



A model to improve user acceptance of e-services in healthcare systems based on technology acceptance model: an empirical study

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Abstract

Improving the quality of electronic services (e-services) is essential when dealing with unforeseen factors and uncertainties in healthcare, such as the outbreak of coronavirus (COVID-19) and changes in the needs and expectations of patients. This paper presents a comprehensive conceptual model in healthcare systems for improving the user acceptance of e-services. A model referred to as the technology acceptance model (TAM) is considered that includes several factors. The factors are computer literacy, website quality, service quality, user attitude, perceived enjoyment, and user satisfaction. According to the collected data and the performed analysis, the fit indices of this survey reveal that the conceptual model has an acceptable fit. The findings are as follows. Computer literacy has positive effects on perceived enjoyment and ease of use. Website quality has positive effects on perceived enjoyment, ease of use, and user satisfaction. Perceived enjoyment has a positive effect on perceived usefulness. Ease of use has positive effects on the usefulness, willingness to use e-services, and user attitude. User satisfaction has a positive effect on user attitude. Perceived usefulness has a positive effect on the willingness to use e-services. Finally, among these variables, only the user attitude has no significant effect on the willingness to use e-services in the healthcare system. Therefore, to promote performance quality and to motivate people to use e-services, healthcare managers should improve these factors.

Keywords Technology acceptance model (TAM) · Computer literacy · Website quality · Service quality · Willingness to use electronic services (e-services) · Healthcare systems

1 Introduction

The worldwide spread of the coronavirus (COVID-19) as an unpredictable factor has changed the daily activities of many nations on an unprecedented scale, with an area of about 210 countries. Although the outbreak of the coronavirus has created unpleasant conditions for the people of the world, in some cases it has been able to turn threats into opportunities. The development of some services, including offline and digital services, in the world, despite numerous and extensive planning, has not made significant progress, but the spread of the virus has accelerated the implementation process and the acceptance of these plans by the people. One of the systems that have undergone this transformation is the health system.

On the other hand, apart from the crisis debate, nowadays, healthcare managers face a lot of challenges in their organizations such as capacity, speed, and quality of responsiveness (Rahmani et al. 2017; Singh et al. 2019). Hence, they try to develop an accessible and appropriate framework to

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respond to customer needs quickly. Different surveys indicate that the internet as a global and comprehensive space for presenting essential services or products around the world has a key role to create a framework in all areas (Chang et al. 2015a, b). Information technology (IT) tools depend highly on the internet (Parvizi et al. 2017). The Internet is considered a cornerstone of virtual communication. Meanwhile, the various unprecedented and diverse applications offered via the internet in recent years assist industries with goals, programs, and tasks in different locations to achieve similar advantages by continuously communicating and collaborating (Fu et al. 2020). Therefore, for efficient management in both economic and non-economic environments, managers should focus on identifying internet applications and related technologies as tools to communicate with users effectively (O'Brien et al. 2017).

In the last decade, substantial effort has been done to provide electronic services (e-services) in the healthcare system using the internet. Many studies address this issue (Heintzman et al. 2014; Canavan et al. 2016; Sulmasy et al. 2017; Witman 2017; Jiang et al. 2019; Tanwar et al. 2020). In most cited papers, researchers emphasize that electronic healthcare services are important in an individual's life and it helps the healthcare system to enhance the speed and quality of medical services and products (Gulliford et al. 2017). Indeed, providing healthcare services over the internet, if combined with modern and acceptable procedures, not only decreases the cost and time wasting but also improves satisfaction and efficiency at different levels (Liu and Huang 2020). Electronic healthcare procedures as modern tools are extremely complex and costly (Tanwar et al. 2020). However, research and development in this area can improve the future of the medical services and education sectors (Tanwar et al. 2020). On the other hand, the identification of barriers and continuous improvement and optimization of healthcare systems requires the exchange of information at the appropriate time and place (Cohen 2020). Given the fact that healthcare professionals need a certain set of reliable data from patients in a short time (Yüksel et al. 2017; Luo et al. 2018; Hai et al. 2020), they are interested in employing conceptual and mathematical models based on the web in recent years. These models allow researchers, healthcare centers, and patients to share critical information easily and effectively (Wager et al. 2017). Hence, to establish efficient communication in electronic healthcare systems, a comprehensive model is necessary and beneficial.

Willingness to use e-services refers to the extent that consumers tend to use services through electronic systems and the internet (Zheng et al. 2019). The Willingness to use this kind of service and related systems is influenced by many variables. Studies show that customer acceptance is a key factor in the use of e-service systems (Kühl et al. 2019). Various models and methods have been applied worldwide

to investigate the variables affecting technology acceptance and the most valid one is technology acceptance model (TAM) (Rafique et al. 2020). The purpose of TAM is to describe the acceptance parameters for communication and information technologies that are generic and capable of describing the behavior of users across a wide range of computing technologies for different uses (Rafique et al. 2020). Indeed, it is a simplified interpretation of the beliefs that influence technology acceptance (Park 2009). Research and empirical evidence in several studies have strongly demonstrated that TAM is a valid and reliable framework for predicting modern technology acceptance such as information and communication technology (ICT) (Lin and Kim 2016; Estriegana et al. 2019; Manis and Choi 2019; Rezvani et al. 2022). Healthcare centers are eager to develop and implement web-based information systems (Zhang and Boulos 2020). Meanwhile, they focus on reducing workloads and improving the efficiency and quality of services through the use of information technology and the internet. Therefore, the development of TAM based on variables related to the healthcare sector will play a significant role in optimizing the acceptance rate of e-services in healthcare systems. Some empirical literature review shows that only a few studies have been conducted to evaluate the user acceptance of e-services in healthcare centers in Iran and thus, there is a research gap in this sector. Therefore, the objective of the work at hand is to provide a model for users' acceptance of e-services in healthcare systems.

