Journal of Innovation & Knowledge 6 (2021) 135–144

Journal of Innovation & Knowledge

https://www.journals.elsevier.com/journal-of-innovation-and-knowledge

Chatbot usage intention analysis: Veterinary consultation

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ARTICLE INFO

Article history:
Received 21 June 2020
Accepted 24 September 2020
Available online 3 November 2020

Keywords:
Technology acceptance model
User satisfaction
Behavioral intention

ABSTRACT

This study uses artificial intelligence and big data technologies to develop a chatbot prototype for veterinary consultations. To understand pet owners' behavioral intentions to use the chatbot for veterinary consultations, we modify the technology acceptance model to develop a usage intention model for the veterinary consultation chatbot. We survey members of a pet network community by using Google Forms to collect data and partial least squares structural equation modeling for analysis. The results indicate that the perceived accuracy, perceived completeness, and perceived ease of use increased pet owners' user satisfaction of veterinary consultation chatbot; the perceived convenience and pet owners' user satisfaction increased pet owners' behavioral intention to use chatbot for veterinary consultations. This study can be used as a basis for evaluation of using intelligent technologies in pet healthcare consultation and pet disease management.

Introduction

The emergence of the Internet changes how people communicate as well as how people and businesses interact. Because of its convenience and global popularization, the Internet drives the development of e-commerce. In addition to driving the development of mobile commerce (Ngai & Gunasekaran, 2007; Wu & Wang, 2005), the ubiquitous accessibility of wireless network and the high penetration rate of mobile devices provide a juncture for enterprise transformation. The process of integrating innovative information technologies with existing operational models allows enterprises to move beyond traditional company cultures, operational processes, value propositions, customer experiences, and fully transform into agile organizations centered on customer values and experiences that continue to update and transform themselves. Enterprises can then provide customers with diverse and convenient services to develop and maintain direct customer relationships; for example, allowing users to complete commercial transactions on their mobile devices was previously impossible (Pavlou, Lie, & Dimoka, 2007).

Instant messaging applications are attracted attention with the development of wireless network and mobile devices. Instant messaging application continues to increase in prominence among the current network generation; people constantly use instant messaging application, which has gradually replaced traditional mobile phone communications and text messaging to become the most common application on mobile devices and integral tool to daily life (Cunningham, 2003; Ramirez & Broneck, 2009).

With the flourishing of instant messaging application and the continued maturing of artificial intelligence (AI) technologies, chatbots are used in Internet marketing or customer relationship management in business activities as well. Chatbots built in instant messaging application are easy to use because they use the instant messaging application's advantages and can be assimilated into daily scenarios. Semantic analysis technology allows chatbots to autonomously converse with users to identify and respond to user needs, and thus chatbots become preferred by enterprises for communicating instantaneously with users in terms of efficiency and benefits. WeChat, the most popular instant messaging application in China, develops chatbot function in its system in 2013 and provides its chatbot development platform for businesses to create their own intelligent customer service chatbots. Later, other instant messaging applications, such as Telegram, Line, and Slack, are continually released their individual chatbot development platforms as well (Quoc, 2016). In addition, at the 2016 F8 Developer Conference, Facebook founder Mark Zuckerberg announced an application programming interface for Facebook Messenger, and this application programming interface allows enterprises to create chatbots for Facebook Messenger. Nowadays, chatbots are the mainstream

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https://doi.org/10.1016/j.jik.2020.09.002

applications in the business world and led the surge of conversational commerce.

Integration with AI and big data technologies is the newest trend in chatbots. Deep learning is the technology most often used by AI chatbots. Using deep learning technologies, chatbots can learn from conversation databases or knowledge database to create a model that helps it predict new message inputs and generate corresponding message outputs. Thus chatbot can converse with users as if it has a human brain capable of autonomous thought. Because AI chatbots are effective in answering questions, they are most often used in commercial customer service and can even be used in complex medical consultations, such as those for pet illnesses.

According to statistics from the American Pet Products Association (APPA), the North American pet economy accounts for 37% of the total value of the global pet market. The United States has one of the largest pet economies in terms of scale and development; as many as 84.60 million households in the United States have pets, and the penetration rate of pet ownership has increased from 56% in 1988 to 68% currently. Because fewer people are married or have children in China, more Chinese own pets. Based on research by the Chinese pet website Goumin.com, pet expenses in China reached CNY 202 billion in 2019, growing by 19% compared with 2018. Furthermore, Japan, the Asia country with the most serious aging problem, is the largest Asian economy in terms of pet ownership and consumerism. As many as 28% of Japanese families own pets, and the Japanese pet market was approximately ¥154 trillion in 2018.

