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# User Acceptance of Fingerprint-based Smart Kiosk:

## A Conceptual Framework

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***Abstract*—This paper presents a conceptual framework on user acceptance of biometrics application, namely fingerprint-based smart kiosk, which is adopted by Malaysia's Employees Provident Fund (EPF). In order to expedite the process and waiting time of EPF's customers, fingerprint-based smart kiosk was introduced enabling customers to (i) acquire activation code in order to create a personalize myEPF website and (ii) print the latest account statement of the fund. This study extends the Unified Theory of Acceptance and Use of Technology (UTAUT) to determine the factors that influence the usage of fingerprint-based smart kiosk. Based on conventional UTAUT, an additional independent variable was added i.e., personal concerns. Qualitative and quantitative approaches will be used for data collection from a sample of 1200 participants. Consequently, descriptive and inferential analysis will be applied to summarize and interpret the relationship between the variables. It is expected that the research findings will provide useful insights for policy makers, users, and industries.**

***Keywords-fingerprint; smart kiosk; employees provident fund;UTAUT***

## I. INTRODUCTION

Electronic service (e-services) is one of the seven flagship applications introduced in Multimedia Super Corridor in Malaysia [1]. With e-services, Malaysian citizens could engage in multiple transactions with government for example to make payment for utilities bills (telephone, electricity and police summons) via Internet. To go in lieu with government initiatives, Employees Provident Fund (EPF), has created myEPF portal enabling its members to personalize the webpage to transact in real time ie. check their statement of account balance as well as records and status of withdrawal applications. Employers are also able to check their employees' membership numbers besides being able to print pre-printed contribution forms. Before one could access myEPF, he/she needs to obtain an activation code through biometrics authentication using smart kiosk.

Fingerprint-based smart kiosk is an interactive self-service kiosk, which users need to insert their identity card into the slot and subsequently validate the identity by placing their thumb on the fingerprint scanner. It takes merely 2 minutes for an authentication to be successfully validated [2]. Fingerprint-based smart kiosk offers two core functions. Upon successful identifying and verifying via fingerprint system, members could obtain the activation code to create an i-Akaun to access myEPF portal. Furthermore, members are able to print the latest update on the fund. With the basic services redundant out of the way, EPF officers can focus their tasks on more complex human interactions. This way, the efficiency and effectiveness of EPF services would be greatly enhanced. The number of people physically visiting the counters reveals this, and the number of complaints received, which have dropped distinctively [3].

Given the enormous interest in biometrics, the investment already made by the EPF, and the number of years this system has been deployed in Malaysia, it would be useful to investigate the factors influence the users to utilize the services provided by fingerprint-based smart kiosk. This is of great interest because public perception can affect the acceptance of biometrics technologies [4]. If users are hesitant or uncomfortable with the technology, improper usage and implementation pitfalls will follow [5]. Furthermore, fingerprint recognition embedded into smart kiosks is a very secure authentication method to detect fraudulent and counterfeit. Sixteen members have been convicted by the courts for making fraudulent withdrawals between January and March 2010 by submitting false documents to facilitate the approval of withdrawal [6]. Therefore, enforcement to use the biometrics application is significant to ensure the genuine identity of the members making the request.

There exist many theories used in information systems adoption, including Technology Acceptance Model (TAM) [7]. Venkatesh [8] consolidated eight competing theories ie. Theory of Reasoned Action, TAM, Motivational Model, Theory of Planned Behavior (TPB), Combined TAM and TPB, Model of PC Utilization, Innovation Diffusion Theory and Social Cognitive Theory to form the creation of Unified Theory of Acceptance and Use of Technology (UTAUT). In this paper, UTAUT is adopted to assess the usage behavior of fingerprint-based smart kiosk because it is able to account for 70 percent of the variance (adjusted $R^2$) in usage intention [8]. Hence, it appears to be an appropriate model to assess the intention to use of innovations.

The remainder of the paper is organized as follows. Literature review is presented in Section II. This is followed by a description of the conceptual model development in Section III. Subsequently, research methodology is described in Section IV, results in Section V, and finally, conclusion in Section VI.

