of technology acceptance models and theories for online banking.

1.6 Objectives

To accomplish the aim of this project, a few objectives have been identified:

1. To acquire the level of knowledge and appreciation of biometric enabled security by internet banking users.

2. To identify the role of influencing factors, security and privacy concerns on the user's attitude towards Internet banking through the use of biometrics technology.
3. To propose a research framework regarding online banking security using biometrics and to evaluate the proposed framework.

1.7 Scope of Project

The scope of the project identifies the boundaries are listed below:

1. The project will focus on proposing framework for Internet banking using biometric technology regarding customer's acceptance.
2. The study will be done by taking a random sample among internet banking users in Malaysia.

1.8 Significance of Study

The study is becoming extremely significant due to the lack of researches that has been identified the importance of user security and privacy concerns within Internet banking when using a new security technology such a biometric technology. Therefore, the project aims to propose a framework to trace the different factors which could contribute to the acceptance of this new technology.

1.9 Summary

This chapter includes the project introduction, problem background, problem statement, project objectives, scope of the project and the significance of the study.

The purpose of this study is to investigate the main influencing factors and attitudes towards online banking using biometric technology. This project was done through exploring the literature review, existing studies and data collecting from some several resources such as books, conferences, journals and the Internet. The findings of the study showed that users expressed their attitudes towards online banking using biometrics. The attitudes categorized into seven dimensions: knowledge, privacy, security benefits, intrusive nature of biometrics, user convenience and technology usage experience.

REFERENCES

- AHMAD, D. T. & HARIRI, M. 2012. User Acceptance of Biometrics in E-banking to improve Security.
- AHMAD, D. T. & HARIRI, M. User Acceptance of Biometrics in E-banking to improve Security. Vol.2, 2012.
- AHMED, F. & SIYAL, M. 2005. A novel approach for regenerating a private key using password, fingerprint and smart card. *Information management & computer security*, 13, 39-54.
- AJZEN, I. 1991. The theory of planned behavior. *Organizational behavior and human decision processes*, 50, 179-211.
- AL-HARBY, F., QAHWAJI, R. & KAMALA, M. 2010. Users' Acceptance of Secure Biometrics Authentication System: Reliability and Validate of an Extended UTAUT Model. *Networked Digital Technologies*, 254-258.
- AL-HARBY, F., QAHWAJI, R., KAMALA, M. & IFENTHALER, D. Year. The feasibility of biometrics authentication in e-commerce: User acceptance. *In: IADIS International Conference WWW/Internet*, 2008.
- ASHBOURN, J. 2000. *Biometrics: advanced identity verification*, Springer-Verlag.
- ASSADI, V. & HASSANEIN, K. 2009. Consumer acceptance of biometrics for identity verification in financial transactions.
- BAMORIYA, P. S. & SINGH, P. 2011. Issues & challenges in mobile banking in India: a customers' perspective. *Research Journal of Finance and Accounting*, 2, 112-120.
- BOHN, D. 2008. Alternatives to Passwords.
- BOUKHONINE, S., KROTOV, V. & RUPERT, B. 2005. Future security approaches and biometrics. *Communications of the Association for Information Systems*, 16, 937-966.

- BREWARD, M. 2009. *Factors influencing consumer attitudes towards biometric identity authentication technology within the Canadian banking industry*. NR64695 Ph.D., McMaster University (Canada).
- BRODY, R. G., MULIG, E. & KIMBALL, V. 2007. Phishing, pharming and identity theft. *Academy of Accounting and Financial Studies Journal*, 11, 43-57.
- CHAN, K. L. 2008. *Adoption of biometric technology in online applications*. USM.
- DAVIS, F. D., BAGOZZI, R. P. & WARSHAW, P. R. 1989. User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35, 982-1003.
- ELGARAH, W. & FALALEEVA, N. Year. Adoption of biometric technology: Information privacy and TAM. *In: Proceedings of the Eleventh Americas Conference on Information Systems*, 2005a. 1209-1212.
- ELGARAH, W. & FALALEEVA, N. Year. Adoption of biometric technology: Information privacy and TAM. *In*, 2005b. 1209-1212.
- EMUOYIBOFARHE, O., FAJUYIGBE, O., EMUOYIBOFARHE, O. & ALAMU, F. 2011. A Framework for the Integration of Biometric Into Nigerian Banking ATM System. *International Journal of Computer Applications*, 34, 1-11.
- FAHAD, A.-H., QAHWAJI, R. & KAMALA, M. 2010. Users' acceptance of secure biometrics authentication system: reliability and validate of an extended UTAUT model. *Networked Digital Technologies*. Springer.
- FISHBEIN, M. & AJZEN, I. 1975. *Belief, attitude, intention and behavior: An introduction to theory and research*.
- FRYE, M. C. 2001. *The body as a password: considerations, uses, and concerns of biometric technologies*. Georgetown University.
- HASSANUDDIN, N. A., ABDULLAH, Z., MANSOR, N. & HASSAN, N. H. 2012. Acceptance towards the Use of Internet Banking Services of Cooperative Bank. *International Journal*, 2.
- HOSSEINI, S. S. & MOHAMMADI, S. 2012a. Acceptance of Banking on Biometric in Iran's Banking System Case Study of Saman Bank.
- HOSSEINI, S. S. & MOHAMMADI, S. 2012b. Review Banking On Biometric In The World's Banks And Introducing a Biometric Model For Iran's Banking System. *Journal of Basic and Applied Scientific Research*, 2, 9152-9160.

