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FACTORS AFFECTING USER'S ACCEPTANCE OF ADOPTING BIOMETRICS TECHNOLOGIES USING THE TAM MODEL

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Abstract

User privacy and security concerns hinder the adoption of biometric authentication technology in Indonesia, especially when consumers are still determining how their biometric data will be stored, accessed and used. This research aims to investigate the variables that influence the adoption of biometric authentication technology in Indonesian society. The Technology Adoption Model is used in this research to estimate the impact of different parameters and investigate the importance of novel elements in adopting biometric authentication. Several factors are examined to see how they affect Actual System Use (ASU), including Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Trust & Security (TS), Perceived Privacy (PP), Attitude towards Using Technology (ATU), and Behavioral Intention to Use (BIU). New theories are presented in this study, focusing on the relationship between PP and BIU, which is supported by respondent data. The results show the rejection of two hypotheses: first, the effect of PU on BIU may not be strong enough to influence user intention, and other variables may be at play; second, the effect of PEOU on BIU implies that perceived ease of use alone may not be sufficient to influence user intention. BIU has a major impact on the adoption of biometric authentication technologies. Furthermore, this research found that compared to PU and PEOU, the original components of TAM BIU are more influenced by variables such as ATU, PP and TS. These results suggest that new considerations such as privacy, trust, and security are more influential in shaping usage intention in biometric authentication.

Keywords: *Authentication Technology, Biometrics, Technology Acceptance Model, User Acceptance.*

1. INTRODUCTION

There is currently a big shift in society from using traditional passwords to using biometrics technology for identification. Traditional passwords have many security risks, such as being hacked and difficult to remember [1]. Careless people can also change them. Many people seek a better way to keep their personal information safe. When someone's name is verified, authentication technology is used to see if the person is real [2]. Using login methods to control who can get into the system can help protect the data and the system [2]. One possible answer is biometric technology, which checks people based on their physical characteristics, such as fingerprints, face and eye [3]. This type of technology is used for identification and access control [4]. Biometric information, such as facial data, is very private and, unlike passwords, can't be changed [5]. A high level of protection is provided because these physical characteristics are unique. However, there are still problems, such as people needing to understand how well the technology works and worrying about privacy issues and data leakage [1].

The Technology Acceptance Model (TAM) is used in this study because it predicts behavior and measures how well a person accepts a technology system [3] [6] [7]. This method is useful in determining how likely people are to use new technologies. It has factors that can be added and modified to suit the study topic in different technology areas [8] [9]. The TAM Acceptance Model looks at whether users will accept something based on two main factors: how helpful they think it is and how easy it is to use [3] [6] [10]. These factors greatly impact how people feel about the technology and how they plan to use it [6] [10]. TAM explores what a variable might mean and the role of new variables in how people accept technology [9]. Perceived ease of use, value, sentiment, desire to use, and actual use are all factors that support user biometric authentication. New factors such as perceived security, trust, and privacy were also added to the study.

Using the TAM Acceptance Model, a previous study found that perceived value is influenced by things like ease of use, trust and security, all of which have a major impact on people's decisions to use biometrics technology for authentication [3]. Patel says that people's feeling of security when using Internet banking services in India makes them want to do so [11]. Privacy concerns [4] [12] have also been shown to make people less likely to trust biometric identity technology [6]. Users are more likely to trust an application if they feel safe using it [11], so it's important to look at what happens when factors are added to this study. When people use a coffee machine in a new environment, perceived trust affects their attitude and intention to use it, but perceived happiness does not affect their attitude toward use [10]. Security is still the most important issue, as people want to use RFID technology because they trust that their personal information will be kept safe [6]. However, using biometrics technology also makes people concerned about privacy and how it could be misused [4] [12].

In two studies with different acceptance models, the risk of future use was the main reason people don't use facial recognition [8] [10]. Nevertheless, the fact that people believe in biometric authentication shows that they think this technology can make things run more smoothly [1]. Studies have shown that biometrics technology is more secure, but how users feel about its usefulness, privacy, security and ease of use greatly impacts how many people choose to use it. However, this study shows that we must fully understand how these factors influence people's use of biometric technology. Concerns about privacy and security are still major issues that need to be addressed to get more people using it.

Therefore, this study uses the TAM model to investigate what makes people successfully adopt biometric technology and to close the gap between what users expect and experience. This research is important because it helps to ensure that biometric security technology is widely used by finding out what makes people accept it and what concerns users have. How well new technologies are used depends on how well users accept them [1]. The results of this study give us a lot of information about how biometric authentication technology is accepted. This study looks at how different factors affect how the system is used. It can also be used to develop, implement and improve biometric authentication technology, which is used in many areas of life. This will ensure that the technology is secure, easy to use, and accepted by most people.

2. RESEARCH METHODOLOGY

2.1. Research Methods

This study uses quantitative methods to collect data from users of biometric authentication. The descriptive analysis uses a cross-sectional research methodology to provide a detailed description of a phenomenon without influencing the variables. Cross-sectional studies collect data at a point in time to examine the correlation between variables within a single population [11]. This study follows a well-organized framework to ensure methodological execution. The author's study process, including data collection and analysis, is outlined in Figure 1.