## II. LITERATURE REVIEW

### A. Malaysia's Employees Provident Fund (EPF)

As at 31 December 2009, EPF has 12.35 million members. However, the number of active and contributing members is 5.79 million [2]. Malaysia has about 453,716 active employers [2]. It is mandatory for employers in the formal sector (government servants and self-employed) to register their workers and both employers and employees to contribute to the fund respectively. Since 1996, contribution rate by members were fixed at 11 percent [9] and it has been reduced to 8 percent this year to enable members to have more disposable income in hands amidst a slowing economy [3]. On the other hand, the employer's contribution rate remains at 12 percent. This makes up 20 percent. However, members who still wish to maintain the contribution rate at 11 percent have the option of doing so.

An EPF member maintains two accounts with the EPF, namely Account 1 and Account 2. Exactly 70 percent of the total contributions are credited into Account 1 and the remaining 30 percent into Account 2. The purpose of Account 1 is to save for old age, for retirement purposes, which can only be withdrawn when a member reaches age 58 years. However, EPF allows members less than 58 years of age to use part of their savings in Account I for approved investment. Nonetheless, the savings in Account 2 is more flexible, which can be withdrawn for various purposes such as funding housing, education and health needs.

Economists are interested to report on how EPF allocates the assets and manages its investments [9]. McKinnon [10] has reported the historical importance of EPF, and the role EPF played in the economic development and growth. Since EPF is one of the social protection schemes to the older employees in Malaysia, it is important to study how the employment issues and financial aspects among older workers in Malaysia are managed [11]. Azlina [12] conducted a study to identify the factors that influence the intention to use myEPF using TAM. Similarly, Tan et al. [13] reported the successful e-government implementation experience of the Central Provident Fund (CPF) Board in Singapore. This study covers the transformation of the traditional CPF management to e-Government implementation and consequently emphasizes on the importance of *my cpf*, an electronic public service delivery.

### B. Biometrics

Biometrics is any human physiological or behavioral traits used to establish an identity as long as it satisfies four requirements – universality, distinctiveness, permanence, and collectability [14]. Physiological biometrics is based on direct measurement of a part of a human body such as fingerprint, face, iris, hand, and retina. Measurements and data derived from an action and measured indirectly from part of a human body refer to behavioral biometrics for instance voice, gait, signature, and keystroke.

There are a wide area of applications for biometrics, for instance physical access control (buildings), logical access control (using laptops), border control, financial (ATM), consumer products (PDA phone), forensics and smart card. In addition, biometrics has numerous benefits. It is convenient, as there is nothing to remember. It cannot be guessed, stolen, shared, lost, or forgotten. Biometrics prevents impersonation, since it has a higher degree of non-repudiation, hence it protects against identity theft. Biometrics enhances privacy as it protects against unauthorized access to personal information and lastly, it can be complemented with other authentication mechanisms such as smart cards and public key infrastructure.

Most of the biometric applications are based on fingerprints. Fingerprints have been recognized since the dawn of humanity, drawings of fingerprints having discovered in caves dating from the earliest ages. In the early 1960s, with the advent of modern technology and computers, the means to create an automated identification system was made possible. These automated applications were primarily focused in law enforcement agencies to identify criminals. As a result, automated fingerprint identification system (AFIS) was created.

Fingerprint recognition is widely accepted in various applications. This is because a person's fingerprint will not naturally change structure after about one year after birth, and the fingerprints of individuals are unique. This holds true even for twins. Therefore, two humans with identical fingerprints are impossible. Due to the uniqueness and consistency over time, fingerprints have been used extensively in the past.

Studies on user perception towards biometrics are few and the existing research focus on the technical aspects of biometrics such as determining the finest method and vigorous algorithm for feature extraction, feature classification and to increase the throughput for the robustness of the system. Most of the biometrics study drew superficial conclusions because the reasons and determinants behind acceptance were not investigated in-depth. For instance, Deane et al. [15] conducted a survey to examine the perceived acceptability of biometric security systems by banking and university staffs while Furnell et al. [16] examined user attitudes towards a range of authentication and supervision techniques.

There are only a few studies conducted to provide empirical analysis of biometrics. Ho et al. [17], Chau et al. [18], Giesing [19], James [20], Jones et al. [21], Kim et al. [22], Tassabehji and Kamala [23] and Al-harby et al. [24, 25] have extended the conventional technology acceptance model (TAM), BioSec Consortium [26] adopted Dynamic Acceptance Model for Re-evaluation of Technology-based Application (DART) model and Uzoko and Ndzinge [27] made used of Diffusion of Innovation model to analyze the determinants of biometrics acceptance. Murphy and Rottet [28] and Michael et al. [29] have created conceptual models to assess intention to use biometrics in the context of hotel and financial industries respectively. Recently, UTAUT is adopted in Al-Harby's work [30-31] to assess users' acceptance towards fingerprint identity management for e-commerce.

