Artificial Intelligence-Based Chronic Disease Detection Application Among Hypertension and Diabetes Mellitus Risk Group in Indonesian Primary Healthcare: A Usability and User Experience Evaluation

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KEYWORDS

Chronic Disease, Artificial Intelligence, Hypertension, Diabetes Mellitus

ABSTRACT

This study aims to considering the assessment of the usability and user experience of applications based on artificial intelligence (AI) for early detection of chronic diseases. Health data is recorded and chronic disease risk is classified using an AI-based early detection of chronic disease application. The study was conducted in Semarang city/regency health service facilities, using quantitative research methodology. The study's inclusion criteria were individuals with a history of diabetes mellitus and hypertension. Using the System Usability Scale (SUS) and User Experience Question (UEQ) surveys, 131 respondents were studied in May–July 2023. The study's findings showed that respondents who were older than 60, female, had not completed their education, worked for a living or were self-employed, did not use a mobile phone, and had never used health applications scored poorly for usability and user experience. The system satisfation aspect receives the lowest grade in terms of system usability, while the memorability aspect has the best score. The efficiency aspect of the system receives the greatest score in terms of user experience, while the novelty aspect receives the lowest. It is known that the AI-based early detection of chronic disease application has a reasonably acceptable usability and user experience based on the findings of the SUS and UEQ questionnaires for patients at risk of hypertension and diabetes mellitus. It is necessary to design an AI-based chronic disease detection application that is easier to learn and more innovative so that it can be used by the wider community.

1. Introduction

Chronic diseases are non-transmissible diseases that last a long time (1), typically longer than a year. Heart disease, diabetes mellitus, stroke, cancer, and hypertension are a few conditions that fall under the category of chronic diseases (2)(3). Non- transmissible illnesses account for 63% of deaths worldwide, with middle- and low-income nations accounting for 80% of these deaths. It is known that the prevalence of hypertension in Indonesia rose from 25.8% to 34.1% in 2018, according to Basic Health Research. In Indonesia, where the prevalence of diabetes mellitus was 1.5% in 2013, there has similarly been an increase in prevalence. increased to 2% in the next year(4)(5). At 37.57%, Central Java Province has the fourth-highest prevalence of diabetes in all of Indonesia; the province's 2.1% prevalence of the disease is still greater than the national average. The province of Central Java's health profile indicates that the city/regency of Semarang has the highest rate of diabetes mellitus patients, and it also has a relatively high rate of hypertension patients (6).

The government has a chronic illness management which is called as Prolanis program, is one of the many initiatives to avoid chronic diseases (7) It applies at all of Indonesia's primary healthcare facilities. In addition, the primary healthcare offer diagnosis and treatment for chronic disorders through the Posbindu program. However, a large number of people suffer from chronic diseases as a result of a lack of public awareness regarding the signs and prevention of these conditions. Previous studies' findings have shown that people with diabetes mellitus typically have poor lifestyle choices and low levels of knowledge. One reason for society's continued poor control of diabetes mellitus and hypertension is a lack of knowledge from healthcare professionals. One of the main obstacles to managing chronic diseases in Indonesian health care facilities is the lack of public awareness on the prevention and symptoms of these conditions, as well as restricted access to information from medical professionals.

These days, information technology is developing at a very fast pace, allowing it to aid in the management of chronic illnesses. One example of this is artificial intelligence (AI), which aids in

learning, problem solving, and pattern recognition (8). In the field of medicine, artificial intelligence (AI) can be used to analyze patient data in order to categorize health concerns and provide advice to patients. The AI-based early diagnosis application for chronic diseases was created as a tool to monitor the health of individuals with chronic diseases as well as to assist people in choosing healthy behaviors to prevent chronic diseases. Research has been conducted on applications for early chronic disease diagnosis utilizing a variety of techniques, such as big data platforms, machine learning, and longitudinal data analysis in various nations (9)(10)(11) but Indonesia has not conducted any study on applications for AI-based chronic illness detection. application of artificial intelligence (AI) for the detection of chronic diseases in health monitoring at community health centers, beginning with the documentation, identification, tracking, assessment, and reporting of chronic conditions. As a result, the AI-based application for chronic disease identification is a tool for both patient monitoring and prevention of chronic diseases.