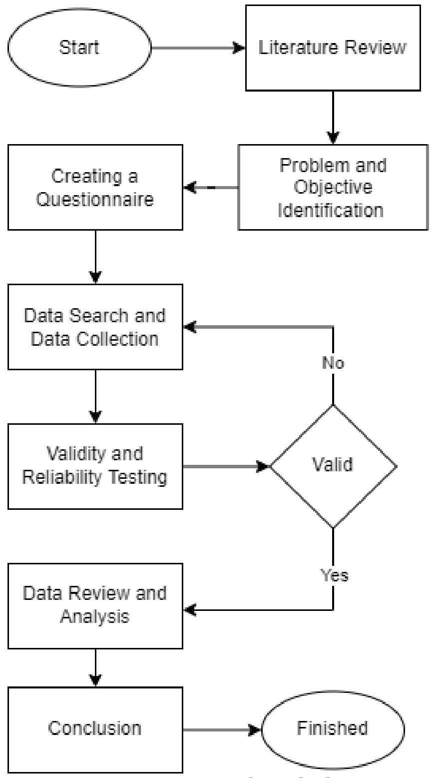

Figure 1. Research Methods

A literature review is the first step in this research project to identify phenomena pertinent to the adoption of the IT research topic. The observed phenomena will be used to identify problems and conclusions for more researching and understanding the factors influencing user acceptance of biometric authentication technology. In addition, a data collection tool will be created by integrating relevant research factors. An online survey will be used for data search and collecting to categorize users who have enabled biometric authentication on their devices. Tests for validity and consistency will be performed on the gathered information to assess the reliability and validity of the questionnaire used to collect the data.

Using the SmartPLS program, investigations of the outer and inner models were carried out. Adjustments will be made, and the instruments will be retested to verify any changes should the findings indicate that they are not valid and consistent. If the test results continue to suggest that the instrument cannot produce reliable and consistent data, recollection of the data may be the last resort. Analyzing the link between the elements impacting user acceptance of biometric authentication technology using the TAM Acceptance Model aims to address the problem statement and test the hypothesis. Following several procedures, the analysis results will be completed and added to the research's final report..

2.2. Hypothesis

This study adds three new variables to the analysis of perceived security, trust, and privacy to predict user acceptance of biometric authentication using the Technology Acceptance Model (TAM) technique. TAM is a framework for analyzing behavior and gauging a person's comfort level with a technological system [3] [6] [7]. Furthermore, TAM is extensively employed due to its efficacy in forecasting users' adoption of technology [7]. With variables that may be expanded upon and tailored to the subject of study for various technological domains, this model seems to be efficacious in evaluating the inclination to embrace novel technologies [8] [9]. TAM identifies the potential for significant influence of a variable and the role of new variables in technology acceptance [9].

Research variables, according to Sugiyono, are qualities or aspects of an item that researchers choose to investigate and make inferences [13]. To measure user acceptability in this study, the TAM model is used for the following variables: attitude to use of technology (ATU), behavioral intention to use (BIU), perceived usefulness (PU), perceived ease of use (PEOU), trust and security (TS), perceived privacy (PP), and actual system usage (ASU). Technology usage considers aspects of the according to the psychological theory behind TAM, the interaction between convinced, attitudes, intentions, and user behaviors [11] [14]. According to this model, several variables significantly affect how biometric authentication is used. For further information, view the TAM model in the Figure 2.

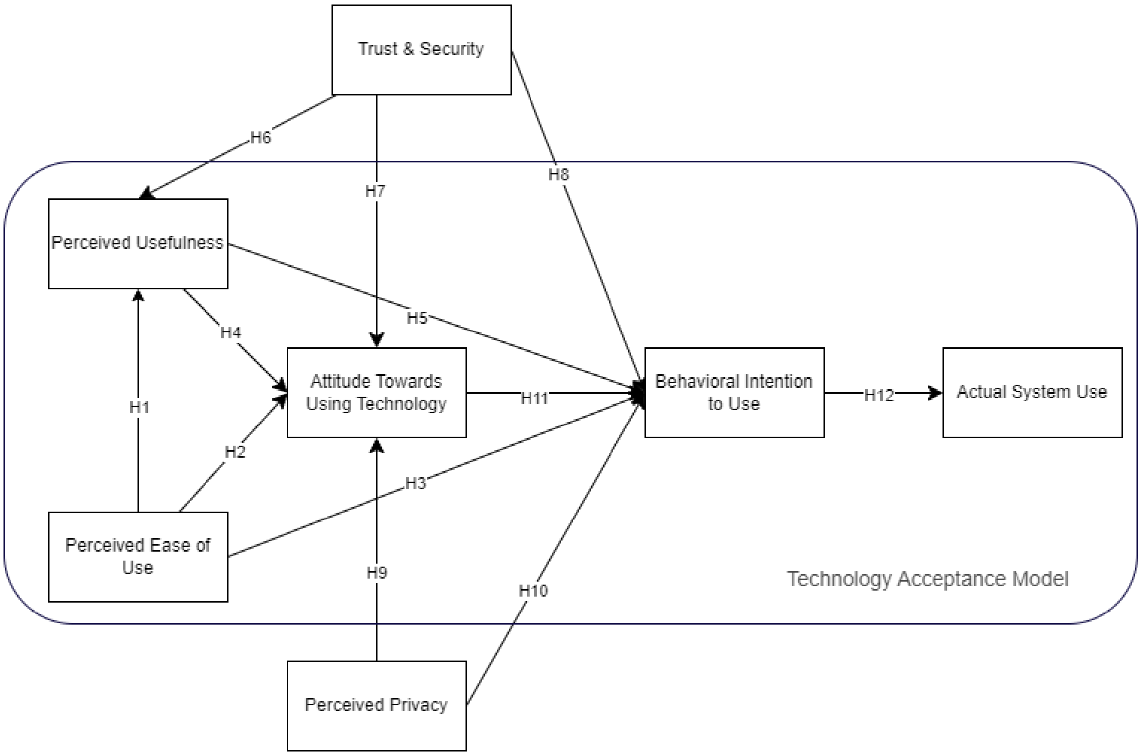

Figure 2. Research Model

Figure 2 illustrates the correlation between 7 variables linked by 12 hypothesized relationships that will be investigated. Hypotheses guide the research process, assist in designing appropriate procedures, and analyze data, testing theories and make evidence-based decisions. This study aims to better understand the impact of several variables on user acceptance of biometric authentication by conducting tests to validate these assumptions. The relationship between the variables in the hypothesis is illustrated in Table 1 below.

