Jurnal Pekommas Vol. 9 No. 2, December 2024: 295 – 307

A Digital Lifeline: User Acceptance of Coronary Heart Disease Detection Apps

Sebuah Jalur Hidup Digital: Penerimaan Pengguna Terhadap Aplikasi Deteksi Penyakit Jantung Koroner

Liza Wikarsa[1)], Junaidy Budi Sanger[2)], Angelica Theresia Taulu

[1,2,3] Program Studi Teknik Informatika, Fakultas Teknik, Universitas Katolik De La Salle Manado
[1,2,3] Kairagi I Kombos Manado, Belakang Wenang Permai II, Manado, 95000, Telp: 0431-813148, Fax: 0431-813160

lwikarsa@unikadelasalle.ac.id[1)], jsanger@unikadelasalle.ac.id[2)], 18013083@unikadelasalle.ac.id

Received: 10 October 2024 || Revised: 18 October 2024 || Accepted: 18 November 2024

Abstract – *Cardiovascular disease, especially coronary heart disease (CHD), is the leading cause of death globally, with Indonesia, particularly North Sulawesi, experiencing significant prevalence due to unhealthy lifestyles. This study aims to assess the adoption and utilization of an early detection application for CHD among residents of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish in Manado. It also seeks to identify opportunities for enhancing user experiences with the application using the Technology Acceptance Model (TAM). TAM includes constructs like perceived usefulness (PU), perceived ease of use (PEU), attitude towards use (ATU), behavioral intention to use (BIU), actual system use (ASU), and three external variables: information quality (PUIQ), service quality (PEUSVQ), and system quality (PEUSQ). This study uses the Partial Least Square (PLS) approach for data analysis. The results confirmed that all measures effectively assess their intended constructs. Strong correlations among the constructs demonstrate solid internal consistency. Regarding reliability, all constructs demonstrate acceptable consistency. Regarding theoretical and practical implications, the study enhances the TAM model, providing a deeper understanding of factors influencing health technology adoption. Its findings can refine future research, improve the CHD early detection application, inform public health initiatives, and shape supportive health policies, ultimately benefiting individuals at risk of coronary heart disease.*

Keywords: *Coronary Heart Disease, North Sulawesi, Technology Acceptance Model, PLS, Statistical Analysis*

Abstrak – Penyakit kardiovaskular, terutama penyakit jantung koroner (PJK), merupakan penyebab utama kematian di dunia, dan di Indonesia, khususnya di Sulawesi Utara, prevalensinya cukup tinggi karena gaya hidup yang tidak sehat. Penelitian ini bertujuan untuk menilai adopsi dan pemanfaatan aplikasi deteksi dini PJK di antara penduduk di Wilayah Rohani Paroki Katedral Hati Kudus Maria di Manado. Penelitian ini juga bertujuan untuk mengidentifikasi peluang untuk meningkatkan pengalaman pengguna dengan aplikasi menggunakan *Technology Acceptance Model* (TAM). TAM mencakup konstruk seperti persepsi kegunaan (PU), persepsi kemudahan penggunaan (PEU), sikap terhadap penggunaan (ATU), niat perilaku untuk menggunakan (BIU), penggunaan sistem aktual (ASU), dan tiga variabel eksternal: kualitas informasi (PUIQ), kualitas layanan (PEUSVQ), dan kualitas sistem (PEUSQ). Studi penelitian ini menggunakan pendekatan *Partial Least Square* (PLS) untuk analisis data. Hasilnya menunjukkan bahwa semua ukuran secara efektif menilai konstruk yang dimaksudkan. Korelasi yang kuat di antara konstruk-konstruk tersebut menunjukkan konsistensi internal yang kuat. Mengenai reliabilitas, semua konstruk menunjukkan konsistensi yang dapat diterima. Implikasi teoretis dan praktis dari penelitian ini adalah menyempurnakan model TAM, memberikan pemahaman yang lebih dalam tentang faktor-faktor yang memengaruhi adopsi teknologi kesehatan. Temuannya dapat menyempurnakan penelitian di masa depan, meningkatkan aplikasi deteksi dini PJK, menginformasikan inisiatif kesehatan masyarakat, dan membentuk kebijakan kesehatan yang mendukung, yang pada akhirnya bermanfaat bagi individu yang berisiko terkena penyakit jantung koroner.

Kata Kunci: *Penyakit Jantung Koroner, Sulawesi Utara, Model Penerimaan Teknologi, PLS, Analisis Statistik*

INTRODUCTION

Cardiovascular diseases are a medical situation arises when the coronary arteries, which are the vessels responsible for delivering oxygen-rich blood to the heart muscle, undergo narrowing or blockage (Asikin, Susaldi, & Nuralamsyah, 2016; Pranata & Prabowo, 2017). According to data released by the World Health Organization (WHO) in 2023, Cardiovascular diseases

doi: 10.56873/jpkm.v9i2.5826

have become the primary cause of death worldwide, accounting for an estimated annual mortality rate of 17.8 million. In line with this, data from the Indonesian Ministry of Health indicated that the annual mortality rate attributed to this condition reached 650,000 individuals in Indonesia in 2023 (Brawijaya, 2023; Ulya & Santosa, 2023).