To make it simple and comfortable for users, an AI-based early detection application for chronic diseases was also developed. To assess the application's usability and user experience by administering a usability and user experience evaluation questionnaire, specifically System Usability Scale (SUS) dan User Experience Question (UEQ) (12)(13)(14). It is believed that by learning about the user's comfort and convenience of use, the application may be made available to a larger audience. Thus, in Indonesian healthcare facilities, the usability and user experience of AI-based early detection of chronic illness applications in populations at risk of hypertension and diabetes mellitus were examined.

2. Materials and Methods

Personal Health Record & Chronic Disease Detection Application

An android software that assists in tracking patient health and identifying signs of chronic diseases is called AI-based Early Detection of Chronic Diseases. The process of using the system involves the patient entering crucial information for their medical records, such as their body temperature, blood pressure, height, heart rate, blood sugar, complaints, doctor's diagnosis, and medications. In addition, patients can get screenings for chronic conditions such as diabetes, hypertension, heart disease, stroke, lung cancer, and hypertension. Patients can frequently evaluate their health by viewing risk findings and risk detection history based on the outcomes of inputting patient health data. This application's ultimate goal is to assist in giving patients recommendations for documenting, screening, and keeping track of each patient's unique health. The field display and recommendations of application shown in Figure 1

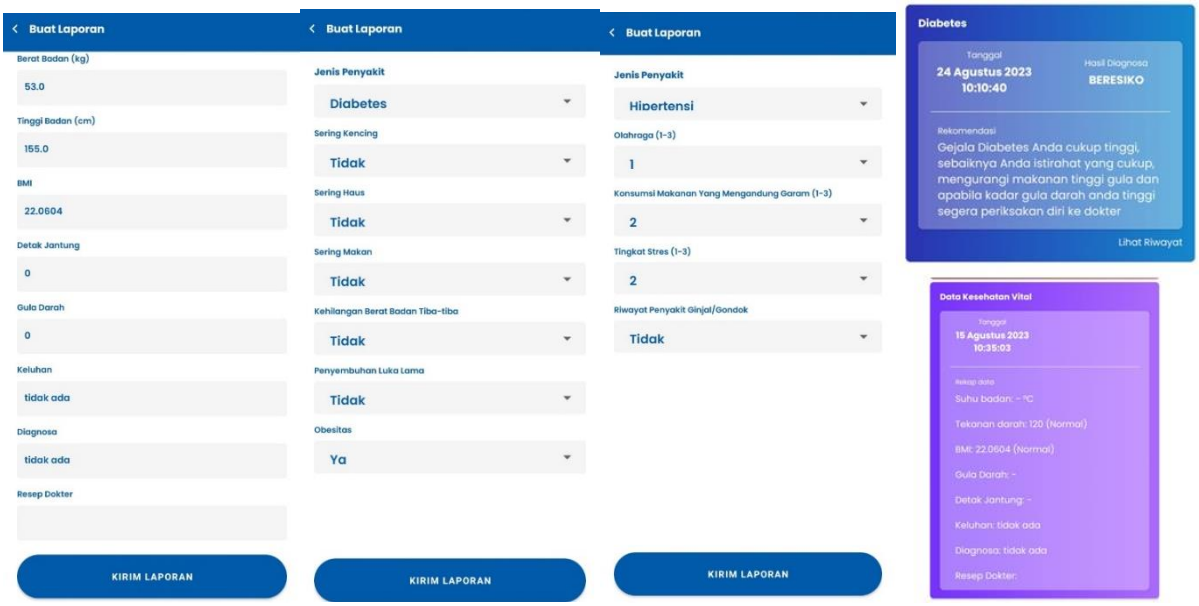

Figure 1. Field Display and Recommendations of Application

Study design, period, and setting

In Semarang city/district health service facilities between May and July 2023, general patients with a history of hypertension or diabetes mellitus and patients registered in the Prolanis program were the subjects of this cross-sectional, quantitative study. The government's JKN program, Prolanis, tracks the health of senior citizens who have a history of diabetes mellitus or hypertension. The study's inclusion criteria were all general patients and Prolanis patients in Semarang district health service facilities having a history of hypertension or diabetes mellitus. In the meanwhile, individuals without a history of diabetes mellitus or hypertension are excluded. Purposive sampling was the technique employed in the study, and the number of samples was determined using the Slovin formula, yielding a statistically feasible sample count of 131 samples with a 95% confidence interval.

