

Customer Satisfaction with Digital Wallet Services: An Analysis of Security Factors

Dewan Ahmed Muhtasim¹, Siok Yee Tan², Md Arif Hassan³, Monirul Islam Pavel⁴, Samiha Susmit⁵

Center for Artificial Intelligence Technology, Faculty of Information Science and Technology

Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia^{1,2,4}

Center for Cyber Security, Faculty of Information Science and Technology

Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia³

Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia⁵

Abstract—This study aimed to determine an efficient framework that caters to the security and consumer satisfaction for digital wallet systems. A quantitative online survey was carried out to test whether the six factors (i.e., transaction speed, authentication, encryption mechanisms, software performance, privacy details, and information provided) positively or negatively impact customer satisfaction. This questionnaire was divided into two sections: the respondents' demographic data and a survey on security factors that influence customer satisfaction. The questionnaires were distributed to the National University of Malaysia's professors and students. A sample of 300 respondents undertook the survey. The survey results suggested that many respondents agreed that the stated security factors influenced their satisfaction when using digital wallets. Previous studies indicated that financial security, privacy, system security, cybercrime, and trust impact online purchase intention. The proposed framework in this research explicitly covers the security factors of the digital wallet. This study may help digital wallet providers understand the customer's perspective on digital wallet security aspects, therefore motivating providers to implement appropriately designed regulations that will attract customers to utilize digital wallet services. Formulating appropriate security regulations will generate long-term value, leading to greater digital wallet adoption rates.

Keywords—Cashless transaction; electronic payment; internet security; consumer satisfaction; e-commerce

I. INTRODUCTION

A digital wallet platform allows individuals to perform electronic transactions using mobile devices, such as smartphones, computers, and other supporting devices. Digital wallets have multiple usages, including making purchases from websites or using mobile devices to make in-store transactions [1]. The current economy is transforming into a cashless economy where daily transactions are being performed using the digital wallet. Several e-commerce companies have developed digital wallet payment systems. The development of digitization through the internet has advanced the transition of globalization and payment systems from manual to online transactions. People have become more reliant on electronic money to perform transactions as a result [2].

The Malaysian government encourages people to go cashless and use digital wallets. A survey by Visa found that nearly half of Malaysians can live without cash. This study illustrated Malaysia's potential to evolve into a cashless society

[3]. The current advanced technologies make it easier for Malaysia to shift toward a cashless society. In support of Industry 4.0, Malaysia has taken significant initiatives to establish the status of a cashless society. According to FinTech News Malaysia's report, approximately 17% of the corporations in the Malaysian financial industry formed a sector to establish digital wallets [4]. Cashless transactions result in enhanced capability, transparency, and accountability [3].

Nevertheless, cybercrime cases still occur, and cases of internet security violations are frequent. Moreover, hackers and tricksters are prone to take advantage of such situations to damage companies and consumers [5]. Thus, customer satisfaction is greatly influenced by their perceptions of security and trust [6]. Customers in the e-banking industry are more advanced, knowledgeable, and demanding [7]. Companies and customers avoid e-commerce operations for several reasons, and security is one of the key reasons [8]. Therefore, security is a serious concern when performing financial transactions through digital transaction methods [9]. Moreover, electronic payment systems are currently facing many difficult hindrances posed by the internet. In comparison, the challenges faced by electronic payment systems are more complicated than the majority of internet security issues [10].

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Financial services are extending their sector to include smartphones as electronic payment devices. Smartphones are popular banking, payment, budgeting, shopping, and stock trading applications for customers [11]. Due to the growth of the e-commerce industry, the electronic payment platform is becoming increasingly prominent and essential for smartphone users [12]. Smartphones and other electronic devices contain confidential information of their users, including transaction details and passwords. Consumers do not need to carry their wallets or purse while using digital wallets. However, they need to carry at least one electronic device, such as a smartphone or tablet. In the case of a stolen or lost device, the user risks losing personal and confidential information [13].

The digital wallet is still at its infancy stage in Malaysia as it is a newly introduced payment system. Electronic transactions are a safer mode for consumer payment, enabling

sellers to enhance their productivity and increase profits [14]. Electronic transactions are traceable, whereas cash transactions are not traceable. Hence, the electronic payment system is a secure way of performing transactions. However, according to the latest VMware Banking User, a 2020 study shows that nearly half or 46% of Malaysian consumers are uncertain of digital wallet protection and payment applications [15]. Consumers are concerned about privacy and security threats due to the fear of data fraud and spam [16]. Security and privacy impose a significant and positive impact on behavioral intention when using digital payment services [17]. Therefore, e-retailers should concentrate on improving consumers' protection, loyalty, and purchase intent. They should also be attentive to enhanced security when developing a consumer privacy policy [18]. Hence, the security factors have a significant impact on consumer satisfaction toward digital in Malaysia. Therefore, security factors that can affect Malaysian customer satisfaction are required to be evaluated thoroughly. Ali et al [19]. The author in proposed a framework for the security factors that influence consumers in online shopping in Malaysia. It contains five security factors, financial security, privacy, system security, cybercrime, trust, and customer satisfaction. However, the research failed to identify the specific security factors of the digital wallet.