Among the various cardiovascular diseases contributing to global mortality, coronary heart disease (CHD) is noteworthy (Mylano, 2023). Mylano and Wahyuni et al. (2022) explained that CHD occurs when the coronary arteries, responsible for supplying blood to the heart, become blocked due to the accumulation of fatty deposits. With the progression of fat build-up, the arteries gradually narrow, leading to a reduction in blood flow to the heart (Hastuti, 2022). Data from the Basic Health Research (Riskesdas) conducted in 2018 reveals that the prevalence of CHD diagnosed by physicians in Indonesia is 1.5% nationally and 1.8% in North Sulawesi (Widyawati, 2021). She also pointed out that 50% of CHD patients are at risk of sudden cardiac death.

Although CHD is a leading cause of death worldwide, it can often be managed or prevented through lifestyle changes, medications, and medical procedures such as angioplasty or coronary artery bypass surgery (Association, 2023; MyHealth London, 2024; Cleveland Clinic, 2023). Hence, early detection and management of risk factors are crucial in reducing the risk of complications associated with CHD. Recognizing the risks associated with coronary heart disease (CHD), a web-based application was developed where users must respond to health-related questions relevant to their condition. Thus, the application will detect the risk level of coronary heart disease for the users that are categorized into three, such as low level risk, medium level, and high level. Furthermore, the users can see the statistical analysis of the risk level of people of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado. This Cathedral has 1,846 parishioners in 16 spiritual territories in Manado city.

Due to the significance of the CHD early detection application, the acceptance and usage of the application are evaluated using the technology acceptance model (TAM) that has been widely used in practices and research (Portz et al., 2019; Andi, Dewi, & As'adi, 2021; Yang, Goh, & Dai, 2024; Panagoulias, Virvou, & Tsihrintzis, 2024). TAM uses several constructs to assess users' intention to use the technology, namely perceived usefulness (PU), perceived ease of use (PEU), attitude towards usage (ATU), behavior intention to use (BIU), actual system use (ASU), and external variables (Nakisa et al., 2023; Bandinelli et al., 2023; Saif et al., 2024). TAM posits that PU directly and positively influences BIU, whereas PEU has both a direct and indirect positive impact on a user's intention to adopt technologies. Meanwhile, PEU directly impacts PU, thus indirectly and directly driving BIU. In other words, PU and PEU impact ATU, which subsequently affects BIU, thereby influencing ASU (Ujakpa & Heukelman, 2018). In this research, there are three external variables used, namely Information Quality (PUIQ), Service Quality (PEUSVQ), and System Quality (PEUSQ). IQ is directly impacting PU while PEU is influenced by PEUSVQ and PEUSQ.

The objectives of this study were to evaluate the acceptance and usage of the CHD early detection application among the people of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado, and to identify potential enhancements to improve user experiences with the application. The structure of this paper is in the following order: 1) introduction to the research background, 2) research method to entail how this research was conducted systematically, 3) results and discussion to elaborate the findings, and lastly 4) conclusions and future works.

RESEARCH METHOD

Research Participants

The research participants included 46 men and 74 women who are parishioners residing in 16 spiritual territories within the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado.

TAM Framework

Figure 1 will depict the constructs used in this research and how these variables are related to one another.

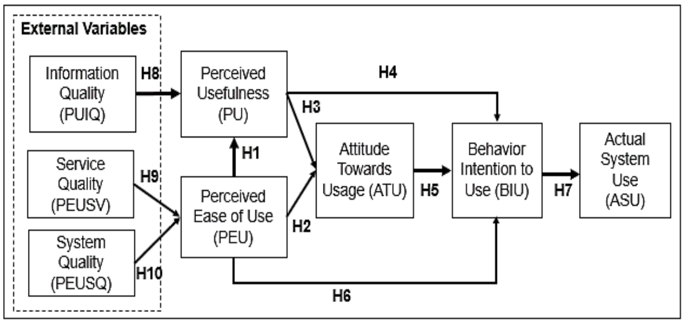


Figure 1 The Technology Acceptance Model Framework

Based on the TAM framework above, the following hypotheses for this research were formulated:

1. PEU directly and positively affects PU to use the Coronary heart disease early detection application.
2. PEU directly and positively affects ATU to use the Coronary heart disease early detection application.
3. PU directly and positively affects ATU to use the Coronary heart disease early detection application.
4. PU indirectly and positively affects BIU to use the Coronary heart disease early detection application.
5. ATU directly and positively affects BIU to use the Coronary heart disease early detection application.
6. PEU indirectly affects and positively BIU to use the Coronary heart disease early detection application.
7. BIU directly and positively ASU to use the Coronary heart disease early detection application.
8. PUIQ directly and positively affects PU to use the Coronary heart disease early detection application.
9. PEUSV directly and positively affects PEU to use the Coronary heart disease early detection application
10. PEUSQ directly and positively affects PEU to use the Coronary heart disease early detection application

Table 1 enlists all the constructs and their definitions used in this research.

Table 1 Research Constructs and Definition

Construct	Definition
PU (Andi, Dewi, & As'adi, 2021).	The extent to which an individual believes that their performance will enhance through the utilization of the system
PEU (Andi, Dewi, & As'adi, 2021).	The extent to which an individual believes that using the system will be straightforward or require minimal effort
ATU (Ujakpa & Heukelman, 2018)	Refers to how each individual assesses and links the target system
BIU (Bandinelli et al., 2023).	The inclination of an individual to utilize a specific technology is determined by their attitudes toward the technology, perceived usefulness, and perceived ease of use
ASU (Andi, Dewi, & As'adi, 2021)	Denotes the practical adoption and usage of a specific technology by individuals, which is impacted by their intention to use the technology and various other factors. ASU is determined by the frequency and duration of interactions with the technology, indicating repeated and more frequent use of the technology.