## III. CONCEPTUAL MODEL DEVELOPMENT

This section describes UTAUT model [8] that we are adopting in this study to assess users' perception towards fingerprint-based smart kiosk as in Fig. 1. Original UTAUT constitutes four independent variables, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. An additional independent variable, namely personal concerns is added to the model. UTAUT is chosen in our study because it is able to account for 70 percent of the variance (adjusted $R^2$) in usage intention [8].

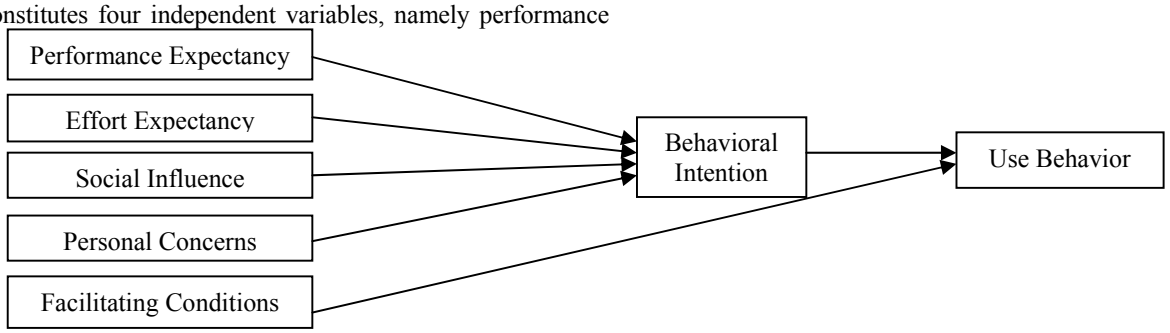


Figure 1. Conceptual Model

### A. Performance Expectancy

Performance expectancy is defined as "the degree to which an individual believes that using the system will help him/her to attain gains in job performance" [8]. This factor is similar to perceived usefulness from TAM and is recognized to be a fundamental attribute in influencing individual's attitude [17-25]. Ho et al. [17], redefined it as "the degree to which a person believes that using a particular biometric system would fulfill the organization's security access requirements in a particular domain". The popularity of fingerprint technology has resulted in it being trialed for spoofing. van derPutte and Keuning [32] were able to defeat all six fingerprint systems they tried, both with and without co-operation from the authorized person for instance to lift the fingerprint from a glass surface or the reader. On the other hand, Matsumoto et al. [33] was able to create a fake silicon and gelatin fingerprints to defeat eleven fingerprint systems. Therefore, security (confidentiality, integrity and availability of information used), reliability (the probability that the system remains successful in achieving its intended objectives) and identity assurance (the assurance that only authorized individuals are given access) [17] would explain the performance expectancy of the intention to use fingerprint-based smart kiosk. Hence, the following hypothesis:

H1: High level of performance expectancy will have a positive influence on the intention to use fingerprint-based smart kiosk.

### B. Effort Expectancy

Effort expectancy is defined as "the degree of ease associated with the use of the system" [8]. Similarly, [17-25] determined this factor as highly significant in influencing intention to use. In the present context, effort expectancy refers to the perception of ease using fingerprint-based smart

They act as facilitators to aid users in interacting with the system. It is especially helpful for the elderly who are not computer- literate. This leads to hypothesis 4:

kiosk in terms of convenience (reducing the effort when using the system, thereby increase the system's ease of use) [17]. Convenience is one of the greatest strengths, as fingerprints do not need to be remembered, hidden, replaced, or repaired. Hence, fingerprint is undoubtedly more convenient than traditional-based identity management methods. In addition, if users expect that smart kiosk will deliver information conveniently by a fingerprint recognition system, they are more likely to use the system. Based on the preceding analysis, we develop hypothesis 2:

H2: High level of effort expectancy will have a positive influence on the intention to use fingerprint-based smart kiosk.

### C. Social Influence

It is defined as "the degree to which an individual perceives that important others believe he/she should use the new system" [8]. Here, social influence refers to the user's intention to use fingerprint-based smart kiosk is affected by social norms for instance using the system represents a symbol of prestige and the belief that society influence the intention of an individual to use the system. Based on the aforementioned, we develop hypothesis 3:

H3: High level of social influence will have a positive influence on the intention to use fingerprint-based smart kiosk.