Nevertheless, limited study has been undertaken to identify the specific digital wallet security factors affecting customer satisfaction in Malaysia. This research proposes a framework for security factors that influence consumer satisfaction in Malaysian digital wallet platforms. This model consists of six security factors: transaction speed, authentication, encryption mechanisms, software performance, privacy details, and information provided. This model is created after studying numerous previous studies from similar fields [19], [20], [29], [30], [21]–[28].

This research introduces security factors to the digital wallet industry in Malaysia that impact customer satisfaction. Besides, this research can assist policymakers of digital wallet applications to concentrate on key security factors and improve platform security while developing security regulations, resulting in a higher rate of consumer adoption. In addition, the research also attempted to study students' and professors' usage and understanding of Malaysia's available digital wallet platforms. The respondents' demographics, comprising both genders, were the students and professors in the National University of Malaysia. They have used the digital wallet services at least once for online purchases. Students between the ages of 18 to 25 were the majority of the respondents.

This research aimed to discover the numerous security concerns that may arise while using digital wallet services for electronic payments besides investigating whether the proposed security factors (i.e., transaction speed, authentication, encryption mechanisms, software performance, privacy details, and information provided) affect the consumer's decision when choosing digital wallet services. This study also aimed to identify variables that have a higher effect on customer satisfaction.

This paper is divided into seven sections. Section 1 presents the introduction and scope of this study, whereas Section 2

reviews previous research on similar topics. In Section 3, the framework and hypothesis of this study are discussed. The methods and analysis techniques of the study are presented in Section 4. Findings of the analysis, the study's limitations, and the conclusions are discussed in Section 5, Section 6, and Section 7, respectively.

II. LITERATURE REVIEW

Digital wallet systems are developed to aid various functionalities. The functions of digital wallet systems are categorized into open digital wallets, semi-closed digital wallets, and closed digital wallet types. Mobile and wireless networking technology, such as smartphones, personal digital assistants (PDAs), and laptops, have eased customers' convenience in utilizing such devices to shop virtually via electronic transaction methods. Transactions are more accessible and transparent through this new method [31]. Nevertheless, several variables may impact the satisfaction of consumers toward electronic transactions. Security, privacy, confidence, and consistency significantly affect e-commerce consumers, among other factors [20]. Mobile perceived security risks determine the consumers' perception of security against conducting mobile transactions, especially the risk of losing important information, resulting in financial losses [32]. Customers' willingness to utilize mobile payment services is influenced by the ease of use, comparative advantage, clarity, and perceived protection.

Furthermore, prevalence and observability positively affect an individual's perception of security, whereas concerns about privacy threats negatively influence the perception [33]. Moreover, the continuous technological development and efforts to promote them are reasons for perceived security as one of the intentions to use digital wallets. Consumers would feel safer when using mobile payment if tools are available to protect the payment systems in unexpected incidences [34]. In an empirical study multiple variables were considered when studying consumer's perceived risk and their attitude toward online shopping in Malaysia. The researchers found that the consumer perceived risks negatively affect the consumer attitude, which positively and significantly affects online shopping behavior [35]. Content quality, peer influence, KOL influence, perceived interaction, effort expectation, and perceived trust all substantially impact users' intention to pay, and their tendency has an indirect impact on users' paying behavior [36].

Although the young generation's actual use of digital payments is driven by behavioral intention and promotional strategies, perceived risks are shown to have a negative effect [37]. Another empirical study asserted that customers were reluctant to use digital wallets when they assumed high perceived risk [11]. Moreover, the study also indicated that financial risks are one of the leading consumer perceived risks. Financial risks emerged as the most significant influence that adversely affects consumer attitude. One of the proposed ideas is to protect the consumers' personal information and decrease credit card fraud cases to minimize financial risks. Due to the risk factors, customers often opt-out from paying via their credit cards [35]. Many researchers concluded that security is a significant factor influencing customer satisfaction in online

shopping [38]–[40]. A study found that behavioral intention to use digital wallets is strongly and vitally associated with perceived utility, perceived ease of use, and privacy and protection [21]. According to Peikari [24], security statements and technical protection significantly impact customer loyalty in the e-commerce industry but did not find a substantial effect on privacy.

Nevertheless, Barry and Jan [22] indicated that privacy and security positively correlate with behavior intention. Consumers may feel vulnerable to digital wallet transactions due to a lack of privacy and security. Nizam et al. [8] conducted empirical research to monitor digital wallets implementation in Malaysia. According to the study's findings, the dependent variable (customer purchasing decision using the digital wallet) is positively linked to all independent variables (convenience, security, and cost-saving).

Furthermore, convenience has the maximum significant positive correlation of 0.624, whereas security showed the coefficient correlation of 0.4999 with customer buying decisions using digital wallets. Based on the analysis, it was concluded that security has a more significant positive association with digital wallets for customer purchase behavior. In addition, Razif et al. [23] conducted empirical research among Malaysian young adults between 18 and 30 years old. The study showed that several factors have a significant relationship with the acceptance of the digital wallet platform. The factors listed were behavioral intention, perceived privacy risk, perceived usefulness, trust, perceived overall risk, and perceived performance risk.