Table 2 contains the constructs, codes, variables for each construct, and related questions (item).

Table 2 Research Constructs and Variables

No	Construct	Code	Variable	Item
1	**Perceived Usefulness (PU)**	PU1	Control	This application would enable me to use it without time and place restrictions.
2		PU2	Perfor-mance	I feel that this application makes it easier for me to find information related to potential risks and ways to prevent coronary heart disease.
3		PU3	Effective-ness	I can find pertinent information about Coronary heart disease in this application.

No	Construct	Code	Variable	Item
4	**Perceived Ease of Use (PEU)**	PEU1	Easiness	I feel this application is easy to use.
5		PEU2	Compu-ter literacy	The instruction on how to use the application is understandable.
6		PEU3		I feel that my interaction with the application is straight forward.
7		PEU4	Flexibility	I would find this application to be flexible to interact with.
8	**Attitude Towards Usage (ATU)**	ATU 1	Influence	This application gives good influences as it can increase awareness of the risks of Coronary heart disease
9		ATU 2	Favorabi-lity	It is a great idea to use the application to enhance my knowledge about Coronary heart disease.
10		ATU 3	Conscious ness (value)	Using this application, it can improve my lifestyle and health.
11		ATU 4		I feel more confident to avoid the risk factors for Coronary heart disease
12	**Service Quality (PEUSV)**	PEUS V1	Suitability	I found this application design is appropriate with the Coronary heart disease.
13		PEUS V2	Vizualiza-tion	I think the application design has provided clear visualization for information display and navigation
14		PEUS V3	Consisten-cy	I found this application design is consistent.
15		PEUS V4	Self-efficacy	I do not need assistance while using the application due to its easy navigation.
16	**System Quality (PEUSQ)**	PEUS Q1	Clarity	My interaction with this application is easy due to clear instruction.
17		PEUS Q2	Response time	The response time when the system detects the risk level of coronary heart disease based on my answers to the questionnaire is acceptable.
18	**Informatio n Quality (PUIQ)**	PUIQ 1	Applica-tion content	I found the application content is understandable and timely.
19		PUIQ 2	Trust in content	I believe in the information provided in the application as it gathered from reliable and trustable sources.
20		PUIQ 3	Knowl-edge	I like the presentation of information pertinent to the Coronary heart disease in this application
21	**Behavioral Intention to Use (BIU)**	BIU1	Future Usage	I plan to use this application in the future.
22		BIU2	Accessi-bility	I intend to use this application should I have access to it.
23	**Actual System Use**	ASU 1	Frequency	I frequently engage with the Kolintang instrument to explore different playing styles

No	Construct	Code	Variable	Item
				and improve my musical creativity.
		ASU 2	Duration	I will dedicate substantial time to practicing with the Kolintang instrument to maintain and improve my proficiency level

Scaling and Measurement

A 5-point Likert scale was employed to assess the participants' opinions for each of the 22 questions in the questionnaire. Meanwhile, the measurement model is analyzed in terms of convergent validity, AVE, discriminant validity, and reliability test. The convergent validity is used to identify the correlation between reflexive variable scores and their latent variable scores. In this research, the scale items' convergent validity was assessed using composite reliability (CR) and Average Variance Extracted (AVE). To establish convergent validity, the CR value should exceed the benchmark of 0.70, and the AVE value should surpass the threshold of 0.50 (Nakisa et al., 2023). The discriminant validity is a measurement that evaluates how much one measure does not correlate with measures of different constructs (Röcker & Schöler, 2022; Hair et al., 2022). In addition, this research utilized Cronbach's Alpha to assess the internal consistency of the instrument, which involves evaluating the proximity or intercorrelation among the items within a group (Taber, 2018).

Data Analysis

This study uses PLS for data analysis due to the non-normal distribution of data and the relatively small sample size (typically recommended between 30 and 100) (Sarstedt et al., 2020) PLS serves the purpose of confirming theories and elucidating the presence or absence of relationships between variables (Hair et al., 2023). PLS is a powerful analysis method because it does not rely on numerous assumptions.

System Analysis

Problems Identification

1. There are only a few parishioners of the Sacred Heart of Mary Cathedral Manado who had ever had a heart check.
2. There has never been a survey on the level of risk of CHD in parishioners of the Sacred Heart of Mary Cathedral Manado.
3. The level of awareness and understanding of the parishioners of the Sacred Heart of Mary Cathedral Manado about coronary heart disease is still low.

To solve these problems, a web-based application was built that can detect early CHD in the spiritual area of the Sacred Heart of Mary Cathedral Parish Manado using the K-Means method. Chest pain, nausea, shortness of breath, heartburn, history of hypertension, obesity, history of diabetes, and genetics are the eight initial symptoms used as independent variables. Meanwhile, the study's dependent variables consist of three categories of CHD risk levels identified as Cluster 1 (low risk), Cluster 2 (medium risk), and Cluster 3 (high risk) based on previous research findings.

Analysis of Targeted Users

Table 3 enlists the targeted users that have different access to the application.