Data Collection

Patients were instructed on how to use the AI-based application for chronic disease detection at the beginning of the study. Following this, respondents attempted to complete the application, filled the informed consent and ultimately completed the System Usability Scale (SUS) and User Experience Question (UEQ) questionnaires. A questionnaire that included questions about respondent characteristics, 10 system usability scale items on a scale of 1–5, 26 user experience questions on a scale of 1–7, and challenges or insights about the AI-based chronic illness detection application was used to gather data. The job status, gender, education, age, occupation, amount of time spent using a mobile phone, and use of health applications are among the characteristics of the respondents.

System Usability Scale (SUS)

The System Usability Scale (SUS) questionnaire is used to gauge how easy a system is for users to use. Ten items make up the SUS questionnaire with five aspect: learnability, efficiency, memorability, errors dan satisfaction. Each with five possible answers on a Likert scale that goes from Strongly Agree (5) to Agree (4) to Neutral (3) to Disagree (2) to Strongly Disagree (1). It's true that even inquiries are negative and odd queries are positive. The overall SUS score is calculated by multiplying the sum of the scores of all questions by 25, and the final scores for odd and even questions are deducted by one and five, respectively, from the user's score. The final SUS score falls between 0 and 100 (15)(16). If the average total SUS score is between 84,1-100 Best Imaginable, 72,6-84 Excellent, 62.7-72.5 Good, 51.7-62.6 Ok, 21.1-51.6 Poor dan 0-25 Worst Imaginable.

User Experience Question (UEQ)

Use the User Experience Question (UEQ) survey to find out how users find the system's engaging and entertaining interactions. There are 26 items on the UEQ questionnaire, covering topics such as innovation, perspicuity, efficiency, attractiveness, and dependability. There are seven possible answers, each on a Likert scale from 1 to 7 (17). Value conversion is done when processing the UEQ data; that is, positive questions on a scale of 1 to 7 are converted to a scale of -3 to 3, and negative questions on a scale of 1 to 7 are transformed to a scale of 3 to -3. The data analysis tools available on the official UEQ website were utilized to examine the data obtained from the UEQ questionnaire results. Sorting UEQ data utilizing Benchmark intervals for the UEQ scale.

Data quality control

The research team that collected the data received training on the goals of the study and the procedures for gathering data. Validity and reliability of the questionnaire were assessed, and before the study, adaptations were performed. After signing an informed consent form, the respondents consented to fill out the questionnaire.

Data analysis

The characteristics of the respondents, including their job status, gender, education, age, occupation,

amount of time they had used a mobile phone, and whether or not they had ever used health applications, were subjected to descriptive analysis. Using the average score and frequency distribution for each question item, the SUS and UEQ questionnaire results are analyzed.

Results

The results of the study are described in the distribution of respondent characteristics in the (Table 1).

Table 1. Responden Characteristic

Characteristic (N=131)	N (%)	Mean	
		Usability (0 to 100)	User Experience (-3 to 3)
Gender			
Men	36 (27.48)	70,14	2,19
Women	95 (72.51)	68,16	2,06
Age (years; mean±SD)	48.2 ± 14.93		
Adult (< 45 years old)	49 (37.40)	69,39	2,02
Pre-Elderly (45-60 years old)	49 (37.40)	66,12	2,31
Elderly (> 60 years old)	33 (25.19)	62,88	1,90
Education			
Not School	6 (4.58)	54,58	1,90
Primary School	22 (16.79)	57,73	2,04
Middle School	21 (16.03)	62,26	2,02
High School	58 (44.27)	67,28	2,14
Diploma	13 (9.92)	66,15	1,99
Bachelor	8 (6.11)	71,25	2,29
Master	3 (2.29)	81,67	2,53
Occupation			
Housewife	56 (42.75)	64,06	2,15
Employee	22 (16.79)	62,73	2,01
Self- employee	39 (29.77)	65,19	1,91
Civil Servant	14 (10.69)	69,46	2,54
Mobile Phone			
Not having	27 (20.61)	60,09	1,85
1-5 years	41 (31.30)	59,88	2,06
6-10 years	34 (25.95)	68,53	2,12
> 10 years	29 (22.14)	71,55	2,35
Using Health Application			
Yes	79 (60.31)	67,99	2,13
No	52 (39.69)	61,61	2,04