- JAIN, A. K., BOLLE, R. & PANKANTI, S. 1999. *Biometrics: personal identification in networked society*, kluwer academic publishers.
- JAIN, A. K., ROSS, A. & PANKANTI, S. 2006. Biometrics: a tool for information security. *Information Forensics and Security, IEEE Transactions on*, 1, 125-143.
- KHREWESH, A. H. 2011. *E-banking Adoption Model in Palestine*. National University.
- KING, W. R. & HE, J. 2006. A meta-analysis of the technology acceptance model. *Information & Management*, 43, 740-755.
- LITTLER, D. & MELANTHIOU, D. 2006. Consumer perceptions of risk and uncertainty and the implications for behaviour towards innovative retail services: The case of Internet Banking. *Journal of Retailing and Consumer Services*, 13, 431-443.
- MCKECHNIE, S., WINKLHOFER, H. & ENNEW, C. 2006. Applying the technology acceptance model to the online retailing of financial services. *International Journal of Retail & Distribution Management*, 34, 388-410.
- NORMALINI, M. & RAMAYAH, T. 2012. Biometrics Technologies Implementation in Internet Banking Reduce Security Issues? *Procedia-Social and Behavioral Sciences*, 65, 364-369.
- OLIVEIRA, T. & MARTINS, M. F. 2011. Literature Review of Information Technology Adoption Models at Firm Level. *The Electronic Journal Information Systems Evaluation*, 14, 110-121.
- REID, P. 2004. *Biometrics for network security*, Prentice Hall.
- REYNOLDS, G. S. & BANK, W. F. 2006. *Facial Recognition: A Biometric For The Fight Against Check Fraud*. Utica College.
- RILEY, C., BENYON, D., JOHNSON, G. I. & BUCKNER, K. Year. Security in context: investigating the impact of context on attitudes towards biometric technology. *In: Proceedings of the 24th BCS Interaction Specialist Group Conference*, 2010. British Computer Society, 108-116.
- ROBERTS, J. & PATEL, S. Biometrics: Does Convenience Outweigh Privacy? *Convenient or Invasive*, 62.
- SATHYE, M. 1999. Adoption of internet banking by Australian consumers: an empirical investigation. *International Journal of bank marketing*, 17, 324-334.

- SCHERER, S. HUMAN COMMUNICATION AND MACHINE LEARNING:
Learning multimodal computational models of human interactions.
- SEYAL, A. H. & TURNER, R. 2012. A study of executives' use of biometrics: an application of theory of planned behaviour.
- SOH, K. L., WONG, W. P. & CHAN, K. L. 2010. Adoption of Biometric Technology in Online Applications. *International Journal of Business and Management Science*, 3, 121.
- TASSABEHJI, R. & KAMALA, M. Year. Improving e-banking security with biometrics: modelling user attitudes and acceptance. *In: New Technologies, Mobility and Security (NTMS), 2009 3rd International Conference on, 2009a. IEEE, 1-6.*
- TASSABEHJI, R. & KAMALA, M. A. Year. Improving E-Banking Security with Biometrics: Modelling User Attitudes and Acceptance. *In: New Technologies, Mobility and Security (NTMS), 2009 3rd International Conference on, 20-23 Dec. 2009 2009b. 1-6.*
- UZOKA, F. M. E. & NDZINGE, T. 2009. Empirical analysis of biometric technology adoption and acceptance in Botswana. *Journal of Systems and Software*, 82, 1550-1564.
- VENKATESH, V. & MORRIS, M. G. 2000. Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *Management Information Systems Quarterly*, 24, 115-140.
- VENKATESH, V., MORRIS, M. G., DAVIS, G. B. & DAVIS, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.
- VOICE, C. 2005. Online authentication: matching security levels to the risk. *Network Security*, 2005, 15-18.
- WANG, Y.-S., WANG, Y.-M., LIN, H.-H. & TANG, T.-I. 2003. Determinants of user acceptance of internet banking: an empirical study. *International Journal of Service Industry Management*, 14, 501-519.
- WILLIAMSON, G. D. & MONEY–AMERICA'S, G. 2006. *Enhanced authentication in online banking*. Utica College.