Another empirical study found that trust, security, and privacy are the main factors affecting adopting a digital wallet [25]. A survey conducted by Subaramaniam et al. [13] demonstrated that security risk problems limit the prospect of using the digital wallet in Malaysia. According to Li et al. [26], cloud computing, security, e-learning, and quality of service are four significant factors that affect customer satisfaction in e-banking services. In addition, another research suggested that trust and privacy have positively impacted behavioral intention to use mobile banking services [27]. Likewise, Putra and Sfenrianto [28] demonstrated that a good payment system's security factor and speed influenced customer satisfaction in the digital payment method. Oliveira et al. [29] suggested that the digital payment system's security and performance directly affect customer loyalty. The research also indicated that security has a significant impact on mobile banking adoption. Customers expect banks to improve their security mechanisms by providing transaction security and privacy protection, particularly over wireless networks [9]. The level of security provided by a third-party online payment provider influences customer satisfaction [41]. In addition, Tang et al. [42] found that service quality, perceived risk, perceived security, perceived simplicity of use, social influence, and compatibility all substantially impact on consumers' intention to utilize digital payment.

A variety of factors influence customer intent to use e-wallets, including consumer perceptions of privacy, security.

Thus, the desire to use e-wallets is determined by the concern for transaction security and the protection of personal information given by users [43]. Furthermore, Qatawneh et al. [30] suggested that security and privacy statistically significantly impact the adoption of electronic payment system methods.

Previous researchers did not consider relevant security factors when assessing customer behavior but studied security as a general factor as shown in Appendix A. Besides, studies have shown that the security and privacy aspect of digital wallet systems when conducting transactions using digital wallet platforms is a primary concern for customers. The list of non-bank digital wallet issuers and the banks providing digital wallet services are shown in Appendix B and Appendix C, respectively.

The digital wallet services were developed for fast payment, school fee payments, handling expenses in fuel stations, global online shopping, NFC (Near Field Communication)-based transportation's payment, money transfer, bill payments, and others. Appendix B and Appendix C show 53 active digital wallet services, with 48 of them provided by Malaysian private and government fintech companies. The remaining five digital wallets are provided by international and local banks in Malaysia [44].

III. FRAMEWORK AND HYPOTHESES

Previous studies found that security substantially impacts consumer satisfaction in the digital wallet, but the studies examined security as an overall component. None of the research conducted identified the specific security factors in Malaysia's digital wallet. Thus, the current research proposed a six-factor security framework encompassing transaction speed, authentication, encryption mechanisms, software performance, privacy details, and information provided. Each factor was considered as a variable in this research. Fig. 1 represents the proposed framework of this study.

A. Transaction Speed

Transaction speed often refers to the rate at which data transfer happens from one record to another. The transfer speed is considered to be high if any transaction cannot be completed under a limited time period. An example of a real-life situation where transaction speed can be considered is the waiting time after the consumers have successfully paid for their online orders. The transaction speed of the payment application is a factor that may increase consumers' concerns [45]. The transaction speed is a characteristic that influences the development and satisfaction with any banking digital wallet technology. Numerous previous research found that transaction speed is a critical factor affecting consumer satisfaction with digital wallets [46]–[51]. Therefore, the following hypothesis is proposed:

- Hypothesis 1 (H1): There is a positive relationship between transaction speed and consumer satisfaction.

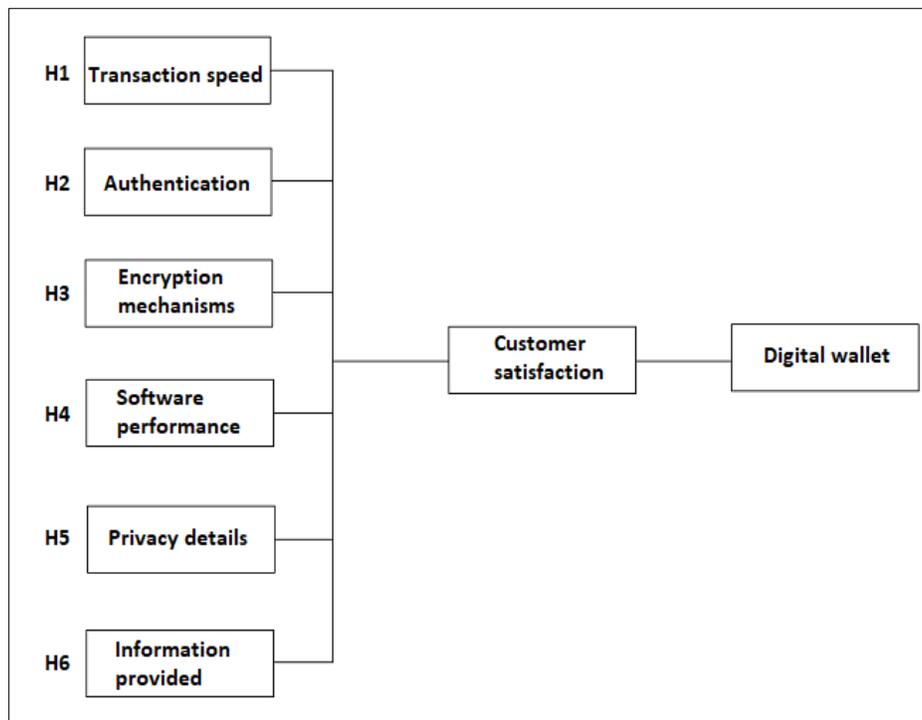


Fig. 1. The Proposed Framework for this Research.