This paper presents an integrated framework compatible with current healthcare systems to achieve deep insight into application of e-services and improve the service quality, satisfaction, and acceptance level in this sector. The main purpose is to develop a model for user acceptance of e-services in healthcare systems based on TAM. This model using structural equation modeling (SEM) and considering causal relationships is a comprehensive conceptual model. Further, the most important reasons for using the SEM method in this article are (Noruzy et al. 2013):

- There are several limitations in preliminary statistical methods, which do not allow the consideration of multiple variables simultaneously and are therefore not capable of taking into account more complex concepts. SEM techniques can be used to confirm or reject theories quantitatively.
- An important aspect of measurement tools is their validity and reliability (e.g. measurement error).
- The growth and development of SEM in recent years, especially the analysis of advanced structural theoretical models

For theoretical and practical evaluation of essential variables and their relationship, TAM can be considered an

effective tool to implement the e-service structure in the healthcare sector. This kind of model can provide a reliable procedure to anticipate the technology potential in different situations (Davis 1989). In the research at hand, new and effective variables are added to the proposed conceptual model for the first time. Investigating the effects of new variables in TAM can lead to improved e-service by considering these variables. Consequently, researchers and managers can use the findings of this work to make decisions in healthcare organizations.

The most important contributions of the current paper are to:

- Providing a comprehensive conceptual model for user acceptance of e-services in healthcare systems.
- Developing a conceptual model based on TAM in healthcare systems.
- Developing a new tool to measure computer literacy, website quality, service quality, user attitude, perceived enjoyment, and user satisfaction indicators in the healthcare sector.
- Applying SEM to investigate the causal relationship between variables in TAM.
- Analyzing results and providing managerial implications to improve e-service in healthcare systems.

The remainder of this paper is as follows: the related works and potential applications of the study in Sect. 2. The hypothesis is developed in Sect. 3. The methodology is presented in Sect. 4. In Sect. 5, results are presented. The discussions and managerial applications are covered in Sects. 6 and 7. Section 8 elaborates on the conclusions, limitations, and suggestions for future studies.

2 Related works and potential applications of the study

Focusing on presenting a framework by identifying the variables and investigating their influence on the acceptance of e-services in healthcare networks is a necessary issue in the coming years. It helps researchers and managers in this sector do better planning to deal with the challenges and needs. In the following, the summary of the important surveys carried out for e-services in the healthcare systems will be described.

Liang et al. (2003) developed a TAM to assess personal digital assistant (PDA) usage in healthcare professionals (HCPs). They found that personal innovativeness influences perceived ease of use. In this line, perceived usefulness has an effective role in enhancing job relevance, compatibility, and perceived ease of use on usage. Dogac et al. (2006) worked on the healthcare information standards to develop

semantical web services within healthcare systems. They emphasized that to have an integrated healthcare enterprise, using efficient web services considering up-to-date information standards is a necessary issue. Mohamadali and Garibaldi (2010) developed an evaluation model to assess the user acceptance of software technology in healthcare organizations. They stated that the efficient information system, unified theory of technology acceptance, and use of technology framework can be considered important tools to reach a structured health care system. Vatnøy et al. (2014) conducted a content analysis on the development of an efficient system to use electronic health records (HER) in the healthcare services network. The achieved results indicated that education, training, and support are three key elements in the HER enhancing the quality and quantity of healthcare services in form of an integrated network. Chang et al. (2015a) developed a TAM to evaluate the factors that influence user acceptance in a healthcare center. The achieved results showed that the web-based appointment system (WAS) should be considered an important service structure in an electronic hospital services network. Campbell et al. (2017) developed a TAM to design a framework for applying the mobile healthcare technologies. They realized that an efficient TAM for resource-limited settings (RLS) would be as an effective tool to design and enhance the electronic healthcare services not only in technological dimension but also in patient/user satisfaction dimension. Razmak and Bélanger (2018) developed a structural equation modeling to design a system structure for electronic personal health records (PHRs) in regional communities. They found that the perceived ease of use is the strongest predictor of the perceived usefulness of PHR technology, but results may be different between patients and physicians. Zhang et al. (2018) developed an elaboration likelihood model along with a structural equation modelling to investigate the role of users' perceived e-health literacy (PEHL) in users' continuance use applications with consideration of information quality, system quality, trust level, and satisfaction rate. The achieved results indicated a significant effect of PEHL on continuance intention by moderating the relationship between the information system quality and trust level considering the positive effects of users' satisfaction. Lemlouma et al. (2019) conducted a comprehensive literature review on e-health pervasive wireless applications and services. The findings showed that smart devices play a significant role in providing and adopting adequate and high-quality e-health services. Katehakis et al. (2020) conducted a statistical analysis on security improvements for safer cross-border e-health services. The achieved results illustrated that technological improvements are necessary to deal with the quality challenges through the adoption of generic building blocks. Karolak et al. (2021) conducted inclusive research on the application of artificial intelligence

modeling in e-service, e-government, and e-health services improvements. The achieved results include the essential strategies to assure electronic system structure efficiency towards a fast-growing Internet users base in the healthcare network. Choukou et al. (2022) conducted a literature review on COVID-19 infodemic and digital and electronic health literacy to draw a portrait of e-services as a digital procedure to support the performance quality in vulnerable populations. The achieved findings illustrated that the barriers and facilitators of this scope play important role in promoting the necessary factors such as digital health literacy and social media usage, increase digital knowledge and skills, decrease health literacy barriers and increase technology acceptance in specific groups.

Important research studies have been done in the field of e-services applications in healthcare systems, which have been discussed in different parts of this study. However, the cases do not cover the different dimensions and details that will lead to challenges in the relevant field. Therefore, the actions taken in this study are a useful effort to meet the present and future needs by considering the existing potential. Identifying all the important and influencing elements of the user acceptance of e-services in healthcare systems, classifying and leveling them in form of an efficient TAM, and determining the quality and quantity of the relationships and interactions among them by applying the efficient tool provide the most effective and useful findings for the researchers and managers in the field. Hence, the nature of this study, the approaches used in it, and the obtained results can be considered as an important and comprehensive step in improving the quality and quantity levels of the user acceptance of e-services within a dynamic and integrated healthcare system structure leading to a sustainable and futuristic healthcare network.