Table 1 shows that, with a high school diploma as the greatest degree of education, 72.5% of the patients were female and the remaining 27.5% were male. Patients' ages range from less than 45 to 60 years old, and the majority work as housewives or entrepreneurs. Sixty percent of respondents had used health applications on their phones, and the majority of respondents have owned them for one to five years. Users who are female, older than 60, have not completed their education, work for pay or are self-employed, do not own a mobile phone, and have never used health applications are those with low usability and user experience scores.. Males who are mature or pre-elderly, have completed a bachelor's or master's degree, work as government servants, have owned a mobile phone for more than ten years, and have used health applications are characteristics of users who score highly on usability and user experience. The AI-based chronic disease detection application was tested by patients at risk for hypertension and diabetes mellitus using the SUS questionnaire, which assessed learnability, efficiency, memorability, mistakes, and satisfaction. The SUS questionnaire findings for the respondents are shown in (Table 2).

Table 2. Results of the SUS questionnaire

Learnability	Strong Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strong Disagree N(%)
I think that I would like to use this system	10 (8%)	82 (63%)	35 (27%)	4 (3%)	0 (0%)
I found the system unnecessarily complex	0 (0%)	17 (13%)	11 (8%)	92 (70%)	11 (8%)
Mean Score	68,6				

Efficiency	Strong Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strong Disagree N(%)
I thought the system was easy to use.	14 (11%)	97 (74%)	13 (10%)	7 (5%)	0 (0%)
I think that I would need the support of a technical person to be able to use this system.	1 (1%)	58 (44%)	12 (9%)	53 (40%)	7 (5%)
Mean Score	61,9				
Memorability	Strong Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strong Disagree N(%)
I found the various functions in the system were well integrated.	5 (4%)	118 (90%)	7 (5%)	1 (1%)	0 (0%)
I thought there was too much inconsistency in this system	0 (0%)	14 (11%)	19 (15%)	87 (66%)	11 (8%)
Mean Score	71,2				
Errors	Strong Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strong Disagree N(%)
I would imagine that most people would learn to use this system very quickly	10 (8%)	89 (68%)	24 (18%)	8 (6%)	0 (0%)
I found the system very cumbersome to use	0 (0%)	17 (13%)	10 (8%)	87 (66%)	17 (13%)
Mean Score	69,6				
Satisfaction	Strong Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strong Disagree N(%)
I felt very confident using the system	7 (5%)	91 (69%)	12 (9%)	18 (14%)	3 (2%)
I needed to learn a lot of things before I could get going with this system	4 (3%)	82 (63%)	15 (11%)	25 (19%)	5 (4%)
Mean Score	52,5				

Table 2 on the learnability aspect shows that 70% of respondents did not think the AI-based chronic disease detection application was difficult to use, and 63% of respondents said they would use it again. Regarding effectiveness, it's known that 74% of respondents have an AI-based application for detecting chronic diseases that is user-friendly, and 44% of respondents require assistance from others in order to utilize the program. It is known that, when it comes to memorability, 90% of respondents said the program was operating smoothly, and 66% said it was consistent. Regarding the error aspect, 68% of respondents said it was easy to learn how to use the AI-based chronic illness detection tool, and 66% said it was not confusing. Regarding the satisfaction aspect, 69% of respondents said there were no barriers to utilizing the application, while 63% said they had to learn how to use it first.

The highest average is 71.2 for the memorability aspect, followed by 69.6 for errors, 68.6 for learnability, 61.9 for efficiency, and 52.5 for satisfaction. With an overall SUS score of 64.5, the system falls into the good category. Additionally, table 3 presents the findings of the UEQ questionnaire, which included items related to attractiveness, perspicuity, efficiency, reliability, stimulation, and novelty in individuals at risk of hypertension and diabetes mellitus (Table 3).