Table 3 Targeted Application Users

Targeted Users	Application Access
People of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado as application users	1. Fill out the questionnaire. 2. View questionnaire results. 3. View CHD risk statistics. 4. View information about CHD.
Parish Secretariat as administrator of the CHD early detection application	1. Upload parishioner data in CSV form. 2. View the uploaded parishioner data. 3. View the calculation result 4. View CHD risk statistics. 5. Add and deleted information about CHD. 6. View information about a CHD.

Design

Unified Modeling Language was used to model the application development. Figure 2 illustrates how the user engages with the application, which offers multiple functionalities for user selection. On the homepage, the application user and staff spiritual region can see the CHD risk statistics in his/her respective spiritual region and the whole parish. Each staff member in every spiritual region can upload a CSV file containing data on the eight symptoms experienced by individuals in that region. For an individual application user, he/she has to fill out a questionnaire to answer the symptoms. The application will show all the user's inputted answers before processing them. Then, if the user or the staff is ready to process, he/she can press the Process button. Once it was done, the application uses the K-Means method to process the data. Later, both types of users can view the displayed detection results. In addition, they can also export the detection results in the form of a PDF file.

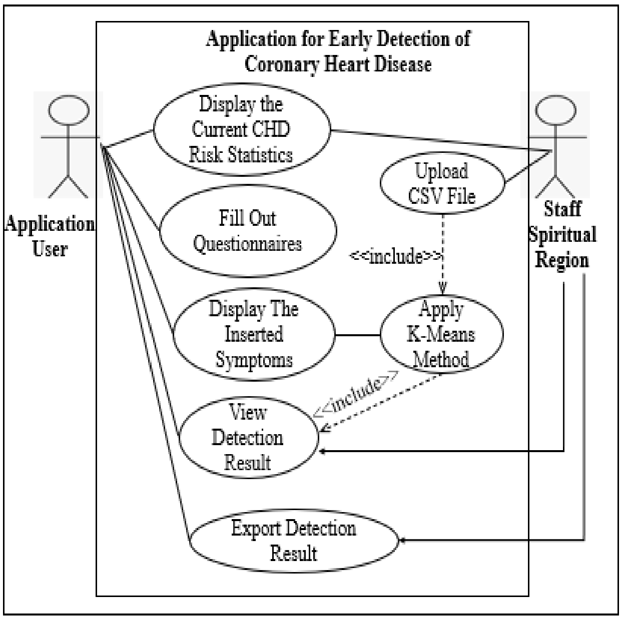


Figure 2 Use Case Diagram of The Application

Implementation

Table 4 has the hardware and software specifications for the application development.

Table 4 Hardware and Software Specifications

A. Hardware	
Processor	AMD A9-9420 RADEON R5, 5 Computer Cores 2C+3G 3.00 GHz
Memory	8GB RAM DDR3
B. Software	
Programming Language	HTML, PHP, JavaScript
Localhost	XAMPP
Database Management System	MariaDB
Other Software	Google Chrome 119.0.6045.124 Microsoft Office 365

Database

Figure 3 shows one of the tables in the database for the application.

#	Name	Type	Collation	Attributes	Null
1	id	bigint(20)		UNSIGNED	No
2	wilayah_rohani	varchar(255)	utf8mb4_unicode_ci		No
3	usia	varchar(255)	utf8mb4_unicode_ci		No
4	jenis_kelamin	varchar(255)	utf8mb4_unicode_ci		No
5	tinggi_badan	varchar(255)	utf8mb4_unicode_ci		No
6	berat_badan	varchar(255)	utf8mb4_unicode_ci		No
7	paham_pjk	varchar(255)	utf8mb4_unicode_ci		No
8	checkup	varchar(255)	utf8mb4_unicode_ci		No
9	nyeri_dada	varchar(255)	utf8mb4_unicode_ci		No
10	mual	varchar(255)	utf8mb4_unicode_ci		No
11	sesak_napas	varchar(255)	utf8mb4_unicode_ci		No
12	nyeri_uluhati	varchar(255)	utf8mb4_unicode_ci		No
13	hipertensi	varchar(255)	utf8mb4_unicode_ci		No
14	obesitas	varchar(255)	utf8mb4_unicode_ci		No
15	diabetes	varchar(255)	utf8mb4_unicode_ci		No
16	genetika	varchar(255)	utf8mb4_unicode_ci		No
17	c	varchar(255)	utf8mb4_unicode_ci		Yes
18	c2	varchar(255)	utf8mb4_unicode_ci		Yes
19	created_at	timestamp			Yes
20	updated_at	timestamp			Yes

Figure 3 Database Implementation

This table is used to save all the data related to the symptoms experienced by the users that are inserted into the questionnaire and the CSV file uploaded by the staff at the spiritual region.

Application Interfaces

Figure 4-7 are just a few interfaces provided in the application. As previously stated, this application allows both users and staff in spiritual regions to obtain coronary heart disease (CHD) results based on the symptoms entered. There are other functionalities included in this application in the form of statistical outcomes that are important to look at.