Table 1. Research Hypothesis

Code	Variables	Description
H1	PEOU – PU	Perceived ease of using technology has a significant effect on perceived usefulness.
H2	PEOU-ATU	Perceived ease of using technology has a significant effect on the attitude that users have towards technology.
H3	PEOU-BIU	Perceived ease of use significantly affects the intention to use technology.
H4	PU-ATU	Perceived usefulness has a significant effect on the attitude that users have towards technology.
H5	PU-BIU	Perceived usefulness has a significant effect on the intention to use technology.
H6	TS-PU	User-perceived trust and security have a significant effect on perceived usefulness.
H7	TS-ATU	User-perceived trust and security have a significant effect on the attitude that users have towards technology.
H8	TS-BIU	User-perceived trust and security have a significant effect on behavioral intention to use.

H9	PP-ATU	User perceptions of privacy have a significant effect on the attitude that users have towards technology.
H10	PP-BIU	User perceptions of privacy significantly affect the intention to use technology.
H11	ATU-BIU	Users' attitude has a significant effect on the intention to use technology.
H12	BIU-ASU	Behavioral intention to use technology has a significant effect on actual system use.

3. RESULT

This research uses quantitative methods by collecting data from biometric authentication users. In this study, the sample calculation uses the Lameshow formula because the population is uncertain [15]. According to Arikunto, a research sample is a small part of the population that can represent the overall characteristics [16]. From the population of biometric technology users in Indonesia, a minimum of 385 respondents is required, and the data collected through the questionnaire reached 401 respondents.

The majority of respondents were female, reaching 85.5%. As many as 88.5% of the users were from Java, with 28.5% from DKI Jakarta. The percentage of respondents in the youth group (12-25 years old) reached 85%. The majority of users, about 75.1%, are currently studying at university, especially S1 or Bachelor students. The demographic characteristics of the respondents are likely to influence the research results. In other studies, perceived usefulness, ease of use, trust and security have a substantial impact on technology adoption. In contrast, socio-demographic aspects, such as facial recognition, have little effect on the variation in biometric adoption rates across regions [17].

After gathering information from respondents and other accessible data sources, data analysis is an important phase of the research process. To test theories and resolve the problem stated, data must be grouped, tabulated, and presented as part of the data analysis process [18]. Using the Partial Least Squares (PLS) technique via the SmartPLS program, the Structural Equation Modelling (SEM) methodology used for data analysis. Measuring the connection between the model's variables is the primary goal.

3.1. Outer Model Analysis

Through the use of measures such as convergent validity, discriminant validity, Cronbach's alpha and composite reliability as measures of the precision of model predictions, outer model analysis in structural equation modeling (SEM) are used to assess the validity and reliability of the constructs [19]. The validity and reliability of the indicators used in the research to accurately reflect the variables utilized in the investigation are evaluated using outer model analysis. Uncertainty and unreliability might arise from the outcomes of the inner and outer model analyses influencing one another.

3.1.1. Validity Test

Validity testing is performed to determine if a measuring tool or instrument can measure what it intends to measure [13] and to ensure the tool is valid and dependable. Assume that no validity test is conducted. If so, there is no assurance that the indicator measures what it is supposed to measure, which might lead to mistakes in interpreting the findings. Convergent and discriminant validity are the two test types often used to determine if a variable is valid. To ensure the reliability of the research, these two checks ensure that the variables under study can be depended upon exactly and properly.

Convergent validity is the first validity test; it assesses how strongly the variable and its indicators are related. The load value and the average variance extracted (AVE) are used to assess convergent validity. A high load value suggests that the measured indicator may accurately represent the variable.

Table 2. Convergent Validity

Variable	Outer Loading	Description	AVE	Description
Perceived Usefulness	0,777	Valid	0,563	Valid
	0,739	Valid		
	0,735	Valid		
Perceived Ease of Use	0,739	Valid	0,514	Valid
	0,709	Valid		
	0,738	Valid		
	0,680	Valid		
Trust & Security	0,729	Valid	0,569	Valid
	0,755	Valid		
	0,706	Valid		
	0,814	Valid		
	0,762	Valid		
Perceived Privacy	0,759	Valid	0,633	Valid
	0,818	Valid		
	0,809	Valid		
Attitude towards Using Technology	0,740	Valid	0,520	Valid
	0,752	Valid		
	0,713	Valid		
	0,676	Valid		
Behavioural Intention to Use	0,766	Valid	0,602	Valid
	0,807	Valid		
	0,753	Valid		
Actual System Use	0,790	Valid	0,621	Valid
	0,796	Valid		
	0,862	Valid		
	0,696	Valid		

Table 2 shows the results of the convergent validity tests findings that the outer load levels varied between 0.6 and 0.9. General guidelines state that an outer load value is deemed legitimate if greater than 0.7 [19]. Nonetheless, Ghozali maintains that an outer loading value of 0.5 to 0.6 is still considered properly qualified [20]. As a result, all outer load indicators are regarded as legitimate in this research because an outer loading value > 0.6 is employed. The indicator could not accurately represent the variable being monitored if the outer loading is below 0.6. On the other hand, the model may become redundant if the outer loading value is too high.