According to the *2019–2020 U.S. Pet Market Outlook Report* (Packaged Facts, 2019), the sales of pet technology products in 2018 reached US$ 565 million. Whether you want new ways to monitor, entertain, or feed your pets, more and more information technologies have provided innovative solutions to keep your pets happy and healthy even when you are away from home. The application of information technology to pet breeding, caring, and managing mainly includes the following aspects:

Pet e-commerce: Using an e-commerce platform to allow pet owners to buy pet supplies and food, and provide the latest pet health information to increase customer loyalty and per unit transaction (Purba, Hery, & Widjaja, 2019; Widmar et al., 2020).

Pet wearable device: A pet wearable device can let you know the physical condition of a pet at any time, or the activities of a pet when you are not at home (Linden, Zamansky, Hadar, Craggs, & Rashid, 2019; Ramokapane, Linden, & Zamansky, 2019).

Smart pet toys: The touchpad of smart pet toys will light up and make sounds in a different sequence. Pets must tap the correct touchpad to get treatment. The software can adjust the difficulty level with longer patterns to improve the agility and memory of pets and keep them active (Lee et al., 2019).

Smart pet feeding: A Smart pet feeder allows you to feed pets from anywhere using your smartphone (Babu, Kumar, & Kuppusamy, 2019; Chen & Elshakankiri, 2020; Sangvanloy & Sookhanaphibarn, 2020).

Pet telemedicine: Using an online medical care platform to provide remote consultation between veterinarians and owners (Roca & McCarthy, 2019; Widmar et al., 2020).

Although the application of the above innovative technologies will make it more convenient for owners to breed and manage their pets, most of these innovative applications only focus on strengthening the connection between owners and pets. As for health care and disease consultation, they focus on the development of online platforms that provide remote veterinary consultations through the Internet. However, this remote consultation mode only allows pet owners to consult a veterinarian on their pet's illness without going out; this means that remote consultation is still constrained by the veterinarians' fixed consultation hours and relies heavily on the support of the Internet bandwidth and video conferencing equipment. It, therefore, cannot meet the consultation needs of all owners. In this study, AI and big data technologies are used to develop a chatbot prototype that can consult on pet diseases. The chatbot prototype can assist veterinary teams in providing pet owners with consultation services and alleviate the inconveniences of transporting pets to veterinary clinics. To understand pet owners' usage intention, we modify the technology acceptance model (TAM) (Davis, Bagozzi, & Warshaw, 1989) to investigate factors that affect pet owners' use of veterinary consultation chatbots.

The technology acceptance model was initially used to study user acceptance factors for computer systems. It was later extended to evaluate user acceptance factors for various information technologies. In recent years, with the popularity of wireless networks and mobile devices, the technology acceptance model has also been widely used to evaluate user acceptance factors for mobile applications and remote services. For example, Estriegana, Medina-Merodio and Barchino used the technology acceptance model to evaluate the student acceptance of virtual laboratories and practical work (Estriegana, Medina-Merodio, & Barchino, 2019); Min, So and Jeong used the technology acceptance model to evaluate the consumer acceptance of Uber mobile applications (Min, So, & Jeong, 2019); Hu et al. used the technology acceptance model to evaluate bank users' adoption intention of fintech services (Hu, Ding, Li, Chen, & Yang, 2019); Portz et al. explored the use behavior of a patient portal among the elderly with chronic conditions (Portz et al., 2019).

According to the results of empirical analysis, in the proposed chatbot usage intention model, the perceived accuracy, perceived completeness, and perceived ease of use increased pet owners' user satisfaction of veterinary consultation chatbot; the perceived convenience and pet owners' user satisfaction increased pet owners' behavioral intention to use chatbot for veterinary consultations. By comparing our proposed model and classic TAM, we found that useful information must be accurate and complete when pet owner uses veterinary consultation chatbot. In addition, chatbot indeed provides more convenience than traditional consultation methods for pet owners who need to veterinary consultation.

The rest of the paper is organized as follows: Section 2 describes the definition, operation model, classifications, and applications of chatbots as well as the two major theories used in this study—technology acceptance model and media synchronization theory. Section 3 explains the research method and structure. Section 4 presents the research results, and Sections 5 and 6 comprise the implication and conclusion.