Figure 4 The Homepage

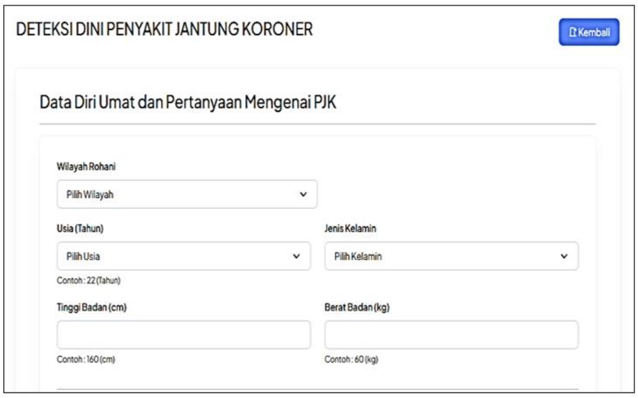
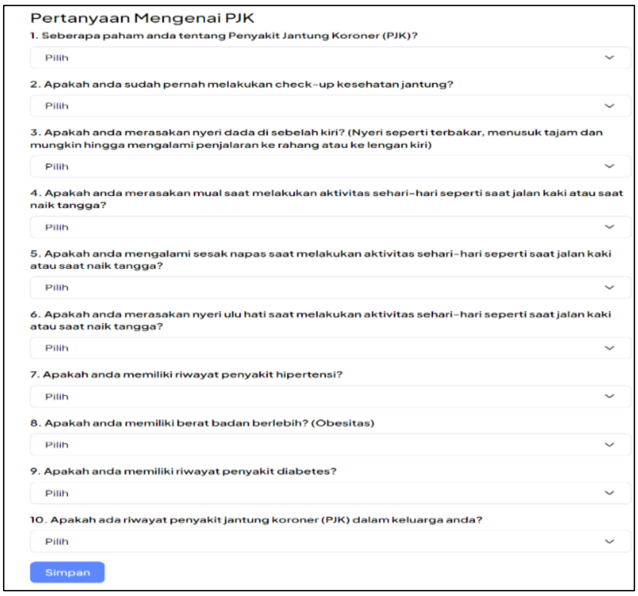


Figure 5 The User Profile

Figure 6 The Questionnaire



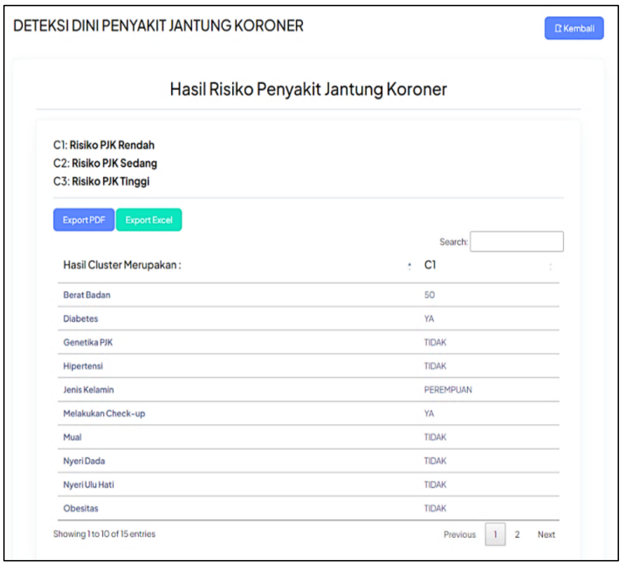


Figure 7 The Detection Result Using the K-Means Method

RESULTS AND DISCUSSION

Descriptive Analysis

The following table entails the results of the descriptive analysis.

Table 5 Descriptive Analysis

Variable	Min	Max	Total	Ave	Std.Dev
PU1	1	3	179	1.48	0.517
PU2	1	3	196	1.62	0.512
PU3	1	2	202	1.67	0.513
PEU1	1	3	183	1.51	0.530
PEU2	1	4	195	1.61	0.483
PEU3	1	2	178	1.47	0.517
PEU4	1	3	195	1.61	0.554
ATU1	1	2	184	1.52	0.469
ATU2	1	3	199	1.64	0.511
ATU3	1	2	179	1.48	0.472
ATU4	1	3	196	1.62	0.496
PEUSV1	2	2	181	1.5	0.516
PEUSV2	1	3	198	1.64	0.541
PEUSV3	2	2	177	1.46	0.497
PEUSV4	1	3	195	1.61	0.483
PEUSQ1	1	2	199	1.64	0.481
PEUSQ2	1	2	179	1.48	0.491
PUIQ1	1	3	186	1.54	0.548
PUIQ2	1	3	179	1.48	0.500
PUIQ3	1	3	196	1.62	0.496
BIU1	1	2	179	1.48	0.579
BIU2	1	4	194	1.6	0.491

Variable	Min	Max	Total	Ave	Std.Dev
ASU1	1	2	175	1.45	0.547
ASU2	1	3	194	1.60	0.491

Table 5 shows the highest and lowest values for each variable, with the variable BIU1 and ASU1 having the lowest minimum of 1 and a maximum value of 4 for each variable. This indicates that BIU1 and ASU1 exhibit less variability than the other variables, with values tightly clustered within a narrow range. This suggests consistent performance or measurement outcomes within a limited band. On the other hand, the total score for each variable ranges from 175 for ASU1, the lowest, to 202 for PU3, the highest. This suggests significant disparities in the overall performance or measurement outcomes represented by these variables.