3 Hypothesis development

3.1 Conceptual model

The type of e-services considered in this survey includes some cases such as "development of related apps", "improving website quality", "cost reduction", "easy to use in private space" and "saving time". All variables linked to tasks and efficiency indicators reflecting the quality of possible decisions in the modeling stage have to be considered. The classic TAM already includes perceived usefulness and perceived ease of use as independent variables, but the literature suggests several other predictors. In the proposed model, three variables are considered independent elements which are computer literacy, website quality, and service quality. There are two good reasons for the consideration of these independent variables. The first reason is the inherent

functionality of the variables so that each of them has a specific function in a specific part of e-services in healthcare systems. For example, computer literacy covers the users' mental attitudes and norms, how to use the ICT tools, and overall a framework for the proper utilization of e-services. On the other hand, website quality covers the practical application and interpretation, providers' performance, and marketing strategies and tools. Also, service quality as the third independent variable covers the users' satisfaction rate and usefulness and acceptance of services. However, these variables affect different aspects. The second reason is to designate these variables as indispensable and independent variables of e-services in healthcare systems. Based on the literature, computer literacy, website quality, and service quality are considered in different conceptual models as independent variables (Kalia 2017; Omar et al. 2017; Huang et al. 2019). Therefore, by applying all necessary independent variables, the proposed model in this study is more comprehensive and reliable leading to more comprehensive and applicable findings. The model highlights the variables related to TAM to allow the experts to gather more detailed information and make a deeper examination of the desire to use e-services. Computer literacy, user satisfaction, and user attitude are included in the proposed model. No other research work has these three variables simultaneously included in the model. There is a fundamental problem with how to achieve health goals using e-services using the previous models that did not include these three variables (Pai and Huang 2011; Chang et al. 2015b). These three new variables can solve this problem by linking the dependent and independent variables in the domain. By using this model, experts can find out the effects of all influential variables. Figure 1 shows the proposed conceptual model of this research.

3.2 Research hypotheses

The research hypotheses are divided into two parts (Nine hypotheses along with nine sub-hypotheses) to evaluate the model. The hypotheses have been identified through the literature and expert opinion. The definition of each variable is shown in Table 1. The proposed hypotheses are based on the relationship of identified variables. In the following, the hypotheses and the reasons for their selection are presented.

3.2.1 Hypotheses

H1 "Computer literacy" influences "perceived enjoyment" and "perceived ease of use".

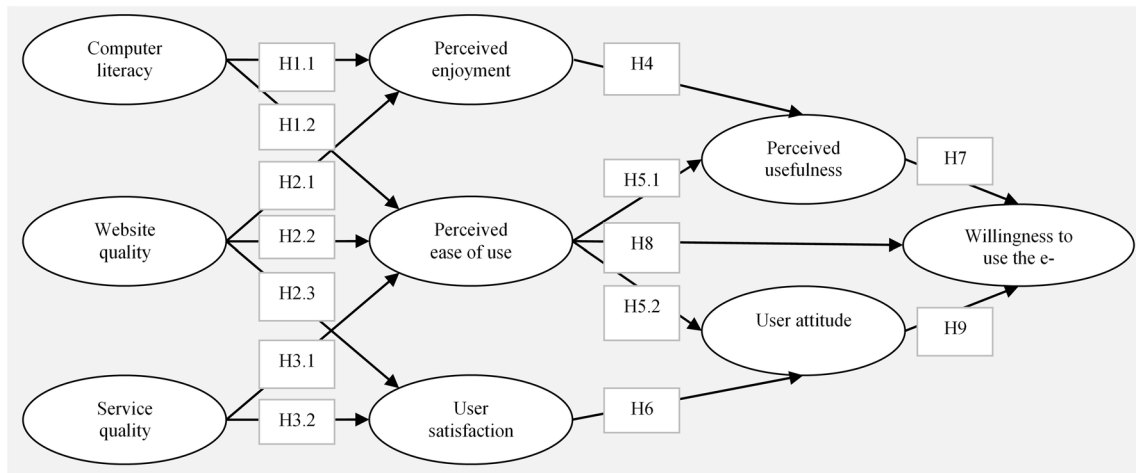


Fig. 1 Conceptual model of this research study

Table 1 The construct definitions of this study

Variable(s)	Definition(s)	References
Computer literacy (V1)	Having knowledge and awareness about computer and its' applications	Stephens and Shotick (2001)
Website quality (V2)	Measuring the websites' speed, security, response time, effectiveness, and total performance	Lin and Lu (2000)
Service quality (V3)	Managing the capability of electronic registration challenges and extent of service information provided by healthcare centers	Parasuraman et al. (1988)
Perceived enjoyment (V4)	It is included to investigate the assertion that an enjoyable shopping experience is essential in online shopping	Ramayah and Ignatius (2005)
Perceived ease of use (V5)	The degree to which a person believes that using a particular system would be free of effort	Davis (1989)
User satisfaction (V6)	Satisfaction in a given situation is the sum of one's feelings or attitudes toward a variety of factors affecting that situation	Bailey and Pearson (1983)
Perceived usefulness (V7)	The degree to which a person believes that using a particular system would enhance his or her job performance	Davis (1989)
User attitude (V8)	A psychological state reflecting the effective or evaluative feelings concerning a new system	Barki and Hartwick (1994)
Willingness to use e-services (V9)	Measuring the users' intentions to use of the electronic actions and applications in the different situations	Fishbein and Ajzen (1977)

H2 "Website quality" influences "perceived enjoyment", "perceived ease of use" and "user satisfaction".

H7 "Perceived usefulness" influences "willingness to use-services".

H3 "Service quality" influences "perceived ease of use" and "user satisfaction".

H8 "Perceived ease of use" influences "willingness to use e-services".

H4 "Perceived enjoyment" influences "perceived usefulness".

H9 "User attitude" influences "willingness to use e-services".

H5 "Perceived ease of use" influences "perceived usefulness" and "user attitude".

3.2.2 Sub-hypotheses

H6 "User satisfaction" influences "user attitude".

H1.1 "Computer literacy" is positively related to "perceived enjoyment".

Computer science has significant effect on all kinds of problems in recent years (Gao et al. 2019). In this regard, researchers find that computer literacy has a vital effect on perceived enjoyment as a fundamental factor of the TAM. It can provide adaptive and flexible situations in using the newest technologies in different research areas such as healthcare. Also, by promoting computer science in the systems, users feel better about the use of the equipment. Thus, the vital influences of computer literacy on perceived enjoyment are determined by this hypothesis.

H1.2 *"Computer literacy" is positively related to "perceived ease of use".*

Computer literacy is a key tool for learning and earning essential skills in healthcare education (Gao et al. 2019). Also, it creates potential interdisciplinary collaboration between healthcare beneficiaries to achieve high usefulness (Roberts et al. 2017). It is an effective tool to increase the speed of performing functions. In this regard, the perceived ease of use is considered a significant improvement in the treatment process of healthcare centers (Omar et al. 2017). It provides a suitable environment to present a different kind of service. This element can also be used as an effective motivator to achieve goals (Portz et al. 2019). Thus, paying more attention to the mentioned variables and the relation between them helps healthcare managers to improve their knowledge.