B. Authentication

Authentication is a term that refers to the process of verifying a user's identification to guarantee that the activity being performed is being conducted by a trustworthy and real individual. It acts as a barrier to decrease the possibilities of identity theft. An exemplary situation of this would be the OTP code verification that consumers are required to do in order to complete their payment transactions. Authentication significantly impacts on consumer experience, which impacts their digital wallet adoption decision [52]–[54]. Because confidence is a significant influencing factor, digital wallet companies must guarantee that relevant aspects such as authentication are adequately regulated to build customer confidence [55]. Therefore, the following hypothesis is proposed:

- Hypothesis 2 (H2): There is a positive relationship between authentication and consumer satisfaction.

C. Encryption Mechanisms

Encryption mechanisms are often specific and unique steps and procedures done in turning order to encrypt data and ensure no third party or hackers can get the crucial information by encrypting the data into a gibberish form, which can only be decrypted using a unique key or mechanism corresponding to the encryption mechanism. Encryption mechanisms prevent hackers from breaking into a financial institution's server system. As a result, encryption mechanisms increase consumer confidence in conducting electronic payments [53], [56]. Therefore, the following hypothesis is proposed:

- Hypothesis 3 (H3): There is a positive relationship between encryption mechanisms and consumer satisfaction.

D. Software Performance

Software performance directs towards the overall performance of the software being used by consumers. In this case, performance acts as an indicator of how effectively the components and functions of the software meet their requirements. One of the most significant variables that directly influences acceptance intention for digital wallet is considered to be performance expectation [23], [57]–[59]. Incorrect functional usage situations and bugs in software may raise consumer worries. Therefore, the following hypothesis is proposed:

- Hypothesis 4 (H4): There is a positive relationship between software performance and consumer satisfaction.

E. Privacy Details

The information obtained from customers by digital services is referred to as privacy details in this context. Private information for registration purposes and authentication mechanisms are frequently included. Various previous studies have shown that customer satisfaction with digital wallets is significantly influenced by their ability to maintain their privacy [25], [60]–[65]. Therefore, the following hypothesis is proposed:

- Hypothesis 5 (H5): There is a positive relationship between privacy details and consumer satisfaction.

F. Information Provided

Because of the information provided by digital wallet services, customers of digital wallets may learn more about security. Customers may feel more confident about the security of the digital wallet system if they are informed of the security

procedures. Similarly, if users of digital wallets are unaware of security procedures, they may not feel secure [66]. Digital payments service knowledge has an important, positive, and simultaneous impact on the customer's ongoing desire to use digital wallet services [67]. The security information given by digital wallet services may thus assist customers in learning more about security and increasing their confidence in the system. Therefore, the following hypothesis is proposed:

- Hypothesis 6 (H6): There is a positive relationship between information provided and consumer satisfaction.

IV. METHODOLOGY

This research adopted an empirical research method. A quantitative online survey was distributed to the students and professors at the National University of Malaysia who fulfilled the criteria of used any digital wallet platform, including mobile applications and web-based systems, at least once. Overall, 300 responses were received. The survey was divided into two sections. The respondents were requested to fill in their demographic data in the first section, whereas the respondents responded to the questionnaire on customer satisfaction in the second section. In the personal information section, respondents provided demographic data, including gender, age, occupation, and the frequency of digital wallet transactions.

A five-point Likert scale was used in the second section for respondents to specify their level of agreement on a statement. The degree of agreement is used for the study's assessment process. There were 18 questions in the second section divided into six sections, respectively. Three questions were asked for every element proposed in the framework. Factor analysis, reliability analysis, and multiple regression analysis were conducted with the recollected questionnaires. IBM's Statistical Package for Social Science (SPSS) version 22.0 software was used to assess the statistical significance. Table I shows the respondents' characteristics.

As shown in Table I, the majority of respondents use digital wallet platforms frequently, and it is famous among youngsters.

TABLE I. CHARACTERISTICS OF RESPONDENTS

Indicator	Total cell	Accuracy (%)
Gender	Male	42%
	Female	58%
Age	18-25	61.80%
	26-35	21.80%
	36-45	9.10%
	46-More	7.30%
Occupation	Student	89.90%
	Professor	10.1%
Frequency of digital wallet transactions	More than 3 times a week	30.90%
	2-3 times a week	46.40%
	Once a week	22.70%
	Less than once a week	0%

V. RESULTS

A. Factor Analysis

Factor analysis is commonly employed in multivariate data analysis to evaluate the underlying dimensions [68]–[70]. It is a data rebate technique that transforms many variables into few variables. The highly influential variables were removed from the dataset during the factor analysis. The dataset was replaced with less influential variables after extracting the highly influential variables. The Kaiser-Meyer-Olkin (KMO) sampling adequacy test and Bartlett's test of sphericity were conducted to examine the dataset's construction validity. Table II demonstrates the KMO and Bartlett's test.