The average score for each variable ranges from 1.446 to 1.67. Such a disparity suggests that some variables may have scores concentrated around higher values (closer to 1.67), while others are closer to lower values (around 1.446). This indicates varied central tendencies among the variables, reflecting differing levels or intensities of performance or measurement characteristics. Lastly, the standard deviation for each variable ranges from 0.481 to 0.579. The higher standard deviation (0.579) suggests greater variability, whereas a lower standard deviation (0.481) indicates scores are more tightly clustered around the mean. Also, it shows the differences in the spread or dispersion of scores around the mean for each variable, providing insights into the consistency or variability of the measured outcomes. These results highlight the diversity in measurement outcomes, performance levels, and variation among various variables. They underscore the importance of considering these statistical measures collectively to gain a comprehensive understanding of the data and its implications.

Analysis of the Measurement Model

The measurement model is analyzed in terms of convergent validity, AVE, discriminant validity, and reliability test.

Convergent Validity

Convergent validity is a measure that indicates its ability to accurately assess its intended target by demonstrating significant correlations with other measures that evaluate either the same construct or closely related constructs (Hancock & Mueller, 2021). Figure 8 demonstrates the result of the convergent validity of this research.

	Actual System Use (ASU)	Attitude Toward Usage (ATU)	Behavioral Intentiom to Use (BIU)	Information Quality (PUIQ)	Perceived Ease of Use (PEU)	Perceived Usefulness (PU)	Service Quality (PEUSV)	System Quality (PEUSQ)
ASU1	0.87							
ASU2	0.885							
ATU1		0.747						
ATU2		0.859						
ATU3		0.802						
ATU4		0.868						
BIU1			0.847					
BIU2			0.883					
PEU1					0.815			
PEU2					0.881			
PEU3					0.806			
PEU4					0.873			
PEUSQ1								0.85
PEUSQ2								0.836
PEUSV1							0.807	
PEUSV2							0.84	
PEUSV3							0.87	
PEUSV4							0.873	
PU1						0.787		
PU2						0.888		
PU3						0.83		
PUIQ1				0.804				
PUIQ2				0.905				
PUIQ3				0.795				

Figure 8 The Values of Factor Loading Variables

Based on the output results, the loading factor values for ASU1 and ASU2 variables exceed 0.5, indicating that these two variables effectively measure the ASU construct. Similarly, the loading factor values for the variables of other constructs exceed 0.5, affirming the validity of all variables in measuring their respective constructs as depicted in Figure 8.

Average Variance Extracted (AVE)

AVE indicates how well the variables of a latent variable represents that variable. AVE ranges from 0 to 1, where a higher value indicates that the variance captured by the latent variable is greater relative to the measurement error. An AVE value of 0.5 or higher indicates acceptable convergent validity, suggesting that the variables adequately represent the latent variable (Hair et al., 2023).

Table 6 The AVE Values

Construct	AVE	Validity
ASU	0.77	Valid
ATU	0.673	Valid
BIU	0.749	Valid
PUIQ	0.699	Valid
PEU	0.714	Valid
PU	0.699	Valid
PEUSV	0.719	Valid
PEUSQ	0.711	Valid

All the constructs in Table 6 show values above 0.5, indicating that the variables for each construct effectively represent and measure their respective constructs.

Discriminant Validity

Figure 9 shows the values of factor-loading variables that play an important role in the discriminant validity. High factor loadings on intended constructs indicate that the observed variables accurately measure the specific construct they are intended to represent, thereby supporting discriminant validity.

	ASU	ATU	BIU	PUIQ	PEU	PU	PEUSV	PEUSQ
ASU1	0.87	0.828	0.832	0.875	0.837	0.756	0.847	0.835
ASU2	0.885	0.863	0.883	0.801	0.881	0.897	0.873	0.839
ATU1	0.694	0.747	0.659	0.73	0.693	0.581	0.665	0.735
ATU2	0.801	0.859	0.798	0.727	0.797	0.799	0.808	0.763
ATU3	0.808	0.802	0.771	0.835	0.78	0.723	0.788	0.8
ATU4	0.851	0.868	0.849	0.763	0.852	0.857	0.864	0.8
BIU1	0.804	0.762	0.847	0.798	0.772	0.696	0.781	0.769
BIU2	0.885	0.863	0.883	0.801	0.881	0.897	0.873	0.839
PEU1	0.759	0.749	0.725	0.795	0.815	0.661	0.781	0.749
PEU2	0.868	0.843	0.866	0.782	0.881	0.877	0.864	0.841
PEU3	0.808	0.775	0.771	0.832	0.806	0.721	0.808	0.823
PEU4	0.868	0.851	0.866	0.792	0.873	0.892	0.854	0.841
PEUSQ1	0.801	0.799	0.798	0.717	0.829	0.814	0.8	0.85
PEUSQ2	0.808	0.791	0.771	0.839	0.797	0.736	0.806	0.836
PEUSV1	0.769	0.771	0.732	0.807	0.77	0.692	0.807	0.756
PEUSV2	0.818	0.782	0.815	0.752	0.836	0.818	0.84	0.804
PEUSV3	0.867	0.824	0.831	0.897	0.842	0.786	0.87	0.847
PEUSV4	0.868	0.865	0.866	0.782	0.871	0.877	0.873	0.819
PU1	0.827	0.787	0.791	0.877	0.808	0.787	0.835	0.821
PU2	0.851	0.831	0.849	0.773	0.854	0.888	0.835	0.821
PU3	0.659	0.633	0.657	0.615	0.661	0.83	0.651	0.634
PUIQ1	0.655	0.659	0.61	0.804	0.654	0.597	0.652	0.636
PUIQ2	0.846	0.809	0.811	0.905	0.837	0.798	0.855	0.841
PUIQ3	0.851	0.831	0.849	0.795	0.844	0.857	0.845	0.8