H2.1 *"Website quality" is positively related to "perceived enjoyment".*

Better website quality helps healthcare managers to improve the enjoyment levels among the members and patients in the centers (Kalia 2017). On the other way, researchers recognized that website quality can increase the quality of healthcare services by enhancing perceived enjoyment (Shim and Jo 2020). Hence, there are important relationships between learning more about website applications and having a sense of pleasure in the healthcare systems.

H2.2 *"Website quality" is positively related to "perceived ease of use".*

Good website quality is needed to manage online health customers and their behaviors to accept smart healthcare products easily (Shim and Jo 2020). It can be taken into account as an important feature to encourage the continued use of medical care. It can be said that by improving the website quality, users can meet their needs easily.

H2.3 *"Website quality" is positively related to "user satisfaction".*

The role of website quality in achieving user satisfaction is significant because it determines service usage (Tang et al. 2019). On the other hand, web services are the most widely used tool in today's world. Also, researchers revealed that the quality of healthcare services has a significant effect on client and patient satisfaction (Carvalho et al. 2017; Shim and Jo 2020). User satisfaction is one of the determinants of healthcare with financial and non-financial advantages. To enhance long-term performance and user satisfaction managers should pay more attention to different kind of services and their improvement. So, the impact of website quality on the satisfaction of the patients and service quality reveals the importance of this component in the healthcare area.

H3.1 *"Service quality" is positively related to "perceived ease of use".*

To reach perceived ease of use in the healthcare systems, promoting the quality of services is a vital issue (Fiorini et al. 2017). Service quality has important effects on the medical electronic record. It indicates that increasing the quality of services helps healthcare managers deal with uncertain situations.

H3.2 *"Service quality" is positively related to "user satisfaction".*

According to the literature, there are positive interactions between web-based service quality and user satisfaction (Haruna et al. 2017). Also, researchers reveal a close inter-relationship between service quality and user satisfaction in the treatment process in medical centers. In fact, managers can improve satisfaction in healthcare centers by improving the elements of service quality such as speed and quality of response.

H5.1 *"Perceived ease of use" influences "perceived usefulness".*

To enhance healthcare education in medical centers, managers define perceived ease of use as an effective tool to earn a high level of usefulness. It influences the perceived usefulness of continuous intentions of using e-services in hospitals (Chirchir et al. 2019). Also, perceived ease of use helps to decrease the insufficient medical recording time and promote the level of usefulness in healthcare centers (Tasma et al. 2017). Therefore, an important relationship is between these elements in TAM.

H5.2 "Perceived ease of use" influences "user attitude".

Healthcare professionals need to feel that system services are easy to use because it affects user attitude in healthcare systems (Sayyah Gilani et al. 2017). Also, developing an effective user attitude can be obtained by providing compatible conditions to present the healthcare services. For example, mobile e-services by modifying the perceived ease of use have a positive influence on the user attitude (Cheng et al. 2019).

Healthcare is closely related to human life. Decreasing the costs of health services and increasing the response speed and performance quality are considered critical issues in recent years (Dingley 2017; Kaplan et al. 2017). Healthcare has an important role in the quality of human life in every aspect (Rousseau et al. 2017). Managers in healthcare centers should determine new and comprehensive practices and strategies that are adaptive to the present and future (Sundberg et al. 2017). Hence, identifying a structured framework is a requirement at present. Modeling critical enablers in research can help the analysis process to obtain more reliable results adaptive to real-world cases (Guo et al. 2019). Beglaryan et al. (2017) state that healthcare systems and relevant products and services have essential needs and should be modified according to the new changes in the human life cycle. Researchers can consider the modeling of vital elements based on TAM to improve the level of performance in all aspects of healthcare (O'leary et al. 2015). It is said that developing an enhanced version of TAM for research provides more accurate and detailed results (Saadi et al. 2017).

4 Research methodology

To implement the proposed framework, some Iranian hospitals providing different e-services have been considered in this survey. The populations of this study were the patients who used these hospital e-services in the previous year and arrived at the hospital at various hours of the day and night. A questionnaire was produced and distributed to patients that do not include any patient information and is anonymous. Since the population size is unlimited in the Cochran formula, the sample number can be 384 people. The sample size increased to 400 patients to ensure enough responses even if some patients doing the survey do not answer some of the questions. Questionnaires were used in the pilot study. About 50 patients completed the questionnaire and provided useful comments. Based on the feedback of the respondents, changes were made to the questionnaire to improve its readability and ensure accuracy and appropriateness. In addition, the validity and reliability of the scales and factor analysis were performed on the pilot study data. The results showed that the tests were adequate.

Ten field experts accepted the responsibility to distribute the questionnaires to the patients. The patients were selected randomly. Also, questions were designed such that do not affect the responses of patients and cause interference. The patients were assured of their privacy and that the process was fully safe for them so that they could provide their answers without any hesitation.

The value of the standard normal variable at a 95% confidence level is 1.96. From 400 questionnaires that were distributed to patients in this survey, 216 valid completed questionnaires were collected. To achieve a complete understanding of this section, comprehensive descriptions of the demographic characteristics of the sample set which includes gender, age, and education degree were presented. Table 2 shows the frequency distribution of respondents by gender, age, and educational level.

4.1 Data collection and measures

Data can be collected in the field or sometimes by reviewing the literature. Among common and popular tools in data collection are questionnaires, interviews, observations, and tests. This research study, it was tried to collect data from a literature review and field surveys. According to the model, there are nine variables to evaluate the relationships. The "Appendix" provides a measurement summary with all remaining items. The measurement tool of each one is explained here.

Computer literacy: To measure "computer literacy", a questionnaire has been developed based on Son et al. (2011). This questionnaire has 14 related questions.

Website quality: To measure "website quality", a questionnaire has been developed based on Shin et al. (2013)

Table 2 Respondents' demographic characteristics

Information	Frequency	Percentage (%)
Gender		
Male	148	68.52
Female	68	31.48
Age (years)		
Under 20	9	4.17
20–30	73	33.79
31–40	111	51.39
Over 40	23	10.65
Educational level		
Diploma	18	8.33
Associate	69	31.94
Bachelor	97	44.91
Master and higher	32	14.82

and Kim and Stoel (2004). This questionnaire has six related questions.