According to Table II, the average value of KMO is $.876 > 0.7$, whereas the Bartlett test's significance level of sphericity is 0.00, demonstrating that the collected data is normally distributed. The variables explained 87.6% of the variance from the total variance. Appendix D represents factor analysis. Each question posed for the six variables was used as a sub-variable to analyze the factors. Each factor was assigned with an abbreviation. TS indicated transaction speed, AT stands for authentication, EM denotes encryption mechanism, SP represents software performance, PD signifies privacy details, IP implies information provided, and CS designates customer satisfaction. Appendix D demonstrates that factor loading variables are more significant than 0.6. The minimum factor loading value is 0.656, and the maximum factor loading value is 0.965.

B. Reliability coefficient

The reliability test was performed using the SPSS software to test the dataset's internal consistency and obtain the Cronbach alpha coefficients. The values of the Cronbach alpha coefficients are illustrated in Table III.

As shown in Table III, the Cronbach alpha coefficients' values for all the variables measured are above 0.700. Cronbach alpha value of 0.700 or higher denotes an internally consistent dataset [71]–[73]. Therefore, the dataset received from the questionnaire survey satisfies the rule of thumb of validity.

TABLE II. KMO AND BARLETT'S TEST

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.876
Bartlett's Test of Sphericity	Sig.	.000

TABLE III. RELIABILITY COEFFICIENT

Variables	Number of Items	Reliability Coefficient (Cronbach Alpha)
Transaction speed	3	.912
Authentication	3	.851
Encryption mechanisms	3	.828
Software performance	3	.942
Privacy details	3	.935
Information provided	3	.902
Customer satisfaction	3	.917

C. Regression Analysis

Regression analysis is a practical way to analyze the variables and their connection [74]. The regression analysis is performed to identify the association between the dependent variable (customer satisfaction) and separate independent variables. The dataset’s model summary is shown in Table IV.

As shown in Table IV, the R² value is .723. The value represents a positive linear connection between customer satisfaction and other factors (independent variables) during the analysis. Table V shows the analysis of variance with a significant value less than 0.05.

Therefore, it is found that the independent variables influence the dependent variable. The descriptions of the coefficients are exhibited in Table VI. The variable with the highest β-Value in Table VI is relatively most important independent variable.

The negative value of constant exhibited in Table VI defines that when transaction speed, authentication, encryption mechanisms, software performance, privacy details, and information provided values are 0, the predicted value of customer satisfaction will be less than 0. The regression coefficient calculates a unit change in the dependent variable when the β-value represents independent variable change. Based on the β-value shown in Table VI, the extent of the independent variable effect on the dependent variable can be identified. A high β-value corresponds to high effects. Table VII shows the results for collinearity when multi-regression is applied. A Variance Inflation Factor (VIF) value greater than ten and a tolerance smaller than 0.2 implies a possible concern.

TABLE IV. MODEL SUMMARY

Model	R	R ²	Adjusted R ²	Std. Error of the Estimation
1	.850	.723	.717	.41674

TABLE V. ANALYSIS OF VARIANCE

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	132.793	6	22.132	127.434	.000
Residual	50.887	294	.174		
Total	183.680	300			

TABLE VI. ANALYSIS OF COEFFICIENTS

Model	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	β-Value
Constant	-0.770	0.181	
Transaction speed	0.176	0.044	0.173
Authentication	0.247	0.049	0.213
Encryption mechanisms	0.112	0.039	0.111
Software performance	0.215	0.045	0.189
Privacy details	0.128	0.034	0.139
Information provided	0.311	0.048	0.285

TABLE VII. COLLINEARITY STATISTICS

Model	T	Sig.	Collinearity Statistics	
			Tolerance	VIF
Constant	-4.248	.000		
Transaction speed	4.024	.000	.513	1.948
Authentication	5.040	.000	.530	1.887
Encryption mechanisms	2.865	.004	.630	1.587
Software performance	4.743	.000	.593	1.687
Privacy details	3.794	.000	.701	1.427
Information provided	6.529	.000	.498	2.008

According to Table VII, The VIF values are below 10, whereas the tolerance values are above 0.2 for all the independent variables. Hence, multi-regression is appropriate for the model, and there is no collinearity problem. The value of statistical significance (p-value) less than 0.05 indicates a statistically relevant correlation between the dependent and independent variables. Table VII indicates that the level of statistical significance for the independent variables is below 0.05. Table VIII shows the relationship between each variable. The Pearson correlation values indicate that the variables have a strong and moderate association with one another.

TABLE VIII. PEARSON CORRELATION

Pearson Correlation	TP ^a	Aut ^b	EM ^c	SP ^d	PD ^e	IP ^f	CS ^g
TP ^a	1						
Aut ^b	.563	1					
EM ^c	.460	.410	1				
SP ^d	.524	.508	.484	1			
PD ^e	.459	.407	.417	.431	1		
IP ^f	.591	.606	.509	.469	.366	1	
CS ^g	.675	.681	.572	.635	.537	.712	1

^a. TP = Transaction Speed

^b. Au = Authentication

^c. EM = Encryption mechanism

^d. SP = Software performance

^e. PD= Privacy details

^f. IP = Information provided

^g. CS = Customer satisfaction

D. Hypothesis Testing and Discussion

Table IX demonstrates the hypotheses testing. The test was conducted based on the data collected.