Literature review

Chatbot

A chatbot is a computer program that conducts conversations by using dialogue or text (Deshpande, Shahane, Gadre, Deshpande, & Joshi, 2017; Hussain, Ameri Sianaki, & Ababneh, 2019). Chatbots are often used in business activities, such as customer service or product information providing. Some chatbots use natural language processing systems to analyze users' inputted sentences, but most simple chatbots identify only inputted keywords and search for the most appropriate response sentences from their repositories or databases. General chatbot operations have three elements: users, instant messaging application, and chatbots. The user sends a message or request, and the instant messaging application is the medium in which users and the chatbot send messages.

On the basis of the scope of questions and answers, chatbots can be divided into two types: virtual assistants and chatterbots. Virtual assistants primarily answer users' questions in a specific field or for a specified objective, whereas chatterbots produce divergent dialogues not limited to specific domains or objectives. On the basis of their response mechanisms, chatbots can be divided into rule-based and generative models. Rule-based models respond to the user by using appropriate algorithms based on the inputted question or by selecting an appropriate response from its repository. Similar to machine translation technology, generative models generate new responses from scratch.

Jepma (2019) argued that the future development of chatbots will involve some critical trends: First, chatbots will be more widely applied in various industries. Particularly with the rapid development of AI, chatbots will be able to perform more tasks as well as more accurately identify user questions and intentions when equipped with AI to respond and resolve problems more intelligently. Second, a enterprise will generally have multiple chatbots and will manage their own chatbot technologies. In addition, the development of chatbots will no longer be limited to technical staff; nontechnical staff will also be able to develop chatbots. Third, organizations generally must handle different messaging channels, and these channels differ in prominence at different stages in the customer experience. Under ideal conditions, organizations will develop their chatbots to offer a unified solution across all channels. However, when the chatbot is unable to answer questions, human services must intervene seamlessly. As a result, human services become the more active service role at this stage. Next, chatbots can provide services through direct communication not only with consumers but also with other automated chatbots and systems. Finally, as voice-controlled assistants such as Google Home and Amazon Alexa increase in prominence, voice-command services will become more common.

These trends demonstrate that chatbots will incorporate critial information technologies such as AI, machine learning, deep learning, natural language processing, and voice recognition. Thus, chatbots will have unprecedented applications even in the complex field of intelligent medical services.

Chatbots have been used in many health related practices, such as sports activities (Kramer et al., 2019), psychological health (Hoermann, McCabe, Milne, & Calvo, 2017), drug compliance (Fang, Bjering, & Ginige, 2018), and depression and anxiety (Bickmore et al., 2010; Fitzpatrick, Darcy, & Vierhile, 2017; Fulmer, Joerin, Gentile, Lakerink, & Rauws, 2018; Philip, Micoulaud-Franchi, & Sagaspe, 2017), as well as expressing sympathy and compassion (Liu & Sundar, 2018).

This study integrated chatbots with professional teams in veterinary clinics to develop a chatbot prototype for veterinary consultation by using AI and big data technologies. This chatbot prototype can assist medical teams in providing pet owners with consultation services for pet diseases.

User satisfaction

The technology acceptance model (TAM) was developed by Davis et al. in 1989 to predict the behavior of information technology users on the theory of reasoned action (Fishbein & Ajzen, 1975) and the use of information systems. This model also accounts for the effects of external factors in the user's internal beliefs, attitudes, and behavior intentions and how internal factors affect technology use (Davis et al., 1989). Davis et al. proposed that in the theory of reasoned action, subjective norms have little influence, whereas uncertainty and difficulties in psychological measurement are the obstacles. Therefore, in TAM, subjective norms are eliminated and replaced with attitude. Furthermore, TAM incorporates perceived usefulness and perceived ease of use; perceived usefulness is defined as the extent of a person's belief that using a specific system will improve their work performance, and perceived ease of use is defined as the extent of a person's belief that using a specific system does not require much effort (Davis et al., 1989).

TAM assumes that some external variables affect perceived usefulness and perceived ease of use, which are mediators within external variables that affect willingness to use a system. Therefore, TAM can provide the basis for relationships among external variables, internal beliefs, attitudes, willingness to use, and actual use (Davis et al., 1989; Legrisa, Inghamb, & Collerettec, 2003).