Service quality: To measure the electronic "service quality", a researcher-made questionnaire has been developed based on the suggested process by Bienstock et al. (1996). This questionnaire has 11 related questions.

Perceived enjoyment: To measure "perceived enjoyment", a questionnaire has been developed based on Chiu et al. (2009). This questionnaire has five related questions.

Perceived ease of use: To measure the "perceived ease of use", a questionnaire has been developed based on Chiu et al. (2009). This questionnaire has five related questions.

User satisfaction: To measure "user satisfaction", a questionnaire has been developed based on Puriwat and Triopsakul (2021) and Wang and Liao (2007). This questionnaire has four questions.

Perceived usefulness: To measure the "perceived usefulness", four questions have been developed (Chiu et al. 2009).

User attitude: To measure the "user attitude" towards the use of technology, a questionnaire has been developed (Yang 2012). This questionnaire has also four related questions.

Willingness to use e-services: To measure the "willingness to use e-services", a questionnaire has been developed (Chang et al. 2015b; Liang et al. 2011). This questionnaire has four related questions.

The reliability of the measurement tools is an essential factor that helps researchers gain some level of confidence in the results. In this study, the reliability analysis is based on Cronbach's alpha method and is performed by IBM SPSS v.23. Based on the assumption, if $\alpha > 0.7$, the results of the research are considered reliable. Validity analysis determines the degree of conformance of the conceptual definition and the operational definition. We have used LISREL 9.1 to conduct a confirmatory factor analysis (CFA) to assess the validity. The CFA is one of the well-known and reliable methods in order to investigate the relations between the observable and latent variables (Schreiber et al. 2006). The reason for using the mentioned software is its high efficiency over other software for evaluating the conceptual models such as TAM, where a large number of independent and dependent variables exists. Moreover, the LISREL is the common, well-known and efficient software to use when there is a predetermined conceptual model with the observable and latent variables as in this study.

The other inferencing analysis is the Path analysis. Path analysis is the development of regression models and the application of multivariate regression concerning the prominent formulation of causal models (Lleras 2005). Its purpose is to obtain quantitative estimates of the causal relationships

between a set of variables. The relations among the variables are in one. Path analysis seems to be one of the best methods to evaluate the relations among the variables in the conceptual models (Kirk et al. 2019). Path analysis is proposed to obtain quantitative estimates where causal relationships between a set of variables exist (Wright 1934).

5 Results

The Kolmogorov–Smirnov test is used to assess the univariate data normality. All the significance values are more than 0.5 and the Null hypothesis should be verified. Hence, the collected data for the research variables can be considered to have a normal distribution. Table 3 shows the final factor loading for each latent construct and Cronbach's alpha. The results show that all constructs have Cronbach's alpha above 0.7. All factors have been loaded highly on relative constructs with an acceptable significance level ($p < 0.01$); hence, it is possible to achieve convergent validity. All CFA models have satisfactory fit indices ($RMSEA \leq 0.06$; $1 \leq \text{Chisquare}/df \leq 3$; GFI, AGFI, CFI, and NFI ≥ 0.9).

5.1 Path analysis

After determining the validity and reliability of the measurement tools, path analysis is done. To determine the relationships between variables in the proposed model, the Pearson correlation coefficient is used in this study. The results of the correlation coefficient between all research variables are shown in Table 4. The results indicate that the correlation coefficient is positive and significant.

Figure 2 shows the tested conceptual model with the standard values for 14 significant paths of cause and effect relations between the variables. From the path correlations, findings indicate that only the influence of the "user attitude on the willingness to use e-services" is not significant but all the others are positive and significant.

All findings of the paths are listed following:

1. Paths one and two indicate that "computer literacy" will positively influence the "perceived enjoyment" and "perceived ease of use".
2. Paths three, four, and five indicate that "website quality" will positively influence "perceived enjoyment", "perceived ease of use" and "user satisfaction".
3. Paths six and seven indicate that "service quality" will positively influence the "perceived ease of use" and "user satisfaction".
4. Path eight indicates that "perceived enjoyment" is significant to the "perceived usefulness".

Table 3 Questionnaire reliability and validity

Model constructs	Scales (questions of factor)	Confirmatory factor analysis				
		Standardized factor loading	T-statistics	Alpha		
Computer literacy (V1)	CL1	0.60	–	0.86		
	CL3	0.77	8.60			
	CL4	0.74	8.30			
	CL5	0.62	7.38			
	CL6	0.64	7.63			
	CL7	0.57	6.95			
	CL8	0.57	6.90			
	CL9	0.54	6.61			
	CL10	0.53	6.51			
	CL12	0.60	7.16			
	CL13	0.54	6.54			
	CL14	0.60	8.40			
	Website quality (V2)	WQ1	0.44		–	0.83
		WQ2	0.59		6.25	
WQ3		0.57	5.13			
WQ4		0.53	4.94			
WQ5		0.81	5.65			
WQ6		0.66	5.45			
Service quality (V3)	SQ1	0.46	–	0.84		
	SQ2	0.38	6.44			
	SQ3	0.74	6.78			
	SQ5	0.37	6.28			
	SQ6	0.65	5.97			
	SQ7	0.68	5.27			
	SQ9	0.62	5.87			
	SQ10	0.54	5.48			
	SQ11	0.85	6.05			
	Perceived enjoyment (V4)	PE1	0.78		–	0.78
		PE2	0.75		12.91	
PE3		0.75	12.94			
PE4		0.77	12.38			
PE5		0.56	8.76			
Perceived ease of use (V5)	PEU1	0.84	–	0.75		
	PEU2	0.79	13.01			
	PEU3	0.74	11.86			
	PEU4	0.77	12.79			
	PEU5	0.79	13.24			
User satisfaction (V6)	US1	0.45	–	0.72		
	US2	0.96	12.10			
	US3	0.72	11.17			
	US4	0.97	12.35			
Perceived usefulness (V7)	PU1	0.80	–	0.74		
	PU2	0.79	18.52			
	PU3	0.89	18.37			
	PU4	0.87	17.74			
User attitude (V8)	UA1	0.78	–	0.77		
	UA2	0.85	16.57			
	UA3	0.88	17.66			
	UA4	0.75	13.28			