Table 3. Results of the UEQ questionnaire

Attractiveness			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree(-) Very Strong Agree (+)		
(+)	Unpleasant	Pleasant	0 (0%)	0 (0%)	0 (0%)	7 (5%)	6 (5%)	63 (48%)	55 (42%)
(+)	Annoying	Enjoyable	3 (2%)	0 (0%)	3 (2%)	10 (8%)	7 (5%)	69 (53%)	39 (30%)
(-)	Good	Bad	67 (51%)	61 (47%)	1 (1%)	2 (2%)	0 (0%)	0 (0%)	0 (0%)

(+)	unlikable	pleasing	1 (1 %)	1 (1 %)	0 (0 %)	7 (5 %)	5 (4 %)	66 (50 %)	51 (39 %)
(-)	friendly	unfriendly	50 (38 %)	64 (49 %)	1 (1 %)	10 (8 %)	0 (0 %)	4 (3 %)	2 (2%)
(-)	attractive	unattractive	48 (37 %)	68 (52 %)	1 (1 %)	9 (7 %)	3 (2 %)	2 (2 %)	0 (0%)
	Mean Score		2.16						
Efficiency			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree (-) Very Strong Agree (+)		
(+)	impractical	practical	0 (0 %)	0 (0 %)	0 (0 %)	3 (2 %)	2 (2 %)	69 (53 %)	57 (44 %)
(+)	inefficient	efficient	0 (0 %)	0 (0 %)	0 (0 %)	5 (4 %)	5 (4 %)	67 (51 %)	54 (41 %)
(-)	organized	cluttered	48 (37 %)	69 (53 %)	4 (3 %)	8 (6 %)	0 (0 %)	2 (2 %)	0 (0%)
(-)	fast	slow	63 (48 %)	60 (46 %)	1 (1 %)	4 (3 %)	1 (1 %)	1 (1 %)	1 (1%)
	Mean Score		2.29						
Novelty			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree(-) Very Strong Agree (+)		
(+)	Conservative	innovative	0 (0 %)	3 (2 %)	0 (0 %)	4 (3 %)	3 (2 %)	69 (53 %)	52 (40 %)
(+)	usual	leading edge	13 (10 %)	8 (6 %)	5 (4 %)	9 (7 %)	4 (3 %)	54 (41 %)	38 (29 %)
(-)	creative	dull	48 (37 %)	66 (50 %)	3 (2 %)	12 (9 %)	1 (1 %)	0 (0 %)	1 (1%)
(-)	inventive	conventional	46 (35 %)	64 (49 %)	3 (2 %)	10 (8 %)	2 (2 %)	5 (4 %)	1 (1%)
	Mean Score		1,88						
Perspicuity			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree(-) Very Strong Agree (+)		
(+)	not understandable	understandable	1 (1 %)	2 (2 %)	6 (5 %)	4 (3 %)	3 (2 %)	65 (50 %)	50 (38 %)
(-)	clear	confusing	60 (46 %)	57 (44 %)	2 (2 %)	7 (5 %)	3 (2 %)	2 (2 %)	0 (0%)
(+)	complicated	easy	4 (3 %)	5 (4 %)	2 (2 %)	4 (3 %)	3 (2 %)	64 (49 %)	49 (37 %)
(-)	easy to learn	difficult to learn	46 (35 %)	59 (45 %)	3 (2 %)	4 (3 %)	4 (3 %)	12 (9 %)	3 (2%)
	Mean Score		1,98						
Dependability			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree(-) Very Strong Agree (+)		
(+)	Obstructive	supportive	1 (1 %)	2 (2 %)	0 (0 %)	3 (2 %)	4 (3 %)	66 (50 %)	55 (42 %)
(-)	secure	not secure	56 (43 %)	65 (50 %)	2 (2 %)	6 (5 %)	0 (0 %)	2 (2 %)	0 (0%)

(-)	meets expectations	does not meet expectations	47 (36 %)	72 (55 %)	4 (3 %)	7 (5 %)	1 (1 %)	0 (0 %)	0 (0%)
(+)	unpredictable	predictable	2 (2 %)	5 (4 %)	1 (1 %)	14 (11 %)	7 (5 %)	60 (46 %)	42 (32 %)
	Mean Score		2.13						
Stimulation			Very Strong Agree (-) Very Strong Disagree(+)				Very Strong Disagree (-) Very Strong Agree (+)		
(+)	not interesting	Interesting	0 (0 %)	3 (2 %)	2 (2 %)	6 (5 %)	4 (3 %)	67 (51 %)	49 (37 %)
(+)	boring	Exciting	3 (2 %)	2 (2 %)	3 (2 %)	11 (8 %)	4 (3 %)	66 (50 %)	42 (32 %)
(-)	motivating	Demotivating	55 (42 %)	64 (49 %)	1 (1 %)	10 (8 %)	0 (0 %)	0 (0 %)	1 (1%)
(-)	valuable	Inferior	59 (45 %)	60 (46 %)	4 (3 %)	4 (3 %)	1 (1 %)	2 (2 %)	1 (1%)
	Mean Score		2.11						