The hypotheses testing reveals that the p-value for the relationship between transaction speed and customer satisfaction is equal to 0.000, lesser than 0.05. Hence, H1 is supported. Therefore, it can be asserted that transaction speed has a significant positive impact on customer satisfaction. The findings suggest that students and academicians are more likely to use digital wallet systems if the transaction speed is high. According to the survey results, faster transaction speed will mitigate the security fears among digital wallet users. Users believe that fast online money transaction boosts the digital e-wallet platforms’ security.

TABLE IX. HYPOTHESIS TESTING

Hypothesis	Factor	β -Value	P-Value	Result
H1	Transaction speed	0.173	0.000	Supported
H2	Authentication	0.213	0.000	Supported
H3	Encryption mechanisms	0.111	0.004	Supported
H4	Software performance	0.189	0.000	Supported
H5	Privacy details	0.139	0.000	Supported
H6	Information provided	0.285	0.000	Supported

In addition, the p-value for the relationship between authentication and digital wallet customer satisfaction is less than 0.05 at 0.000. Thus, the H2 is also supported, denoting that authentication has a significant positive impact on customer satisfaction. This finding shows that user's digital wallet account authentication process influences the digital wallet system's consumer satisfaction. Digital wallet users believe that user authentication keeps scammers at bay and enhances digital wallet security.

Furthermore, the p-value for the relationship between encryption mechanisms and customer satisfaction is 0.004, which is less than 0.05. Therefore, H3 is supported. Thus, encryption mechanisms are found to exert a significant positive impact on customer satisfaction. The survey participants are concerned about accepting or denying digital wallet services with the encryption mechanisms. Similarly, the participants believe that a strong encryption mechanism will avoid abuse or hacking user information while using a digital wallet.

The p-value of software performance is 0.000, which is less than 0.05. Thus, the H4 is supported, indicating that software performance significantly impacts customer satisfaction. The findings confirm that digital wallet users are aware of software performance when using digital wallet platforms. Moreover, digital wallet users suspect that software with vulnerabilities increases the risk of digital wallet fraud.

Additionally, the p-value for the relationship between privacy details and customer satisfaction is 0.000, less than 0.05. Hence, H5 is also supported, concluding that privacy details significantly impact customer satisfaction. It suggests that private data collected from digital wallet users concern them. The digital wallet users opined that security vulnerabilities could be triggered by information collected through digital wallet platforms.

According to Table IX, H6 is also supported because the information provided has a p-value of 0.000, less than 0.05. Hence, the information provided has a significant positive impact on customer satisfaction. The finding shows that information provided by the digital wallet systems allows users of digital wallets to learn more about security. Providing additional security information increases the online payment systems' credibility. Furthermore, consumers will feel reassured about the digital wallet system's security when they are aware of software performance. Therefore, the study concluded that the proposed security factors significantly influence digital wallet consumer satisfaction based on the hypotheses tested.

From Table IX, among the studied factors, the information provided has the highest β -value (.285), indicating that the information provided to digital wallet users most significantly influence consumer satisfaction, followed by authentication (.213), software performance (.189), transaction speed (.173), privacy details (.139), and finally, encryption mechanisms (.111). From the analysis, the six influencing factors on customer satisfaction are arranged in ascending order according to their significant influences: Information Provided > Authentication > Software Performance > Transaction Speed > Privacy Details > Encryption Mechanisms.

VI. LIMITATION OF THE STUDY

Security was only covered as a general factor in previous studies. This study is the first research undertaken to identify the specific security factors for the digital wallet in Malaysia. However, this research was carried out based on responses from students and professors from the National University of Malaysia who may have better security factors awareness. Further research is required in this area of study. Security variables are complicated theoretical subjects for comprehension and research. An in-depth study of various populations is required to assess the factors suggested in this research. In addition, prospective researchers should also consider different security variables.

VII. CONCLUSION

This research has proposed a six-factor security framework that influences consumer satisfaction in Malaysia's digital wallet. Conclusively, all the proposed factors in the research have a significant positive influence on consumer satisfaction. Based on the analysis, the information provided most significantly influences customer satisfaction in digital wallets, followed by authentication, software performance, transaction speed, privacy details, and encryption mechanisms. Hence, improvised information security management principles are essential for the advancement of the digital wallet industry.

Digital wallets have gained popularity in recent times for providing cashless and comfortable daily payments or transactions. Although digital wallets deal with payments or transactions, research on considering and deducing security factors when developing digital wallet payment systems is limited. The progress of the digital wallet industry may impede without a thorough understanding of security factors. This research contributes to understanding the specific security factors necessary for financial technology companies. This study identifies new security factors that influence consumer satisfaction in digital wallet payment methods. The factors have not been analyzed in previous research. Therefore, this study contributes critically to the theoretical literature in digital wallet payments.

Consumer satisfaction is a crucial factor in the future for the booming digital wallet industry. Digital wallet security must be advanced to deal with emerging hackers and frauds. The outcome of this research can assist digital wallet providers in reinforcing the security of the system and focusing on crucial security factors to enhance customer satisfaction towards digital wallets. Moreover, this study can assist future

researchers planning to study this field by considering the variables proposed in this study.