Table 3 (continued)

Model constructs	Scales (questions of factor)	Confirmatory factor analysis		
		Standardized factor loading	T-statistics	Alpha
Willingness to use e-services (V9)	WUE1	0.77	–	0.72
	WUE2	0.83	10.62	
	WUE3	0.68	9.36	
	WUE4	0.59	8.08	

Table 4 Correlation matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9
V1	1.00								
V2	0.35**	1.00							
V3	0.29**	0.28**	1.00						
V4	0.43**	0.49**	0.36**	1.00					
V5	0.48**	0.36**	0.35**	0.38**	1.00				
V6	0.43**	0.31**	0.42**	0.40**	0.50**	1.00			
V7	0.50**	0.35**	0.30**	0.42**	0.66**	0.65**	1.00		
V8	0.35**	0.29**	0.51**	0.34**	0.34**	0.46**	0.41**	1.00	
V9	0.57**	0.39**	0.25**	0.35**	0.54**	0.48**	0.64**	0.18*	1.00

* $p < 0.05$; ** $p < 0.01$

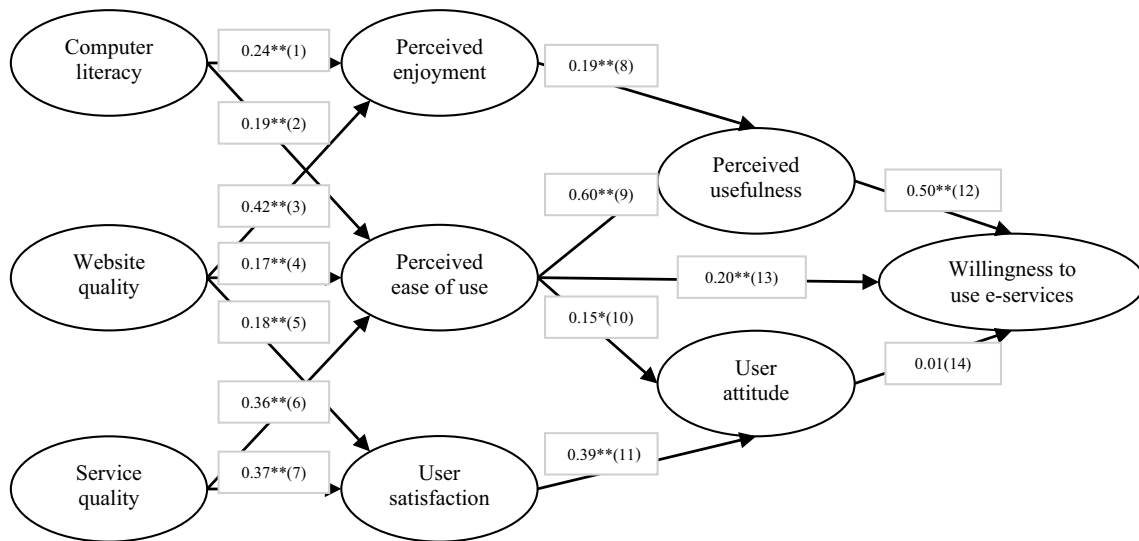


Fig. 2 Standard coefficients of the tested research model (* $p < 0.05$, ** $p < 0.01$)

- Paths nine, ten, and eleven indicate that "perceived ease of use" is significant to the "perceived usefulness", "willingness to use e-services" and "user attitude".
- Path twelve indicates that "user satisfaction" is significant to the "user attitude".
- Path thirteen indicates that "perceived usefulness" is significant to the "willingness to use e-services".
- Path fourteen indicates that "user attitude" is not significant to the "willingness to use e-services".

Table 5 shows the direct, indirect, and total influence of the research variables and the explained variance for each variable. Based on the results in Table 5, only the indirect influence coefficient of user satisfaction on the willingness to use e-services and service quality is not significant. Also, 42% of the variance of the "willingness to use e-services", 20% of the variance of the "user attitude", 45% of the variance of "perceived usefulness", 31% of the variance of the "perceived ease of use", 30% of the variance of

Table 5 The results of direct, indirect, and total influence coefficients

Paths	Direct	Indirect	Total	Variance extracted (%)
On the V9 from				
V8	0.01	–	0.01	
V7	0.50**	–	0.50**	
V5	0.20**	0.30**	0.50**	
V6	–	0.01	0.01	42
V4	–	0.10**	0.10**	
V3	–	0.12**	0.12**	
V2	–	0.13**	0.13**	
V1	–	0.18**	0.18**	
On the V8 from				
V5	0.15*	–	0.15*	
V6	0.39**	–	0.39**	
V4	–	–	–	20
V3	–	0.03	0.03	
V2	–	0.10**	0.10**	
V1	–	0.20**	0.20**	
On the V7 from				
V5	0.60**	0.60**	0.60**	
V6	–	–	–	
V4	0.19**	–	0.19**	45
V3	–	0.16**	0.16**	
V2	–	0.19**	0.19**	
V1	–	0.22**	0.22**	
On the V5 from				
V3	0.36**	–	0.36**	
V2	0.17**	–	0.17**	31
V1	0.19**	–	0.19**	
On the V4 from				
V2	0.42**	–	0.42**	30
V1	0.24**	–	0.24**	
On the V6 from				
V2	0.18**	–	0.18**	22
V3	0.37**	–	0.37**	

Table 6 Fitting indices of the proposed model

χ^2/df	RMSEA	CFI	GFI	NFI	AGFI
1.89	0.065	0.99	0.96	0.98	0.93

the "perceived enjoyment", and 22% of the variance of the "user satisfaction" are determined by the variables of the proposed model in this research study. The final fit indices of the tested model are given in Table 6. The results reveal that all fit indices are at a suitable level for the research variables. Hence, the collected data in this survey have a good fit with the factorial structure of the proposed model.

6 Discussion

The purpose of this research study was to develop a conceptual model for users' acceptance of e-services in healthcare centers. The procedure of this research study was descriptive and the method used was path analysis based on correlation coefficients. 216 patients using e-services in Iranian hospitals participated in this survey. In addition, the measuring tool used in this research study consisted of questionnaires related to computer literacy, website quality, service quality, perceived enjoyment, perceived ease of use, user satisfaction, perceived usefulness, user attitude, and willingness to use e-services as the variables of the proposed model. In the following, a brief discussion of the results is provided.