Furthermore, AVE (Average Variance Extracted) values are considered by convergent validity is achieved when the AVE, which is used as a measure of validity, is greater than 0.5 [19]. The AVE aims to evaluate a variable's measurement accuracy based on its research markers. An indicator's failure to adequately describe the construct is indicated by an AVE value of less than 0.5. At the same time, an indicator's redundancy is indicated by an AVE value that is too high.

Two AVE items (the PU and TS variables) had previously scored below 0.5. Still, retesting was done to ensure that only strong indications (those that met the criteria) could be included in the research. It is necessary to remove things from the external load for the AVE to increase. The AVE value is more significant than 0.5 and meets the threshold when six indicator items - PU2 (0.703), TS1 (0.611), TS3 (0.616), TS7 (0.699), PP1 (0.812) and BIU3 (0.655) - are removed. The AVE values in TS change from 0.477 to 0.569, and PU from 0.495 to 0.563. Retesting also affects the discriminant validity score, resulting in changes in the Heterotrait-Monotrait Ratio (HTMT) score.

Table 3. Discriminant Validity

	ASU	ATU	BIU	PEOU	PP	PU	TS
ASU							
ATU	0,885						
BIU	0,869	0,846					
PEOU	0,728	0,832	0,708				
PP	0,733	0,877	0,825	0,762			
PU	0,829	0,889	0,725	0,858	0,690		
TS	0,622	0,881	0,756	0,657	0,894	0,623	

The results of the validity test are shown in Table 3, to determine if the indicator's link with its variable is greater than that of other variables, the validity test is conducted from the perspective of discriminant validity [19]. Put differently, there has to be variation among the indicators that are being assessed. The Heterotrait-Monotrait ratio (HTMT), cross-loadings, and the Fornell-Larcker criteria for discriminant validity assessment can be used.

The HTMT makes sure that there is less correlation between indicators on the same variable and between variables. Hair states a situation is acceptable if the HTMT is less than 0.90. The inability to discriminate between the variables in the model may be shown if the HTMT is greater than 0.90. Looking at Table 3, we can see that all the items have a value of less than 0.90. For example, ATU vs. ASU has a value of 0.995, and TS vs. PU has a value of 0.623. This means that the HTMT value is accurate because it is less than 0.90.

3.1.2. Reliability Test

Reliability testing aims to evaluate the measuring instrument's consistency and the measurement findings' suitability for making decisions [19]. The test findings will be more accurate and consistent if the instrument is dependable. According to Ghozali, a Composite Reliability (CR) of over 0.7 and a Cronbach's alpha (CA) of over 0.6 are required, the instrument may be deemed dependable [19] [21].

A reliability coefficient (CA) of more than 0.6 suggests that the research instrument is suitable for study use. A CA of less than 0.6, on the other hand, indicates that the instrument has a poor level of measurement and that certain items need to be eliminated or retested. A CR of higher than 0.7 suggests strong consistency for research. Still, a CR of less than 0.7 indicates poor consistency and requires reevaluating and enhancing the instrument items.

Table 4. Constuct Reliability

Variable	CA	CR	Description
ASU	0,795	0,867	Reliable
ATU	0,691	0,812	Reliable
BIU	0,668	0,819	Reliable
PEOU	0,684	0,809	Reliable
PP	0,709	0,838	Reliable
PU	0,612	0,794	Reliable
TS	0,809	0,868	Reliable

The reliability test results shown in Table 4 indicate that all variables meet the construct reliability criteria, as each variable has a CA value above 0.6, and the CR value is also above 0.7. The variable PU has the lowest values for both reliability measures, with a value of 0.612 for CA and 0.794 for CR. Nevertheless, this test shows a good level of reliability.

3.2. Inner Model Analysis

The inner model analysis is currently being used to investigate the proposed causal relationship between the latent variables in the model [19]. The model proposed in the hypothesis is tested and validated using the coefficient of determination, predictive relevance, and model fit. The hypothesis's conclusion might be erroneous if the internal model analysis is skipped because there is ambiguity about the model's validity. As a result, it's critical to confirm that the data supports the causal links between the latent variables and that the model fits well.

3.2.1. Determination Coefficient (R^2)

The coefficient of determination, often known as the R-square, measures the effect of the independent variable on the dependent variable [15] [18] [19]. The case context influences how the strength of the R-squared value is evaluated. R-squared has a range of 0 to 1. When the independent variable explains the observed variance in the dependent variable better, 1 is shown [19]. Conversely, a score of 0 suggests that there are limits to the independent variable's ability to explain the variance seen in the dependent variable [15]. Nonetheless, 0.75 denotes strong, 0.50 denotes moderate, and 0.25 denotes weak in this research [22] [19].

Table 5. R-Square

Variable	R-Square
Actual System Use	0,406
Attitude towards Using Technology	0,584
Behavioral Intention to Use	0,439
Perceived Usefulness	0,351

Table 5 shows that ASU, ATU, BIU, and PU are dependent variables that are influenced by independent factors according to the values of the R-squared table. With an R-squared value of 0.406, the variable actual system use shows that users' intention or desire to employ biometric authentication technology influences 40.6% of the actual usage of biometric authentication. By contrast, 59.4% are impacted by other variables not examined in this research. In the meanwhile, the technology use attitude (ATU) variable has an R-squared value of 0.584, meaning that users' perceived usefulness (PU), ease of use (PEOU), trust and security (TS), and privacy (PP) all have an impact on 58.4% of the usage attitude. In contrast, additional variables not included in this research impacted 41.6% of the sample.