Figure 9 The Values of Factor Loading Variables

Within the ASU construct, ASU1 and ASU2 have correlations of 0.87 and 0.885, respectively. These correlations are relatively high, suggesting strong internal consistency within the ASU construct. Likewise, the other constructs exhibit strong correlations, indicating robust internal consistency within each construct. Also, it is notable that ASU variables (ASU1, ASU2) show higher correlations with each other (0.87, 0.885) compared to correlations with variables from other constructs, such as ATU, BIU, PUIQ, PEU, PU, PEUSV, and PEUSQ. This insinuates strong discriminant validity for ASU, as the correlations between ASU variables and variables from other constructs tend to be comparatively lower.

Reliability Test

Reliability pertains to how consistent, stable, or dependable a measure is. It also reflects the degree to which a method, technique, or instrument produces consistent and reproducible outcomes when applied repeatedly in the same circumstances (Ma, Mak, & Wong, 2020).

Table 7 The Reliability Test Values

Construct	Cronbach's Alpha	Composite Reliability
ASU	0.702	0.87
ATU	0.837	0.891
BIU	0.665	0.856
PUIQ	0.786	0.874
PEU	0.866	0.909
PU	0.784	0.874
PEUSV	0.87	0.911
PEUSQ	0.594	0.831

The Cronbach's Alpha and composite reliability values for all constructs are satisfactory, except for PEUSQ, where the Cronbach's Alpha is 0.594, indicating it is low. PEUSQ has a low consistency and dependability of the construct as a whole that requires further investigation.

Analysis of Structural Models

Figure 10 displays a structural model that shows the acceptance and usage of the CHD early detection application among the people of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado. This measurement model delineates the evaluation of each construct through its observable variables, involving the determination of factor loadings (weights) that indicate the strength of the relationship between each construct and its variables. Figure 10 has the values of variables for their respective constructs that represent the correlation coefficients between variables and constructs.

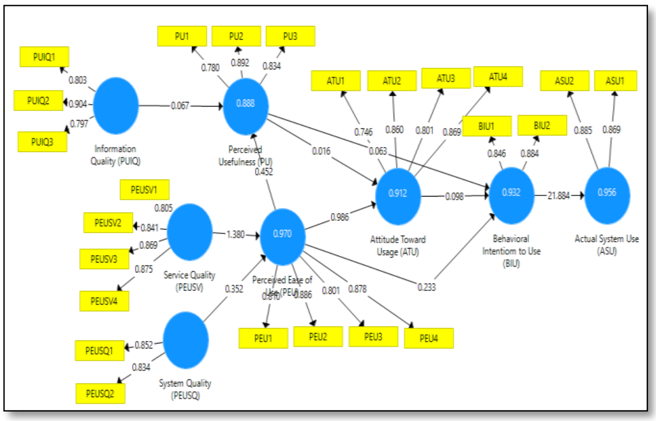


Figure 10 The Measurement of Structural Models

In support of this model in Figure 10, Table 6 is provided to enlist the R^2 values for the main constructs, namely ASU, ATU, BIU, PEU, and PU. According to Tabachnick and Fidell (2019), the value of R-squared > 0.8 is considered to be very strong. Higher R-squared values indicate a better fit of the regression model to the data, as seen in Table 8.

Table 8 The R Values for Constructs

Construct	R^2	Criteria
ASU	0.956	Very strong
ATU	0.912	Very strong
BIU	0.932	Very strong
PEU	0.97	Very strong
PU	0.888	Very strong

The R^2 value for the ASU construct is 0.956, indicating a very high level of explanation. The relationship between ASU and the BIU construct is considered very strong. The remaining 4.4% variance is influenced by other constructs not included in the model. Additionally, the BIU construct has an R^2 value of 0.932, indicating that 93.2% of its variance can be explained by the ATU, PEU, and PU constructs. The remaining 6.8% variance is influenced by other constructs not accounted for in the model.

The R^2 value for the ATU construct is 0.912, suggesting that 91.2% of its variability is accounted for by the PEU and PU constructs. Conversely, the remaining 8.8% variance is influenced by external constructs. The PEU construct has an R^2 value of 0.97, explained by the constructs PEUSV and PEUSQ. However, the remaining 3% variance is influenced by constructs not hypothesized in this research. Lastly, the R^2 for the PU construct is 0.888, indicating that 88.8% of its variance can be explained by the PEU construct. On the other hand, the other 11.2% is influenced by other constructs outside this model.

Path Coefficient Estimation

The path coefficient, also known as a path coefficient or path weight, typically ranges from -1 to 1. A positive path coefficient (ranging from 0 to 1) signifies that there is a positive association between the variables within the path model. A higher coefficient value indicates a stronger positive relationship between these variables as it approaches 1.