Lee and Lehto (2013) argued that information systems can provide more content to increase their perceived usefulness (Park, Son, & Kim, 2012). The concept of content comprehensiveness is similar to that of information quality (Tung & Chang, 2008), which includes relevance, timeliness, and sufficiency (Jung, Perez-Mira, & Wiley-Patton, 2009); relevance refers to the degree of matching between the content and user needs (Park, Roman, Lee, & Chung, 2009), and timeliness refers to the degree to which information systems can provide users with current information (Wulf, Schillewaert, Muylle, & Rangarajan, 2006). Relevance and timeliness are defined in this study as the ability to respond to users with the most current and accurate information; therefore, they are expressed as "perceived accuracy."

In this study, attitude in TAM is defined as the level of satisfaction with using the chatbot to consult on pet diseases and is expressed as "user satisfaction." According to the above description, this study proposed the following hypothesis:

Hypothesis 1. (H1): Perceived accuracy increases user satisfaction.

In addition, sufficiency refers to the amount and total categories of data an information system can provide to users. In this study, sufficiency is defined as the ability to respond to a user with information with the most completeness and is expressed as "perceived completeness." The following hypothesis was proposed:

Hypothesis 2. (H2): Perceived completeness increases user satisfaction.

Furthermore, based on the TAM theoretical framework, perceived ease of use is a key perception that affects users' attitudes toward information systems. Therefore, this study proposed the following hypothesis:

Hypothesis 3. (H3): Perceived ease of use increases user satisfaction.

Behavioral intention to use

Lee and Lehto (2013) argued that apart from perceived usefulness and perceived ease of use, user satisfaction affects users' behavioral intention to use information systems. TAM also posits that users' attitudes toward information systems affects their behavioral intentions to use them. Therefore, the following hypothesis was proposed:

Hypothesis 4. (H4): User satisfaction increases behavioral intention to use.

Furthermore, many studies have demonstrated that perceived convenience is a key factor influencing consumer behavioral intentions. Most consumers desire simplicity when shopping and cannot spend too much time on searching for products or services, collecting information, or the general shopping process; therefore, simplifying the shopping process increases the possibility of attracting repeat customers. Gehrt and Yale (1993) indicated that improving the convenience of a service can enhance the customers' intention to return in the future. Berry et al. (2010) argued that experiencing the core benefits of a store's services reduces customer perceptions of time and energy spent when shopping and increases their intention to buy. Many studies on mobile commerce have also demonstrated that when users perceive benefits of using a new system, their intention to adopt or buy also increases. Cotte and Wood (2004) argued that consumers enjoy exploring new products; the convenience of saving time and energy when accepting services often drives consumers to use new ticket-purchasing channels and explore their functions. Providing consumers with transaction convenience in finance, payment, and delivery systems can increase their intention to buy.

Brown (1990) divided convenience into five aspects—time, location, access, use, and execution—to describe the degree of convenience of services and products for consumers. Berry, Seiders, and Grewal (2002)) evaluated the degree of convenience using time and efforts required. Yoon and Kim (2007) used Brown's definition of convenience as the basis of their study on wireless area networks and redefined convenience as time, location, and execution, eliminating access and use.

Dennis, Fuller, and Valacich (2008) argued that people use two communication processes in interpersonal relationships and perception: conveyance and convergence. Conveyance and convergence occur through another two processes: information transmission (including preparing information for transmission, using media, and receiving information from a medium) and information processing (understanding a message and integrating it into a shared understanding). Dennis et al. argued that on the basis of how media capabilities are deployed, the capabilities provided by each medium in supporting information transmission and information processing differ, and this determines media capability in achieving synchronized communication. Dennis, Fuller, and Valacich (2008) outlined the five media capabilities: 1. Transmission Velocity: Messages between the sender and recipient are sent rapidly by using a media tool, suggesting continual communication and exchanges between both parties through improved coordination and more rapid feedback. 2. Parallelism: For senders and recipients, allowing multiple messages to be sent and received simultaneously can reduce time that would be lost to transmission priorities or channel congestion to improve communication efficiency. 3. Symbol Sets: Many media allow the simultaneous transmission of different symbols (such as text, pictures, and video). A medium provides a symbol set appropriate for the message; symbol sets facilitate improved information transmission and processing processes and support synchronicity. 4. Rehearsability: Rehearsability refers to the sender's ability to rehearse or adjust a message during the editing process and before sending. Rehearsability allows the sender to precisely process information and increases the recipient's understanding of the message. 5. Reprocessability: Storage and reprocessing abilities provided by media allow users to understand past behaviors and reinterpret message content; this is crucial for large volumes of new and complex messages.