Moreover, the Behavioral Intention to Use (BIU) has an R-squared value of 0.439, indicating that users' usefulness (PU), ease to use (PEOU), attitude to use (ATU), trust and security (TS), and privacy (PP) influence 43.9% of their intention or desire to use biometric technology. In comparison, other factors not covered in this study influence 56.1% of users' intentions. Lastly, the perceived usefulness (PU) R-squared value is 0.351, indicating that ease of use (PEOU) and trust and security (TS) account for 35.1% of user confidence. Comparatively, 64.9% is impacted by other variables not examined in this research.

3.2.2. Predictive Relevance (Q^2)

The Q-square test is used to assess the feasibility of the model for the dependent variable [19], which is derived using SmartPLS blindfold computations. Based on available data, this test gives a general idea of the model's capacity to forecast data that hasn't been seen before. The greater the value, the better the model's predictive power, as the Q2 value is considered viable when it is positive. The model has to be evaluated if the Q2 is negative since it has a low predictive value. Q-squared is acceptable if the value is greater than zero, according to Ghozali [22].

Table 6. Q-Square

Variable	Q-Square
Actual System Use	0,247
Attitude towards Using Technology	0,293
Behavioral Intention to Use	0,254
Perceived Usefulness	0,187

As Table 6 shows, the Q-squared values for actual system use, attitude towards technology, behavioral desire to use, and observed usefulness are all greater than zero. This shows that the model is good at making predictions.

3.2.3. Model Fit

Using route analysis, model fit is used to show how well the model fits the data [10]. The model may need to be changed if there is a mismatch between it and the data, which suggests that the model does not adequately explain the variance in the data. This test provides an overview of the relationships between variables and the model's ability to accurately describe the data. Ghozali states that the Normed Fit Index (NFI) and the Standardized Root Mean Square Residual (SRMR) are used to evaluate how a model matches the data [22]. If a model exhibits a strong data representation (SRMR of less than 0.10 or 0.08 and an NFI of close to 1.00 or better than 0.90), it is considered fit [22].

Table 7. Model Fit

	Saturated Model	Estimated Model
SRMR	0,071	0,095
NFI	0,707	0,684

As you can see in Table 7, model's SRMR value in this research is 0.071, below the 0.080 limit, and suggests a decent match. The better the model fit, the lower the SRMR value is, or the closer it is to zero. However, the fitting of the model to the observed data becomes worse the higher the SRMR value, or well over 0.10. As it approaches the ideal value, the NFI value of 0.707, near 0.90, indicates a satisfactory degree of fit. An extremely excellent model fit is indicated by an NFI value near 1.00; a very poor fit is shown by an NFI value close to 0 or negative.

3.3. Hypothesis Test

This research aims to determine the variables affecting Indonesian users' acceptance of biometric authentication. Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Trust & Security (TS), Perceived Privacy (PP), Attitude towards Using Technology (ATU), Behavioral Intention to Use (BIU), and Actual System Use (ASU) were the variables in the TAM model used in this study for the measurement of user acceptance. The results showed that some factors significantly affect the use of biometric authentication.

The degree of importance of a hypothesis may decide whether it is accepted or rejected [19]. The comparison between the t-statistic and t-table values—which need to be higher than 1.96—is the subject of this study [19] [22]. A t-statistic result of less than 1.96 indicates that the association is either insignificant or has no impact on the situation. The p-value is also subject to a 5% significance criterion, denoted by the symbol 0.05. If the p-value is less than 0.05, the hypothesis is accepted. [22] [19] [20] [21]. P-values greater than 0.05, on the other hand, suggest that there is insufficient data to rule out H0 It means that the observed variables are not related to each other

Table 8. Path Coefficients

Variable	*Original Sample*	*T Statistics*	*P Values*	Description
PEOU -> PU	0,448	9,738	**0,000**	Accepted
PEOU -> ATU	0,173	2,999	**0,003**	Accepted
PEOU -> BIU	0,095	1,352	**0,177**	Rejected
PU -> ATU	0,248	4,482	**0,000**	Accepted
PU -> BIU	0,118	1,892	**0,059**	Rejected
TS -> PU	0,225	4,736	**0,000**	Accepted
TS -> ATU	0,353	6,330	**0,000**	Accepted
TS -> BIU	0,176	2,213	**0,027**	Accepted
PP -> ATU	0,170	2,825	**0,005**	Accepted
PP -> BIU	0,222	2,658	**0,008**	Accepted
ATU -> BIU	0,197	2,734	**0,006**	Accepted
BIU -> ASU	0,638	18,711	**0,000**	Accepted

This is Table 8, study's findings indicate a positive connection or link between each component, indicating that users are more likely to employ biometric authentication when their impression of the technology is greater. Two hypotheses, however, do not have a significant effect, which would suggest that certain variables have less of an impact on user behavior. Here is a more detailed look at each theory in Table 8.

H1: PEOU-PU: Perceived ease of use of technology significantly affects perceived usefulness.

According to the analysis's findings, perceived usefulness is positively impacted by the variable perceived ease of use. The t-statistic value of 9.652, higher than the 1.96 threshold value, suggests that the observed sample considerably impacts the relationship between perceived usefulness and ease of use. Furthermore, there is enough data to reject H0 according to the p-value of 0.000, which is less than the significance threshold of 0.05. Additionally, the positive direction of the association between the two variables is shown by the path coefficient value of 0.448.

H2: PEOU-ATU: Perceived ease of use significantly affects users' attitudes towards the technology.