Table 9 The Value of Path Coefficients

Hypothesis	Coefficients
H1. PEU->PU	0.688
H2. PEU -> ATU	0.852
H3. PU -> ATU	0.109
H4. PU -> BIU	0.202
H5. ATU -> BIU	0.278
H6. PEU -> BIU	0.503
H7. BIU -> ASU	0.978
H8. PUIQ -> PU	0.917
H9. PEUSV -> PEU	0.661
H10. PEUSQ -> PEU	0.335

Based on the results in Table 9, the structural model can be interpreted as follows:

1. PEU directly and positively affects PU with a coefficient of 0.688, meaning that when PEU construct increases by one unit, it will increase PU construct by 0.688.
2. PEU directly and positively affects ATU with a coefficient of 0.852, meaning that when PEU construct increases by one unit, it will increase ATU construct by 0.852.
3. PU directly and positively affects ATU with a coefficient of 0.109, meaning that when PU construct increases by one unit, it will increase ATU construct by 0.109.
4. PU indirectly and positively affects BIU with a coefficient of 0.202, meaning that when PU construct increases by one unit, it will increase BIU construct by 0.202.
5. ATU directly and positively affects BIU with a coefficient of 0.278, meaning that when ATU

construct increases by one unit, it will increase BIU construct by 0.278.

6. PEU indirectly affects and positively BIU with a coefficient of 0.503, meaning that when PEU construct increases by one unit, it will increase BIU construct by 0.503.
7. BIU directly and positively ASU with a coefficient of 0.978, meaning that when BIU construct increases by one unit, it will increase ASU construct by 0.978.
8. PUIQ directly and positively affects PU with a coefficient of 0.917, meaning that when PUIQ construct increases by one unit, it will increase PU construct by 0.917.
9. PEUSV directly and positively affects PEU with a coefficient of 0.661, meaning that when PEUSV construct increases by one unit, it will increase PEU construct by 0.661.
10. PEUSQ directly and positively affects PEU with a coefficient of 0.335, meaning that when PEUSQ construct increases by one unit, it will increase PEU construct by 0.335.

In terms of theoretical implications, this study contributes to the existing body of knowledge on technology acceptance by extending the TAM model with additional external variables (Information Quality, Service Quality, and System Quality). This extension provides a more comprehensive understanding of factors influencing users' adoption of health-related applications. Additionally, the research findings can be used to refine and improve future TAM-based studies, particularly in the context of health technology adoption.

There are three practical implications of this research, such as application improvement, public health, and health policy. For the application improvement, the identified areas for improvement can be used to enhance the CHD early detection application, making it more user-friendly, accessible, and effective. In terms of public health, the findings can inform public health initiatives aimed at promoting the use of health technology for early disease detection and prevention. From a health policy standpoint, this study can contribute to the development of policies that support the adoption and implementation of innovative health technologies.

By addressing the identified challenges and leveraging the strengths of the application, the study's findings can ultimately contribute to improving the health and well-being of individuals at risk of coronary heart disease.

CONCLUSION

The findings affirmed the validity of all variables in measuring their respective constructs. The constructs exhibit strong correlations, indicating robust internal consistency within each construct. In terms of reliability, all constructs show satisfactory consistency except for PEUSQ, which has a Cronbach's Alpha of 0.594, indicating relatively lower reliability. PEUSQ exhibits insufficient consistency and reliability across its entire construct, necessitating additional investigation. Ten hypotheses were accepted, highlighting significant factors influencing the acceptance and utilization of this web-based application in statistical analysis:

- PEU directly and positively affects PU
- PEU directly and positively affects ATU
- PU directly and positively affects ATU
- PU indirectly and positively affects BIU
- ATU directly and positively affects BIU
- PEU indirectly and positively affects BIU
- BIU directly and positively affects ASU
- PUIQ directly and positively affects PU
- PEUSV directly and positively affects PEU
- PEUSQ directly and positively affects PEU

The results also revealed that people of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado found this web-based application to be useful in detecting CHD risk. Users can easily access and use this application independently, without needing any assistance. Furthermore, this application can be used at any convenient time and place as long as there is an Internet connection. Using this application, can help and encourage preventive measures and increase health awareness.

The study expands the TAM model to include additional external variables, providing a deeper understanding of factors influencing health technology adoption. Its findings can also be used to refine future research using the TAM framework. Three practical implications of this research are application improvement, public health, and health policy. The study's findings can be applied to improve the CHD early detection application, inform public health initiatives, and shape health policies that support the adoption of innovative health technologies, ultimately benefiting individuals at risk of coronary heart disease.

This research has several limitations. The system quality (PEUSQ) construct showed low reliability, with a Cronbach's Alpha of 0.594, indicating the need for refinement. Additionally, the study's focus on a specific population limits the generalizability of its findings, and its cross-sectional design and reliance on self-reported data may introduce biases and prevent the establishment of causal relationships. Moreover, the web-based application's reliance on internet access may restrict its usability in areas with poor connectivity.

To address these limitations, there is a need to conduct a further study with a larger and more diverse sample to improve the generalizability of the findings. Furthermore, it is suggested to employ a longitudinal design to track changes in application usage over time and establish causal relationships between variables. Also, it is important to incorporate objective measures, such as usage data or performance metrics, to complement self-reported data and reduce biases. Along with this, it needs to consider including additional external variables, such as perceived social influence or perceived risk, to explore their impact on application adoption and usage. Notably, it is urged to revise the items used to measure System Quality (PEUSQ) to improve its reliability and validity.

ACKNOWLEDGMENT

We would like to convey our gratitude towards Universitas Katolik De La Salle Manado for its continuous support for this research. Also, we thanked the people of the Spiritual Region of the Sacred Heart of Mary Cathedral Parish Manado for their valuable inputs and wonderful contributions that made this research possible.

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