Dennis et al. (2008) posited that the rapid transmission of information enabled by the high transmission speeds of social media applications facilitates continual communication between senders and recipients and immediate recipient feedback; therefore, senders believe that communicating using social media apps is the most efficient. Because chatbots benefit from the transmission velocity and parallel traits of social media apps, users can receive veterinary consultations outside the confines of veterinary clinic hours and without in-person interactions. This can increase the willingness of pet owners to use chatbots for veterinary consultation. Therefore, the following hypothesis was proposed:

Hypothesis 5. (H5): Perceived convenience increases behavioral intention to use.

Research design

Conceptual framework and hypotheses

The research framework of this study (Fig. 1) is based on the TAM proposed by Davis et al. (1989) with revisions. Perceived usefulness, perceived ease of use, and behavioral intention to use are three critical variables of TAM. Lee and Lehto (2013) proposed that the quality of information is directly related to the user's perception of the information system's usefulness, and the quality of information can be interpreted in terms of relevance, timeliness, and sufficiency.

For veterinary consultation using chatbots, relevance, timeliness can be considered as accuracy information, while sufficiency can be considered as complete information. Therefore, perceived usefulness was replaced by perceived accuracy and perceived completeness in this study.

The operational definitions of each variable in the study framework are as follows:

1 Perceived accuracy (*PA*): users believe they can receive accurate consultations on pet diseases by using a chatbot.
2 Perceived completeness (PC): users believe they can receive complete consultations on pet diseases by using a chatbot.
3 Perceived ease of use (*PE*): users believe that they can easily use chatbots for veterinary consultation.
4 Perceived convenience (*PV*): users believe that using a chatbot for veterinary consultation is convenient.
5 User satisfaction (*US*): users are satisfied with using a chatbot for veterinary consultation.
6 Behavioral intention to use (*BI*): users are willing to use and promote chatbots for veterinary consultation.

Based on the literature review and framework of this study, we proposed the following hypotheses:

H1: Perceived accuracy increases user satisfaction.
H2: Perceived completeness increases user satisfaction.
H3: Perceived ease of use increases user satisfaction.
H4: User satisfaction increases behavioral intention to use.
H5: Perceived convenience increases behavioral intention to use.

Research context

The increase in number and status of pets globally has caused diversified and differentiated development in the pet industry. Veterinary medicine is the most technical subsector of the pet industry and has the highest standards for hardware and talent. According to APPA data, the scale of the veterinary medicine market in the United States reached US$15.95 billion in 2016. Specific subitems indicated that the largest three expenses for dog owners were surgical veterinary visits, kennel boarding, and routine veterinary visits. For cat owners, these expenses were food, surgical veterinary visits, and routine veterinary visits; these rankings demonstrate the scale of the pet medicine market.

When a pet becomes ill, in addition to the costs of examination, treatment, and medicine are expensive, transporting a pet to a veterinary clinic for consultation and treatment is another inconvenience. Pet owners need to cooperate with facility consultation hours and spend a lot of time for time-intensive travel and on-site waiting required. The number of pets waiting for examination often limits the duration of veterinarian visits; therefore, a single veterinarian visit is often insufficient for consultation on a pet's every symptom. As a result, frequently ferrying pets to veterinary clinics increases the burdens of labor, money, and time on pet owners. To resolve these problems in veterinarian visits, instant messag-

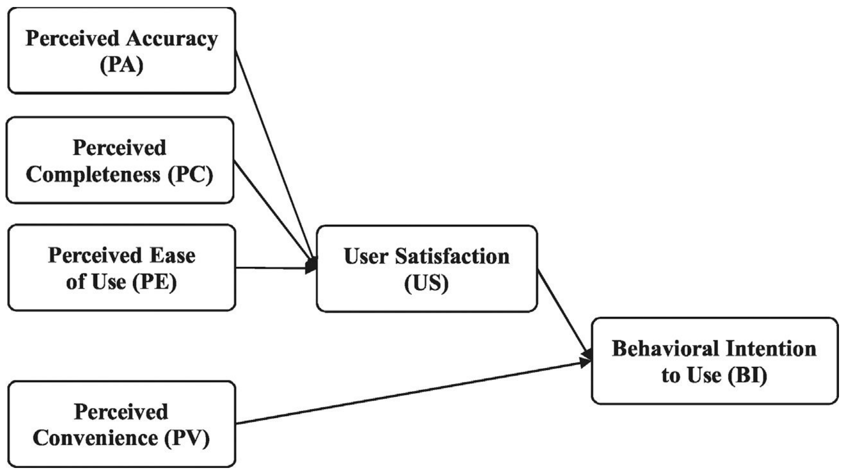

Fig. 1. Research framework.