The influence of "computer literacy" on "perceived enjoyment" is positive and significant (0.24), when $p < 0.01$. It means that H1.1 is verified. Patients with a high level of "computer literacy" can create, sustain, and deepen their communication with others to access, evaluate and use the essential information to meet their needs. Therefore, being computer literate leads to an increase in individual capabilities and perceived enjoyment in the use of technology.

Furthermore, the influence of "computer literacy" on the "perceived ease of use" is positive and significant (0.19), when $p < 0.01$. H1.2 is verified. When reliable information, collaborative services, a high level of security, and minimum patient waiting time are available on computers, satisfaction in all sections can be achieved. Again, computer literacy leads to an increase in individual capabilities and perceived ease of use in the use of technology.

The influence of the "website quality" on the "perceived enjoyment" is positive and significant (0.42), when $p < 0.01$. Hence, H2.1 is verified. Customers are satisfied when the process of ordering goods or services through the company's websites is simply done and the e-commerce websites of the company are designed to make it possible in the shortest possible time. Also, their perception will affect the ease of use and will increase the attractiveness of the purchase. Hence, having a high-quality website leads to an increase in individual capabilities and perceived enjoyment in the use of technology as well.

Next, the influence of the "website quality" on the "perceived ease of use" is positive and significant (0.17), when $p < 0.01$. It means that H2.2 is verified. Here too, the process of ordering products or services through the company's websites and the e-commerce websites of the company is designed to do it in the shortest possible time and satisfy customers. Also, their perception will affect the ease of use and will increase the attractiveness of

purchase. High level of "service quality" in cyberspace can help patients and healthcare centers to achieve the required satisfaction and efficiency. Therefore, high quality website leads to an increase in individual capabilities and perceived ease of use in the use of technology.

Tables also show that the influence of "website quality" on "user satisfaction" is positive and significant (0.18), when $p < 0.01$. This means that H2.3 is verified. When the patient is satisfied with the healthcare services such as website services, it can affect their attitudes. So, when the process of ordering products or services through the website of the healthcare center is simple and the healthcare electronic shopping website has a perfect design, it can speed up the purchase and the treatment process. It has a significant influence on user satisfaction. Hence, a high level of website quality leads to an increase in individual capabilities and user satisfaction with the use of technology.

Another data, the influence of the "service quality" on the "perceived ease of use" is positive and significant (0.36), when $p < 0.01$. This means that H3.1 is verified. The high level of perceived ease of use can help patients and healthcare centers to obtain a high level of person's self-confidence and self-efficacy, which also creates a positive attitude toward the use of the system. If the high quality of healthcare services is constantly maintained, the expectations of the patients in healthcare systems can be met and this will affect the ease of use of patients. Similarly, a high level of service quality leads to an increase in individual capabilities and perceived ease of use in the use of technology.

The influence of the "service quality" on "user satisfaction" is positive and significant (0.37), when $p < 0.01$. This means that H3.2 is verified. If the healthcare services are maintained with high quality, the expectations of the patients can be met in the healthcare systems and increase the satisfaction of the patients. A high service quality can help the members and patients to perform their tasks as well as to meet their needs in the healthcare centers. Again, a high level of service quality leads to an increase in individual capabilities and user satisfaction with the use of technology.

Another outcome shown in those tables is the influence of the "perceived enjoyment" on the "perceived usefulness" is positive and significant (0.19), when $p < 0.01$. Thus, H4 is verified. If the use of e-services provided by healthcare centers such as the website health services are attractive and satisfactory to customers, perceived ease of use of e-services can be increased. Hence, a high perceived enjoyment leads to an increase in individual capabilities and perceived usefulness in the use of technology.

Next item, the influence of the "perceived ease of use" on the "perceived usefulness" is positive and significant (0.60), when $p < 0.01$. H5.1 is also verified. Based on the technology acceptance pattern, the perceived ease of use is an important variable that influences the acceptance of

computer technology. If the use of computers increases the efficiency of members and patients, the positive attitude and usefulness of the persons can be enhanced. Hence, an acceptable perceived ease of use leads to an increase in individual capabilities and perceived usefulness in the use of technology.

The influence of the "perceived ease of use" on the "user attitude" is also positive and significant (0.15), when $p < 0.05$. Now H5.2 is verified. If e-services in healthcare systems are easy for the users to learn and remember, it will affect the user's attitude. In addition, the ease of use of a system improves the self-confidence and self-efficacy of the individual, which also creates a positive attitude toward the use of that system. Therefore, an acceptable perceived ease of use leads to an increase in individual capabilities and user attitudes toward the use of technology.

The influence of "user satisfaction" on the "user attitude" is positive and significant (0.39), when $p < 0.01$. H6 is verified. If the patients are satisfied with the order of the healthcare e-services, it affects their attitude. Hence, the high level of user satisfaction leads to an increase in individual capabilities and user attitudes toward the use of technology.

Furthermore, the influence of the "perceived usefulness" on the "willingness to use e-services" is positive and significant (0.50), when $p < 0.01$. H7 is verified. Since using the e-services provided by healthcare centers decreases the costs, and increases both the speed of service and the usefulness of the service delivery process, it can affect the "willingness to use the e-service". Hence, the high level of perceived usefulness also leads to an increase in individual capabilities and willingness to use e-services in the use of technology.

Same as above, the influence of the "perceived ease of use" on the "willingness to use e-services" is positive and significant (0.20), when $p < 0.01$. Thus, H8 is verified. If the use of e-services is easy, then the "willingness to use e-services" will increase. Therefore, an acceptable perceived ease of use leads to an increase in individual capabilities and willingness to use e-services in the use of technology.

The influence of the "user attitude" on the "willingness to use e-services" is positive but not significant (0.01), when $p > 0.05$. Thus, H9 is not verified. Note that the "user attitude" has no acceptable effect on the "willingness to use e-services". Therefore, the high level of user attitude does not lead to an increase in individual capabilities and willingness to use e-services in the use of technology.

7 Managerial implications

The findings of this work provided a comprehensive set of guidelines for healthcare managers to promote the quality of e-services and to improve the willingness to use e-services.