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APPENDIX A

Ref	Objective	Finding	Limitation
[8]	Identify the significant factors affecting the purchasing intention of customers using E-wallet in Malaysia.	Convenience, cost-savings, and security were identified to impact customer purchasing behavior using E-wallet.	Security factors were not considered as variables.
[9]	Analyze the variables affecting the customer's decision to use mobile banking in India.	Perceived ease of use, usability, social effects, security, and perceived cost affect the decision of customers to use mobile banking.	The influence of security variables was not addressed in this study.
[11]	Examine the variables that impact the acceptance of E-wallet services in Sarawak, Malaysia.	The acceptance of e-wallet services is influenced by perceived risk, perceived usefulness, and perceived ease.	Security variables were not considered to identify the perceived risk factors.
[13]	Assess the positive and negative effects of e-wallet on Malaysian users.	The limitations of using the digital wallet in Malaysia are technological challenges and security risks.	The analysis did not classify digital wallet security risks but instead considered security as a general aspect.
[17]	Explain and recognize the nature of adopting the digital payment system in Jordan on the framework of the UTAUT2 model.	Performance expectations, social effect, price value, security, and privacy were important digital payment system acceptance indicators.	Security factors were not considered as variables.
[18]	Identify the relative primary factors that impact online purchase intentions.	Privacy, security, and delivery have a significant positive impact on customer satisfaction when it comes to online purchase intention.	The study does not identify the specific security factors for digital wallet systems.
[19]	Proposed a framework of the security factors in online shopping.	This framework has five security factors: financial security, privacy, system security, cybercrime, trust, and customer satisfaction.	The study does not identify the specific security factors for digital wallet system.
[20]	An analysis to determine the attributes that impact customer satisfaction in online shopping.	Privacy, merchandising, convenience, trust, delivery, usability, product customization, product quality, and security are the important attributes to the consumer for online satisfaction.	Specific security factors were not considered as variables.
[21]	Identify the primary factors that contribute to the acceptance of electronic payment systems.	Compatibility, the perceived security of technology, performance expectations, creativity, and social impact have important beneficial and detrimental effects on the acceptance and recommendation of electronic payment systems.	The analysis did not consider security factors but rather addressed security as a general factor to assess consumer behavior.
[22]	Investigate the variables that have a significant impact on the adoption of Jordan's electronic payment systems.	Security and privacy have a statistically significant impact on the adoption of electronic payment system methods.	This research does not identify particular security factors to assess the behavior of consumers to prevent ambiguity.
[23]	Examine the driving factors over the use of e-wallet as a payment method by Malaysian young adults.	Perceived usefulness, perceived ease of use and privacy and security have a positive and vital association with the e-wallet behavioral intention.	Security was considered as a general factor; specific security variables were not studied.
[24]	Analyze the factors influencing m-commerce use in Malaysia.	Perceived usefulness, perceived satisfaction, security, and privacy have a significant positive impact on the behavioral intention of m-commerce use in Malaysia.	The study does not consider specific security factors as variables. Security was considered a general factor.
[25]	Analyze the perceived risk that represents the ambiguity of adverse effects over e-wallets in Malaysia on consumer emotions.	The perceived risk of privacy, perceived usefulness, trust, perceived general risk, and perceived risk of performance are directly linked to the acceptance of the e-wallet platform.	The study does not specify the specific security factors for the digital wallet system.
[26]	Investigate the influence of security statements, technical protection, trust, and privacy on customer satisfaction, in the world of e-commerce.	Security statements and technical protection significantly impact customer loyalty in the e-commerce industry, and the study found no substantial effect on privacy.	The study considered security statements as a variable and did not study specific security factors.
[27]	Predict the extent of adoption of the People-to-People (P2P) services of the WeChat wallet in South Africa.	Trust, security, and privacy impact the decisions of South Africans to accept the WeChat wallet.	The research was based on WeChat wallet mainly, did not include other e-wallet services, and did not analyse security factors.
[28]	Examine the variables impacting consumer satisfaction with e-banking systems.	Cloud computing, security, e-learning, and quality of service are factors that can improve customer loyalty with e-banking.	The study did not specify digital wallet security variables.
[29]	Examine the influence of socio-cultural factors on ICT innovation, emphasizing mobile banking services in South Africa.	Trust and privacy have a significant impact on the behavior intention of using mobile banking services.	The analysis does not identify the security factors that affect consumer behavior.
[30]	Identify the variables that affect consumer satisfaction on the systems of electronic payment in Indonesia.	Customer loyalty has a significant influence on service effectiveness, benefits provided, the security of transactions, speed, active usage, benefits received, and convenience of transactions.	The analysis did not classify digital wallet security risks but rather considered the security of transactions as a general aspect.
[35]	Identify the variables that impact consumer perceived risk and their attitude toward online shopping in Malaysia.	The attitude of online shoppers is adversely influenced by product risk, financial and non-delivery risks. Convenience risk was shown to have a positive impact on the mindset of the customer.	The study does not identify the security factors that impact consumer behavior.