ing applications and chatbots can be used to develop an intelligent medical platform in the special field of veterinary medicine.

Questionnaire design and data collection

In this study, data were collected using a seven-part questionnaire; part 1 collected demographic data, and parts 2–7 involved the six variables of the research framework: perceived accuracy, perceived completeness, perceived ease of use, perceived convenience, user satisfaction, and behavioral intention to use. The survey comprised a total of 23 items, including 5 items on demographic information and 3 items for each variable. The questionnaire used Likert five-point scales to measure the strength of each item from "strongly disagree" to "strongly agree" expressed using the numbers 1–5.

Study participants were members of a pet network community. By using Google Forms, 260 surveys were collected; however, two surveys were incomplete, resulting in 258 valid surveys and a 99.23% return rate.

Participants

Our study participants come from a pet network community, and we select members who have experience in raising pets or who have experience in transporting a pet to a veterinary clinic. The demographic information research participants are presented in Table 1. Women formed the majority of participants (65.12%). The largest age group was 11–20 years (37.21%), and the smallest age group was 10 years and younger (0.39%). College graduates accounted for the largest proportion (44.97%) of participants, and participants with a junior high school education or less formed the smallest proportion (0.76%). Most participants were experienced in owning pets (70.16%), and 53.10% of participants had experience in transporting a pet to a veterinary clinic.

Statistical methods

In this study, partial least squares structural equation modeling (PLS-SEM) is used to analyze collected data. PLS-SEM is superior to general linear structural relations models when analyzing causal relationships among latent variables and is suited to exploratory research because it can use single-topic dimensions and is not limited by variable allocation types or sample size. PLS-SEM has favorable predictive and interpretative capabilities (Medina & Chaparro, 2007/2008; Pavlou & Fygenson, 2006). Furthermore, PLS-SEM can simultaneously detect paths (structural models) and factors (measurement models) in the same model. In this study, analysis was conducted using SmartPLS 3.0 (Ringle, Wende, & Becker, 2015) and the bootstrap resampling method to repeatedly draw samples for formal parameter estimations and inferences (Hair, Hult, Ringle, & Sarstedt, 2017; Henseler & Chin, 2010).

Empirical analysis

This section analyzes and interprets the PLS-SEM results by using descriptive statistics, measurement model evaluation, and structural model evaluation.

Descriptive statistics

The statistical analysis results for each dimension variable in the survey are presented in Table 2. In all the dimensions, the three variables with the highest mean scores (in order) were "I believe the inconvenience of restrictive veterinary clinic hours can be bypassed by using the chatbot for veterinary consultation" (4.070), "I believe the inconvenience of taking public transits or driving and parking can be reduced by using the chatbot for veterinary consultation" (3.988), and "I believe the inconvenience of transporting my pet to the clinic can be eliminated using the chatbot for veterinary consultation" (3.713). The variables with the lowest mean scores (in order) were "I believe I can accurately understand the cause of my pet's illness by using the chatbot for veterinary consultation" (2.996), "I believe I can accurately express my pet's disease by using the chatbot for veterinary consultation" (3.012), and "I believe I can fully describe my pet's disease by using the chatbot for veterinary consultation" (3.097).

Evaluation of measurement model

First, construct validity of the measurement model was tested. Construct validity is evaluated by testing the two indices of convergent and discriminant validity. For all variables, factor loading, Cronbach's alpha (CA), and composite reliability (CR) must all be greater than 0.7, and average variance extracted (AVE) must be greater than 0.5 (Henseler & Chin, 2010; Hair, Hult, Ringle & Sarstedt, 2016).

As shown in Table 3, the factor loadings of every variable were greater than 0.8, which exceeded the 0.7 threshold and demonstrated the variables' convergent validity. CA values were greater than 0.8, and the CR values were greater than 0.9, demonstrating the items had favorable reliability and internal consistency. The

Table 1
Results for demographic information (N = 258).