Table 3 provides information that the attractiveness aspect most respondents reported feeling good (51%), pleasing (50%), enjoyable (53%), pleasant (48%), user-friendly (49%), and attractive (52%). Regarding effectiveness, most participants said it was fast (48%), organized (53%), efficient (51%), and practical (53%). When it came to novelty, most respondents felt innovative (53%), leading edge (41%), creative (50%) and inventive (49%). In terms of perspicuity most respondents said it was understandable (50%), clear (46%), easy (49%) and easy to learn (45%). Regarding dependability, the majority of respondents said it was predictable (46%), meets expectations (55%) secure (50%) and supportive (50%). Most respondents thought that in terms of stimulation it was interesting (51%), exciting (50%), motivating (49%), and valuable (46%).

The aspect with the highest average in the excellent category is the efficiency aspect (2.29), which is followed by the attractive aspect (2.16), the dependability aspect (2.13), the stimulation aspect (2.11), the novelty aspect (1.98) in the excellent category, and the perspicuity aspect (1.88) that entered the good category. Nearly all are rated as outstanding based on the mean UEQ value. It is known that the AI-based early detection of chronic disease application has a reasonably acceptable usability and user experience based on the findings of the SUS and UEQ questionnaires for patients at risk of hypertension and diabetes mellitus.

Discussion

According to the study's findings, older users of applications give poorer usability and user experience ratings than do adult or pre-senior users; as a result, elderly users find using the program more challenging. It is imperative to create visually appealing and user-friendly apps when creating software for senior citizens (18). The usability and user experience scores of individuals with incomplete education were worse than those with elementary, high school, bachelor's, and master's degree completions. The application's usability and user experience are also influenced by the user's educational background (19). Compared to women, men typically adjust to information technology more readily (20). The user's familiarity with utilizing smartphones and health apps contributes to their proficiency with digital technologies.

It is evident from the usability findings that users feel they must become accustomed to the system

before utilizing it, as the satisfaction aspect receives the lowest score. This occurs because the application requires repeated usage before it can be used to its full potential. To make the program easier to use, its appearance has to be improved. For instance, writing uniformity would make it easier to recall (21). According to the user experience data, the novelty aspect receives the lowest score when users believe there are a lot of health applications overall—not just ones for chronic diseases. In order to present the new side, engaging and current content must be shown (22). In addition, to set them apart from other applications, additional components are incorporated that may be helpful in preventing chronic diseases.

It is well known that memorability has the greatest score in system usability, whereas system satisfaaction has the lowest. Users feel that they must acquaint themselves with the system before using it in the satisfaction aspect. SUS falls into the good category according to the mean value. The efficiency aspect of the system receives the greatest score in terms of user experience, while the novelty aspect receives the lowest. It is known that 10% of users believe there are already a lot of similar health applications, which speaks to originality. Nearly all are rated as Excellent or exceptional based on the mean UEQ value.It is known that the AI-based early detection of chronic disease application has a reasonably acceptable usability and user experience based on the findings of the SUS and UEQ questionnaires for patients at risk of hypertension and diabetes mellitus. Next, in order to prevent users from having to become used to using the application and to make them feel as though it is unique compared to other applications, both in terms of content and application interface, it is imperative to create an application design that is more inventive and easier to understand.

Conclusions

According to the study's findings, patients at risk of hypertension and diabetes mellitus might realistically enjoy a usability and user experience of AI-based early detection of chronic disease applications. The memorability and efficiency aspect of the system obtains the highest score, while the novelty and satisfaction aspect receives the lowest. Usability and user experience scores were low for respondents who were over 60, female, had not finished their education, worked for pay or were self-employed, did not use a mobile phone, and had never used health applications.

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