The analysis's findings demonstrate that perceived ease of use significantly improves attitudes toward technology usage. The preceding table shows that the t-statistic value of 3.212 indicates a high significance level, which is more than the 1.96 threshold. Moreover, there is compelling evidence to reject H0 with a p-value of 0.001, below the significance threshold of 0.05. The positive direction of the association between the variables is confirmed by the path coefficient value of 0.173. Therefore, these findings suggest that consumers' opinions toward the adoption of biometric authentication are significantly positively impacted by ease.

H3: PEOU-BIU: Perceived ease of use significantly affects intention to use the technology.

According to the analysis, behavioral intention to use is positively but marginally impacted by perceived ease of use. The t-statistic result of 1.346, which is less than the 1.96 threshold value and indicates no significance in the association between the variables, demonstrates this. Furthermore, there is insufficient data to reject H0 since the p-value of 0.179 is higher than the significance threshold of 0.05. The association between the ease of use variable and intention to use is likely weak owing to the tiny value, even if the path coefficient value of 0.095 suggests that the direction of the relationship between the two variables is positive. The result that biometric authentication ease of use is weakly positive but has no discernible impact on intention to use is supported by this number.

H4: PU-ATU: Perceived usefulness significantly affects users' attitude towards the technology.

The investigation demonstrates that attitude toward utilizing the technology is significantly positively impacted by perceived utility. The link between usability and attitude toward usage is considerably affected by the variations between the observed samples, as shown by the t-statistic value of 4.601, which is higher than the threshold of 1.96. Additionally, there is a strong reason to reject H0 since the p-value is 0.000, which is less than the significance criterion of 0.05. Furthermore, a positive direction of the association between the variables is shown by the route coefficient value of 0.248. These findings suggest that an increase in perceived usefulness corresponds with an increase in use attitude.

H5: PU-BIU: Perceived usefulness significantly affects intention to use the technology.

The analysis's findings indicate that behavioral intention to use is positively but marginally impacted by perceived usefulness. Less below the threshold value of 1.96, the t-statistic value of 1.867 indicates no significant relationship or, to put it another way, no association between usability and intention to use. Furthermore, there is insufficient evidence to reject H0, as shown by the p-value of 0.062, which is higher than the significance threshold of 0.05. The positive direction of the association is shown by the path coefficient value of 0.118. This indicates that although there is a trend for the use intention variable to rise in proportion to the perceived usefulness variable, the data gathered do not support the notion that this link is substantial.

H6: TS-PU: User perceived trust and security significantly affect perceived usefulness.

The analysis demonstrates that the trust and security variable significantly increases perceived usefulness. The t-statistic value of 4.908, which is higher than the 1.96 threshold value, suggests that the sample substantially impacts the association between Trust & Security and Usability. There is enough data to reject H0, as shown by the p-value of 0.000, which is less than the significance threshold of 0.05. The positive direction of the association between the variables is also shown by the route coefficient value 0.225. These findings suggest that the perceived utility of biometric authentication is positively and significantly impacted by users' perceptions of its security and trustworthiness.

H7: TS-ATU: Users' perceived trust and security significantly impact their attitude towards the technology.

The analysis demonstrates that the trust and security variable significantly increases perceived usefulness. The t-statistic value of 4.908, which is higher than the 1.96 threshold value, suggests that the sample substantially impacts the association between Trust & Security and Usability. There is enough data to reject H0, as shown by the p-value of 0.000, which is less than the significance threshold of 0.05. The positive direction of the association between the variables is also shown by the route coefficient value 0.225. These findings suggest that the perceived utility of biometric authentication is positively and significantly impacted by users' perceptions of its security and trustworthiness.

H8: TS-BIU: User perceived trust and security significantly affect behavioral intention to use.

According to a study of the hypothesis test findings, behavioral intention to use is significantly positively impacted by trust and security. The t-statistic value of 2.203, which is higher than the crucial threshold of 1.96 and indicates that the variation between the observed samples considerably impacts the connection between the two variables, confirms this. There is enough data to reject H0, as shown by the p-value of 0.028, which is less than the significance threshold of 0.050. The variable association points in a positive direction, as the route coefficient value 0.176 indicates.

H9: PP-ATU: Users' perception of privacy has a significant effect on users' attitude towards technology.

The results of the hypothesis tests indicate that attitudes about technology usage are significantly positively impacted by perceived privacy. The association between privacy and attitude toward usage is considerably affected by the difference between the observed samples, as shown by the t-statistic value of 2.692, which is higher than the threshold of 1.96. With a p-value of 0.007 that is still below the significance threshold of 0.05, compelling evidence supports the hypothesis and rejects H0. Furthermore, the path coefficient value of 0.170 shows a positive association direction. This confirms the theory that views about using biometric authentication technologies are strongly favorably impacted by privacy.

H10: PP-BIU: Users' privacy perceptions significantly impact their intention to use the technology.

The analysis's findings demonstrate that behavioral intention to utilize the technology is significantly positively impacted by perceived privacy. The t-statistic value of 2.726 shows a strong significance level, which is higher than the threshold of 1.96 and represents the difference between privacy and intention to use. There is enough data to reject H0 since the p-value of 0.007 is less than the significance threshold of 0.05. Furthermore, the positive direction of the association between the two variables is shown by the path coefficient value of 0.222.

H11: ATU-BIU: User attitude significantly affects intention to use the technology.

The analysis's findings demonstrate that behavioral intention to utilize technology is substantially favorably impacted by attitude. The t-statistic value of 2.679, which is more than the 1.96 threshold and supports this, shows that the differences between the observed samples considerably impact the link between attitude and intention to use the technology. Furthermore, there is substantial support for rejecting H0 since the p-value of 0.008 is still below the significance threshold of 0.05. With a path coefficient of 0.197, it can be concluded that there is a positive association between the variables. This confirms the hypothesis that the intention to employ biometric authentication technology is favorably influenced by user attitude.