Variables	Items	Number of times	Percentage (%)
Gender	Woman	168	65.12
	Man	90	34.88
Age	10 years and younger	1	0.39
	11–20 years	96	37.21
	21–30 years	44	17.05
	31–40 years	35	13.57
	41–50 years	45	17.44
	51–60 years	30	11.63
	60 years and older	7	2.71
Education level	junior high school	2	0.76
	senior high school	56	21.72
	junior college	11	4.26
	college	116	44.97
	graduate institute	73	28.29
Pet owning experience	yes	181	70.16
	no	77	29.84
Experience in transporting a pet to a veterinary clinic	yes	137	53.10
	no	121	46.90

Table 2
Mean and SD of each construct and items.

Construct	Item	Mean	SD
Perceived Accuracy (PA)	PA1: I believe I can accurately express my pet's disease by using the chatbot for veterinary consultation.	3.012	1.094
	PA2: I believe I can accurately understand the cause of my pet's illness by using the chatbot for veterinary consultation.	2.996	1.166
	PA3: I believe I can learn how to accurately treat my pet's illness by using the chatbot for veterinary consultation.	3.225	1.094
Perceived Completeness (PC)	PC1: I believe I can have a full consultation session by using the chatbot for veterinary consultation	3.597	1.148
	PC2: I believe I can inquire about all my pet's problems by using the chatbot for veterinary consultation.	3.256	1.183
	PC3: I believe I can fully describe my pet's disease by using the chatbot for veterinary consultation.	3.097	1.097
Perceived Ease of Use (PE)	PE1: I believe I can easily receive consultation for my pet's illness by using the chatbot for veterinary consultation.	3.322	1.142
	PE2: I believe I can easily understand the cause of my pet's disease by using the chatbot for veterinary consultation.	3.163	1.126
	PE3: I believe I can easily learn how to treat my pet by using the chatbot for veterinary consultation.	3.318	1.110
Perceived Convenience (PV)	PV1: I believe the inconvenience of restrictive veterinary clinic hours can be bypassed by using the chatbot for veterinary consultation.	4.070	1.076
	PV2: I believe the inconvenience of transporting my pet to the clinic can be eliminated by using the chatbot for veterinary consultation.	3.713	1.208
	PV3: I believe the inconvenience of taking public transits or driving and parking can be reduced by using the chatbot for veterinary consultation.	3.988	1.073
User Satisfaction (US)	US1: The chatbot for veterinary consultation satisfies my consultation needs.	3.434	1.033
	US2: The chatbot for veterinary consultation can respond to my questions about diseases.	3.419	1.087
	US3: The chatbot for veterinary consultation can resolve my pet-related problems.	3.322	1.061
Behavioral Intention to Use (BI)	BI1: I am willing to use the chatbot for veterinary consultation.	3.632	1.078
	BI2: I would recommend the chatbot for veterinary consultation to my friends and family.	3.531	1.125
	BI3: I would recommend the chatbot for veterinary consultation to other pet owners on online social networks.	3.521	1.093

Table 3
Measurement model.

Construct	Item	Factor Loading	CA	CR	AVE
Perceived Accuracy (PA)	PA1	0.950	0.942	0.963	0.895
	PA2	0.961			
	PA3	0.928			
Perceived Completeness (PC)	PC1	0.877	0.891	0.933	0.822
	PC2	0.918			
	PC3	0.924			
Perceived Ease of Use (PE)	PE1	0.936	0.935	0.959	0.885
	PE2	0.950			
	PE3	0.936			
Perceived Convenience (PV)	PV1	0.904	0.900	0.937	0.833
	PV2	0.926			
	PV3	0.907			
User Satisfaction (US)	US1	0.945	0.935	0.959	0.885
	US2	0.955			
	US3	0.922			
Behavioral Intention to Use (BI)	BI1	0.963	0.960	0.974	0.925
	BI2	0.959			
	BI3	0.963			

Table 4
Correlations and square root of average variance extracted (AVE).