### D. Facilitating Conditions

Facilitating conditions are defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" [8]. It is a direct determinant to individual's usage behavior. In this paper, it refers to the objective factors for instance infrastructures, processes, and resources that encourage the usage of fingerprint-based smart kiosk. In EPF office, staffs are stationed near the kiosk to stand-by for any inquiries.

H4: High level of facilitating conditions will a have positive influence on the actual usage of fingerprint-based smart kiosk.

### E. Personal Concerns

Personal concerns refer to the "inherent discomfort felt when interacting with biometric technology" [20]. Various considerations arise when come to biometrics usage. For some, there may be intrinsic uneasiness feelings in terms of religious objections [20], perceived safety [15], hygiene [15], perceived invasiveness [15] and fear [34]. There are several religious groups criticize biometrics because individuals are forced to sacrifice a part of them. In addition, due to religious practice, biometrics such as face recognition becomes problematic for Muslims. On the other hand, some people might think that using biometrics system will damage their biometrics traits for instance fingerprint reader or iris scanner will harm their thumb or retina. Hygiene becomes a factor for users who perceive that direct contact with the fingerprint reader is germ-infested. Therefore, perceived invasiveness is largely dependent on the level and type of physical contact involved. In 2005, the police in Malaysia hunted for members of a violent gang who chopped off a car owner's finger to get round the vehicle's hi-tech security system. Based on the aforementioned, personal concerns are a significant factor, which if not addressed, users will not gain confidence and will not promote the intention to use fingerprint-based smart kiosk. Hence, hypothesis 5:

H5: High level of personal concerns will have a negative influence on the intention to use fingerprint-based smart kiosk.

### F. Behavioral Intention

Behavioral intention is the direct determinant to usage behavior prior to successful validation of H1 to H4. As a result, hypothesis 6 is formed:

H6: Behavioral intention will have a positive influence on fingerprint-based smart kiosk.

## IV. Methodology

Qualitative and quantitative analysis will be used for data collection, which are interview and questionnaire survey. Secondary data sources such as published journal articles, magazines, and newspapers will be used mainly for literature, and primary data sources will include survey and interview. The questionnaire will be designed based on related past literature. There will be two core parts to the survey questionnaire: Part A, which will solicit demographic information of the respondents; and Part B, which, will solicit information on the conceptual factors. The participants in this study will be Malaysians, who use the kiosk.

We will conduct a pilot survey in Malacca, Malaysia to test the face validity of the questionnaire. This would provide an evaluation on whether the questionnaire is free from errors, the clarity of the questions, if there are any relevant missing questions, and if too much time is taken to complete the questionnaire. Thereafter, based on the feedbacks from participants, the questionnaire will be refined to enhance clarity and ease of completing. We plan to use a sample of 1200 in this study, and they will be selected from states such as Penang, Selangor, Wilayah Persekutuan Kuala Lumpur, Perak, and Johor.

The data collected will be analyzed with a statistical software SPSS (Statistical Package for the Social Science) version 16. Descriptive and inferential analysis will be useful to summarize and interpret the relationship between variables. Factor analysis, correlation analysis and multiple regression analysis, analysis of variance will be conducted to test the hypotheses outlined in this paper.

## V. Results

The data obtained in this research will be useful to evaluate and to provide the bases for each of the hypotheses. Data collection and analysis for this research is expected to be accomplished in 2011. Hence, findings are expected to be shared in a discussion paper thereafter. In addition, a detailed analysis for the arguments developed in this paper will be conjectured to provide valuable information to practitioners and researchers in the near future.

## VI. Conclusion

Biometrics provides a secure and reliable means over traditional authentication method. Malaysia EPF has adopted fingerprint-based authentication in smart kiosk to enhance its service delivery and increase the productiveness and competency of its staff. Hence, an empirical study on users' acceptance of fingerprint-based smart kiosk would be useful.

Based on our findings we expect to provide insights to policy makers on EPF to guide those making decisions on whether further enhancement on the fingerprint-based smart kiosk is necessary. Besides, through the participation in survey, findings from this research could raise the consciousness for users to recognize the benefits of smart kiosk. It would encourage more users to make adequate use of the fingerprint-based smart kiosk. Industries would also benefit from our research with respect to developing smart system that is more functional and friendlier in application. By understanding the level of acceptance of the smart kiosk, they may appreciate the system more and possibly gain more confidence in biometrics applications, which could greatly enhance usage and efficiency. Consequently, more entities could be willing to accept and implement such technologies in their workplace.

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