The results and discussion indicate the importance of the variables and their relations leading to efficient use of the e-services by users and patients in healthcare centers and also over the web. The managerial implications are as follows:

1. computer literacy influences perceived enjoyment and perceived ease of use. Thus, it is suggested that health officials should promote the users' computer literacy skills by organizing short-term courses for them to improve their ability to use e-services.
2. website quality has an effect on perceived enjoyment, perceived ease of use, and user satisfaction. Healthcare centers should design their website simple to use, attractive and acceptable to find related information in a short time. It is also recommended to use appropriate graphic shapes, colors, and fonts on the hospital website.
3. The service quality affects the perceived ease of use and user satisfaction. Healthcare centers should incorporate relevant, detailed, and comprehensive information on their websites. In addition, other features that should be considered are reliable and updated knowledge and information, providing timely e-services, cyberspace security of patient personal information, speed of resolving e-services problems, coordination of virtual service with non-virtual service, and continuous service delivery. Observing these items can increase the perceived ease of use and user satisfaction.
4. The perceived enjoyment relates to the perceived usefulness. Hence, healthcare centers should focus on the structure of their websites to be more usable and enjoyable for the users. It should be noted that if the structure of the e-service is attractive and useful, then the acceptance rate by the users will keep increasing.
5. user satisfaction and user attitude are related. Healthcare centers should increase user satisfaction by designing a comprehensive website with accessible services according to the needs and educational level of the societies. It improves the attitudes of the users about e-services leading to better and greater use of these services at the macro level.
6. The perceived ease of use influences the perceived enjoyment, user attitude, and willingness to use. Thus, healthcare centers should try to localize their health apps and related services, design or translate the health apps into the native language of the users and improve the quality of the graphical User Interface (UI) and User Experience (UX) and accessibility of the apps.
7. The perceived usefulness relates to the willingness to use e-services. Required information such as reduced costs, increased speed of access and other advantages of e-services should be presented to users to increase their willingness to use these services.

8 Conclusion

A comprehensive conceptual model in healthcare systems to improve user acceptance of e-services based on TAM is presented. The statistical population for the study was patients who used the electronic services of the hospitals during the past year. Also, data were collected through a questionnaire and survey method. About 400 patients who were selected using a simple random sampling method filled out the questionnaire. To determine the relationship between variables and their effect, a path analysis model (with SPSS and LISREL software) and SEM were used. The results showed that computer literacy has positive effects on perceived enjoyment and ease of use. Website quality had positive effects on perceived enjoyment, ease of use, and user satisfaction. Perceived enjoyment had a positive effect on perceived usefulness. Ease of use had positive effects on the usefulness, willingness to use electronic services, and user attitude. User satisfaction had a positive effect on the user attitude. Perceived usefulness had a positive effect on the willingness to use e-services. Finally, among these variables, only the user attitude had no significant effect on the willingness to use e-services in the healthcare system. In future research, researchers are open to developing a research approach based on qualitative variables or a combination of a qualitative and quantitative approach (mixed method) in introducing a model to identify factors affecting the use of hospital e-services. Furthermore, the model presented in this paper analyzed only some of the *factors* affecting e-services. It is suggested that future research can focus on other backgrounds and implications.

8.1 Limitations of the study

- Inadequate accuracy in patient responses or unwillingness of some patients to answer the questions is a limitation in this questionnaire-based survey study as well as the distribution and collection process.
- The collected information can be incorrect and based on wrong judgments. Research data were collected through the self-reporting of respondents. Therefore, opinions and perceptions may be mixed with prejudices, ideas, and personal judgments that affect the validity of research results.
- 400 questionnaires were distributed but only 216 patients responded which was less than the expected number. A larger sample size is preferred.

8.2 Suggestions for the future studies

- In this study, a quantitative approach has been used. It might be worth trying a qualitative approach or an integrated quantitative–qualitative approach and comparing the results to this work.
- The model presented in this study be compared to other hospitals in different locations in the world.
- Having a 42% variance in the “willingness to use e-services”, it is recommended to identify and investigate the other effective variables in this manner.

Appendix: Measurement summary with all remaining items

Scale	Items
Computer literacy	Turning the computer on and off File management including deleting and renaming files, etc. Installing a software program Scanning disks for viruses Writing files onto a CD Resizing a photograph Recording and editing sounds? Printing a document using a printer Creating a basic Excel spreadsheet Creating a simple presentation using PowerPoint Searching for information online using a Web search engine Downloading and saving files from the Web Using a video conferencing tool on the Web Using your professional software
Website quality	This website is very convenient to use It takes a short time to use this website A first-time user can use this website without much help The website is visually appealing This website has a good selection The website's appearance is professional

Scale	Items
Service quality	There is good information on the hospital website Hospital website information is up to date Reliable information is available on the hospital website Services are provided on a scheduled basis on the hospital's website Patient information on the hospital website is secure There is the necessary speed of action in solving the problems of the hospital website The exact time to provide services will be announced on the hospital website I trust the hospital website for services I feel safe and secure when using the hospital website The hospital's website is serviced on an ongoing basis Patients' expectations are met on the hospital website
Perceived enjoyment	I have fun when interacting with the website Using the website to use services provides me with a lot of enjoyment I think that using services from the website is interesting Based on my experience with online websites in the past, I feel it is more attractive than other hospitals I have fun when using the electronic service processes
Perceived ease of use	Learning to operate the website is easy My interaction with the website is clear and understandable The website is easy to use It is easy to become skillful at using the website The website is flexible to interact with

Scale	Items
User satisfaction	I feel satisfied with using the electronic services of this hospital
	I feel pleased with using the internet services of this hospital
	I feel content with the information provided about the services of this hospital when using it electronically
Perceived usefulness	Overall, I am delighted with the electronic services of this hospital
	The website improves my performance when searching for and getting services
	The website makes it easier to search for and get services
	The website enhances my effectiveness in services searching and getting services
User attitude	The website is useful for searching for and getting services
	In my opinion, using the electronic services of this hospital is attractive and interesting
	I have a positive attitude toward using the electronic services of this hospital
	In my opinion, using the electronic services of this hospital is a wise idea
	I am more interested in using the electronic services of this hospital when I need services
Willingness to use e-services	I intend to continue using the electronic services of this hospital
	If possible, I will keep on using the electronic services of this hospital in the future
	I would strongly recommend others use the electronic services of this hospital
	I prefer the use of e-services in this hospital to physical services

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Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest All authors declare that they no conflict of interest.

Consent to publish The authors agree to publish this paper in the Journal of Ambient Intelligence and Humanized Computing.

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