H12: BIU-ASU: Intention to use the technology significantly affects actual system usage.

The analysis's findings demonstrate that actual system utilization is significantly positively impacted by behavioral intention to use. This is supported by the t-statistic value of 19.132, which is much higher than the 1.96 threshold and shows a high degree of significance in the sample's difference between intention and actual use. Furthermore, there is sufficient evidence to reject H0 according to the p-value of 0.000, which is less than the significance criterion of 0.05. The direction of the association between intention and actual system usage is categorized as very positive, with a path coefficient value of 0.638.

4. DISCUSSION

This study uses the Technology Acceptance Model (TAM) to explore the factors that influence user acceptance of biometric authentication technology. The analysis results show that attitude, perceived privacy, trust, and security have a more significant influence on users' intention to adopt biometric authentication technology than perceived usefulness and ease of use. This finding aligns with previous research emphasizing the importance of trust and privacy in technology acceptance. Privacy concerns were shown to affect users' trust in biometric technology significantly.

This study extends the traditional TAM factors by integrating the influence of privacy, security, and trust, which are less emphasized in previous studies. For example, the TAM model by Davis (1989) focuses on perceived usefulness and ease of use, but this study shows the need to include security, trust, and privacy factors in the model. This highlights the importance of technology acceptance models that are adaptive to new factors influencing user behavior.

The findings provide important insights for biometric technology developers to increase the adoption of information technology. Strong privacy and security measures can significantly improve user attitudes and intentions, facilitating wider acceptance and use of biometric technology.

The results of the study indicate that there is a positive association or correlation between the factors, meaning that as the user's perception increases, the likelihood of using biometric authentication increases. However, two hypotheses fail to demonstrate a statistically significant impact, suggesting that there may be specific elements that have a limited impact on user behaviour.

There was a significant correlation between reported ease of use and perceived usefulness. When consumers find biometric authentication easy to use, they are more likely to view the technology as very useful. Perceived ease of use has a positive impact on users' confidence in the technology's ability to achieve their goals. This finding is consistent with research conducted by Rukhiran, M. et al. [3], Wahid, L. O. A. et al.[6], Nakisa, B. et al. [10], and Wang, Q. et al. [7]. These studies confirm that the perceived convenience of biometric authentication technology has a significant impact on its perceived usefulness.

The second finding on the relationship between perceived convenience and users' attitudes towards the technology shows a significant impact. Users generally have a positive attitude towards biometric authentication when they perceive the technology to be easy to use. In contrast, when consumers experience challenges in using biometric authentication, they are likely to develop a negative attitude towards the technology. This study uncovered a novel finding that the perceived ease of use of biometric authentication has a significant impact on users' attitudes towards the adoption of biometric authentication. Previous studies suggest that the perception of ease of use has a strong and positive impact on user sentiment. These issues are addressed in research on augmented reality [22] and online lending technologies [20]. However, previous studies have yet to directly investigate the relationship between the usability of biometric autentication technologies and user opinion.

The third finding shows that the level of usability has little impact on the propensity to use biometric authentication technology. This finding suggests that the primary motivator for consumers to experiment with and adopt new technologies is not the ease of biometric autentication. While people may find the technology easy to use, they may need a stronger inclination to use it. This may be due to other variables that influence user choice. This finding is consistent with research by Rukhiran M et al. [3] and Stylios I et al. [8], which indicate that perceived ease of use does not have a positive impact on the behavioural propensity to use biometric authentication. This suggests that there may be other factors that have a more significant influence in shaping the user's intention to adopt biometric authentication technology. However, a separate study by Wang, Q. et al. [7] found that perceived ease of use had a significant impact on user intention to use, perhaps due to differences in user characteristics.

The fourth finding on the relationship between perceived usefulness and users' attitudes towards the technology shows a significant impact. Users who perceive biometric authentication technology to be very useful are more likely to have a favourable attitude towards its use. The perceived usefulness of the technology can significantly influence user attitudes towards the adoption of biometric authentication technologies. These findings are consistent with other studies conducted by Wahid, L. O. A., et al. [6] and Nakisa, B. et al. [10], which show that usability has a significant impact on user attitudes towards a product or system.

The fifth finding is that the usability of biometric authentication technology has little impact on the intention to use it. While people recognise the significant benefits of biometric autentication, this only sometimes translates into a greater inclination or preference actually to use it. This phenomenon may occur when the level of usability is insufficient to influence user intentions significantly, and other elements contribute to the outcome. This conclusion contrasts with the studies by Rukhiran, M, et al. [3], Wahid L. O. A. et al. [6], Wang Q. et al. [7], and Stylios, I et al. [8], who concluded that perceived usefulness had a significant positive effect on behavioural intention to use. This suggests that there is variability in the impact of perceived usefulness on the intention to use authentication, perhaps due to differences in the technical characteristics and demographics of the study samples.

The sixth finding, regarding users' perceptions of trust and security on perceived usefulness, showed a significant effect. Perceived usefulness increases in direct proportion to the level of trust and security experienced by users. Users' perceptions of the usefulness of a technology are enhanced when they have a sense of trust and confidence in its security. This finding is consistent with other research by Rukhiran M. et al. [3], Wahid, L. O. A. et al. [6], and Stylios I. et al. [8], which demonstrate that trust and security have an impact on the perceived usefulness of technology. Efforts to build trust and increase users' perceptions of security in biometric authentication can influence the effectiveness of the technology and help increase user acceptance of biometric-based authentication technology.