[36]	Identify the variables that impact users' paying behavior.	Content quality, peer influence, KOL influence, perceived interaction, effort expectation, and perceived trust all have a substantial impact on users' paying behavior.	The findings of the research do not identify which security variables influence customer behavior.
[37]	Examine the factors that influence the satisfaction of the younger generation with digital payment systems.	Perceived risks are shown to have a significant impact on the behavior intention of using digital payment services.	The research did not identify any factors relating to the security of digital wallets.
[42]	Analyze consumers' intention to utilize digital payment.	Service quality, perceived risk, perceived security, perceived simplicity of use, social influence, and compatibility all have a substantial impact on consumers' intention to utilize digital payment.	The findings of the study do not reveal which security variables influence consumers' purchase decision. In this case, security was taken into consideration in a wide sense.

APPENDIX B

No.	Issuers (Non-Banks)	Wallet name	No.	Issuers (Non-Banks)	Wallet name
1	AEON	AEON Member, Plus Card	25	Mobile Money International	Money Pin
2	Alipay Malaysia	Lazada Wallet	26	MobilityOne	eM-onei
3	Axiata Digital eCode	Boost	27	MOL AccessPortal	Razer Gold
4	Bandar Utama City Centre	IPAY	28	MRuncit Commerce	Mcash
5	Bayo Pay (M)	Construx	29	MyEG Alternative	iPayEasy
6	BigPay Malaysia	BigPay	30	TNG Digital Remittance	NAPP (Numoni App)
7	BLoyalty	B Infinite Pay	31	PayPal Pte. Ltd	PayPal
8	Chevron Malaysia Limited	Caltex StarCard Debit	32	Petron Fuel International	Petron Prepaid Fleet Card
9	DIV Services	Whalet	33	Presto Pay	Presto Pay
10	Fass Payment Solutions	Fasspay	34	qBayar	qBayar
11	Finexus Cards	Visa / Master Prepaid Card	35	Raffcomm	e-Info
12	Fullrich Malaysia	TaPay	36	Razer Pay Wallet (M)	Razer Pay
13	Gkash	Gkash eWallet	37	Serba Dinamik IT Solutions	Qwikpay
14	Google Payment Malaysia	Google Play Gift Card	38	Setel Ventures	Setel App
15	GoPay	GoPay	39	ScanPay	MyScanPay
16	GPay Network (M)	GrabPay	40	ShopeePay Malaysia	ShopeePay
17	Instapay Technologies	Instapay e-Wallet	41	SiliconNet Technologies	Sarawak Pay
18	iPay88 (M)	iPay88 e-Wallet	42	SMJ Teratai	eWANG
19	I-Serve Payment Gateway	Zapp	43	Touch 'n Go	Touch 'n Go, Prepaidcard
20	JuruQuest Consulting	QBpay e-wallet	44	TNG Digital	Touch 'n Go eWallet
21	KiplePay	kiplePay	45	U Mobile Services	GoPayz
22	ManagePay Services	Mpay	46	Wavpay Systems	Wavpay
23	Maxis Broadband	Prepaid Airtime	47	WeChat Pay Malaysia	WeChat Pay
24	Merchantrade Asia	Valyou Wallet	48	XOX Com	XOX eWallet

APPENDIX C

No.	Banks	Products
1	AmBank (M) Berhad	Prepaid Card (MasterCard)
2	Bank of China (M) Berhad	Prepaid Card (China Union Pay)
3	CIMB Bank Berhad	Prepaid Card (MasterCard) CIMB Pay
4	Malayan Banking Berhad	QR Pay
5	RHB Bank Berhad	Prepaid Card (Visa)

APPENDIX D

Variables	ID	Measurements Items	Values
Transaction speed	TS1	Slow online money transaction speed can increase the chances of becoming a fraud victim while making payments using a digital e-wallet.	.816
	TS2	Fast online money transaction speed improves the security of the digital e-wallet platform.	.847
	TS3	A faster online money transaction speed gives hackers less time to commit fraud.	.965
Authentication	AT1	User authentication has a directly proportional relationship with digital e-wallet security.	.880
	AT2	User authentication helps in ensuring the genuine cardholder is in charge while completing transactions online.	.846
	AT3	User authentication acts as another form of measure to keep scammers away.	.768
Encryption mechanisms	EM1	A good encryption mechanism can prevent the user information from being misused or hacked.	.656
	EM2	An encryption mechanism acts as a barrier between the customer and third parties with malicious intent to steal the customer information.	.681
	EM3	Encrypted data would have no value when stolen by a hacker because the data is encrypted.	.816
Software performance	SP1	A software with bugs increases the chances of fraud in the digital wallet.	.939
	SP2	The higher and better a software's performance, the harder it is for a hacker to break in.	.877
	SP3	A software with a slower performance gives a bigger scope for hackers to find the defects in the system.	.916
Privacy details	PD1	Information taken from the user can cause security issues perceived risk.	.868
	PD2	User's information is vulnerable.	.877
	PD3	The more confidential information stored results in a higher user perceived risk.	.954
Information provided	IP1	Information provided by the digital wallet system can help the user to understand more about security.	.923
	IP2	Providing more information about security improves the transparency of an online payment system.	.834
	IP3	Users will feel more assured and at ease if they are provided with more security information.	.880
Customer satisfaction	CS1	Digital wallet services have accelerated my regular activities.	.860
	CS2	Compared to conventional techniques, the digital wallet is a time-saving system.	.872
	CS3	I expect that in the near future, I would be using digital wallet systems.	.842