The seventh finding, which relates to users' perceptions of trust and security, shows a significant impact. The level of trust and security experienced by consumers has a significant impact on their attitudes towards biometric authentication technologies. As the level of trust and security experienced by consumers increases, their attitude towards the use of biometric authentication technology becomes more favourable. These findings are consistent with the studies by Rukhiran, M. et al. [3] and Nakisa, B. et al. [10], who found that trust and security have a direct and positive impact on attitude.

The eighth finding about the relationship between users' perceptions of trust and security and their behavioural intention to use biometric authentication technology has a significant impact. The trustworthiness and security of biometric authentication have a significant impact on people's propensity to adopt the technology. Users are more likely to be inspired to use biometric authentication technology if they perceive it to be reliable and secure. This is consistent with the findings of Stylios et al. [8], who claim that trust plays a significant role in influencing users' desire to use biometrics. However, some studies provide opposing results, such as the research conducted by Rukhiran M et al. [3], which concluded that trust and security did not have a positive impact on adoption intentions. This suggests that several other variables could influence the results of the research, including demographic and technical attributes.

Users' views on privacy have a significant impact on their attitudes towards technology, as shown in the ninth finding. Users often show a positive attitude towards the use of biometric authentication when they perceive that their personal information is protected and maintained. Users' perceptions of strong privacy protection positively influence their attitudes towards the technology they use. This conclusion is in line with the study conducted by Wang, J.S [9], which indicates that the privacy of facial recognition technology ranks higher in terms of user behaviour. This shows that privacy concerns play a significant role in shaping user attitudes towards biometric authentication technologies.

The tens finding, which relates privacy to the desire to use the technology, has a notable impact. This shows that increasing the sense of privacy experienced by users during biometric authentication results in an increased inclination or preference to use biometric authentication. There has been no previous research into privacy factors in relation to user acceptance of biometric authentication technologies. This research highlights a need for improvement in the existing body of knowledge by enhancing our understanding of the elements that influence the acceptability of biometric autentication technologies.

The eleventh finding, the relationship between user attitude and desire to use the technology, had a significant impact. Based on this finding, consumers' favourable attitude towards technology increases their willingness to use biometric authentication technology. An optimistic attitude can act as a motivating force for individuals to explore and adopt new advances such as biometric autentication actively. However, this finding contradicts the study by Rukhiran M et al. [3], which shows that attitudes do not have a significant impact on the desire to use biometric authentication. These findings suggest that the impact of attitudes on the intention to use the technology may vary according to different demographic parameters. In addition, Wahid, L. O. A. et al. [6] and Nakisa, B. et al. [10] have conducted research on authentication that supports the conclusion that user attitude influences the user's desire to use biometric authentication.

The twelfth finding on the correlation between the desire to use the technology and the actual use of the system showed the most significant impact. This shows that those with a strong desire to use the technology are more likely to be motivated and take the necessary steps to put their desire into practice. The study conducted by Widyaretno N et al. [1] and Rukhiran M. et al. [3] provides evidence that users' behavioural intentions towards the actual use of biometric authentication are significantly positively influenced. The Technology Acceptance Model (TAM) posits that user enjoyment and perceived ease of use are influential factors in determining user behaviour intentions, which in turn serve as the primary motivators for adopting new technologies.

In summary, the results of this research are unique and original. The low correlation between usability and intention to use results in findings that contradict previous studies that have shown a significant impact of usability on intention to use. This may be due to differences in demographics. In addition, previous research on biometric authentication has shown no correlation between ease of use and user attitude or between privacy and intention to use. This study suggests that criteria previously thought to be important in determining the desire to use the technology may only be universally applicable across some demographic and cultural situations.

These findings provide new perspectives on how demographic factors may significantly influence consumer perceptions and attitudes towards emerging technologies. However, this study has some limitations. First, the sample may not be representative of the wider population. Second, using surveys as the primary method may lead to respondent bias. Third, the TAM model used may still not cover all relevant factors. In addition, this study is cross-sectional, so it does not consider changes in user attitudes over time.

This study successfully highlighted the critical role of attitude, privacy perception, trust, and security in the acceptance of biometric technology. However, gaps need to be bridged to understand more comprehensively the factors that influence this technology's acceptance. Future research must overcome these limitations and conduct a more in-depth analysis of different biometric technologies, such as fingerprinting, facial recognition, and iris scanning, to provide more specific and applicable insights.

5. CONCLUSION

This study examines how users feel about biometric identity technology by looking at the factors that influence their likelihood of using it. When it comes to the acceptance of biometrics autentication technology in Indonesia, the results show that the desire to use it has the greatest impact on the actual use of the system. Two theories were tested in this study: perceived ease of use (PEOU) and perceived value (PU). Although these two factors improved things, they did not affect the desire to use the technology. This could be because the people in the study group came from different backgrounds. This study adds privacy variables as an important factor in biometrics autentiction, which adds to what is known about how people accept new technologies.

Although PU and PEOU are part of the Technology Acceptance Model (TAM), in this case, Attitude to Use (ATU), Trust and Security (TS) and Perceived Privacy (PP) are more important when it comes to users' decisions to use biometric autentication technology (BIU). Privacy strongly impacts the willingness to use, which shows the importance of considering privacy issues when developing biometrics technology. Security factors are also a key driver in technology acceptance, with users' confidence in personal data protection strongly influencing their intention to adopt this technology. This study shows how important it is to think about new things like privacy, trust and security when developing biometric identity technology and making it available to people. As a result, biometrics autentication technology will likely become more popular and useful, making things safer and more enjoyable for users.

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