	PA	PC	PE	PV	US	BI
Perceived Accuracy (PA)	0.946					
Perceived Completeness (PC)	0.840	0.907				
Perceived Ease of Use (PE)	0.849	0.781	0.941			
Perceived Convenience (PV)	0.541	0.641	0.614	0.913		
User Satisfaction (US)	0.839	0.816	0.883	0.616	0.941	
Behavioral Intention to Use (BI)	0.682	0.696	0.740	0.669	0.773	0.962

AVE for each dimension was greater than 0.8, which exceeded the 0.5 threshold. As shown in Table 4, the AVE root value of each Fornell–Larcker criterion value's diagonal was greater than the value of the corresponding correlation coefficient in the matrix, which demonstrated that the Fornell–Larcker criterion values had dimensional discriminant validity. These values indicated that the study's measurement model had favorable convergent and discriminant validity.

Evaluation of structural model

The path coefficients and predictive ability of the structural model were tested. For the five hypotheses developed in this study, $p < .05$ indicated significance (Hair et al., 2017; Henseler & Chin, 2010), as presented in Fig. 2 and Table 5. The results of the model are displayed as follows:

PA increased *US* ($\beta = 0.159$, $t = 2.385$, $p = .017 < .05$), thereby supporting H1. This indicated that perceived accuracy by pet owners has a significantly positive effect on users' satisfaction with chatbots to receive consultations on pet diseases.

PC increased *US* ($\beta = 0.252$, $t = 4.360$, $p = .000 < .001$); therefore, H2 holds. This demonstrated that perceived completeness by pet owners significantly increases users' satisfaction with using chatbots to receive consultations on pet diseases.

PE increased *US* ($\beta = 0.552$, $t = 9.309$, $p = .000 < .001$); therefore, H3 holds. This indicated that perceived ease of use by pet owners significantly increases user satisfaction with using chatbots to consult on pet diseases.

US increased *BI* ($\beta = 0.581$, $t = 9.214$, $p = .000 < .001$); therefore, H4 holds. This demonstrated that pet owners' user satisfaction significantly enhances their intention to use chatbots to receive consultations on pet diseases.

PV increased *BI* ($\beta = 0.311$, $t = 4.865$, $p = .000 < .001$); therefore, H5 holds. This indicated that perceived convenience by pet owners significantly increases their intention to use chatbots to consult on pet diseases; hence, higher perceived convenience by pet owners results in stronger intention to use the chatbot to receive consultations on pet diseases.

Implication

This section interprets the theoretical implication and the managerial implication based on the results of empirical analysis.

Theoretical implication

According to the results of empirical analysis, all the hypotheses in this study are supported. Thus, the usage intention model of the veterinary consultation chatbot is shown in Fig. 1. Based on TAM, we consider the actual situation of veterinary information and the research by Lee et al. to replace perceived usefulness with perceived accuracy and perceived completeness. As for the user attitudes in TAM and because the range of user attitudes is too wide, this research focuses on user satisfaction with the veterinary consultation chatbot, so user attitudes in TAM have been replaced by user satisfaction. Therefore, perceived accuracy, perceived completeness, and perceived ease of use have positive effects on user satisfaction, and user satisfaction has a positive effect on behavior intention to use, as shown in the upper part of Fig. 1.

There are five media capabilities proposed by Dennis et al.: transmission velocity, parallelism, symbol sets, rehearsability, and reprocessability. They provide more convenience than traditional consultation methods for pet owners who use chatbots for veterinary consultation. According to the results of empirical analysis, such perceived convenience has a positive effect on behavioral intention to use.

We have modified the technology acceptance model and come up with the hypothesis and research framework of this study. Empirical analysis results of this study support all the hypotheses we put forward, so the usage intention model of the veterinary consultation chatbot is shown in Fig. 1.

Managerial implication

Empirical analysis results of this research confirm that when pet owners use chatbots for veterinary consultation, perceived accuracy, perceived completeness, and perceived ease of use affect user satisfaction, and user satisfaction and perceived convenience affects users' behavioral intentions to use. Accuracy means that a chatbot's response to pet owners must be relevant and up to date. Completeness means that a chatbot must provide complete response information for pet owners. Ease of use means that the way pet owners use chatbots for veterinary consultation must be simple and easy. These results mean that when developing a chatbot for veterinary consultation, the knowledge base, and the database reaction rules behind it must be updated from time to time, or it is better to have a self-learning function to ensure that a chatbot can reply to pet owners with the latest, most relevant and complete information. It must also be able to complete veterinary consultation with minimal question-answer pairs so that the pet owner will not find it hard to use due to the lengthy questions and answer process. Additionally, convenience means that users can use the veterinary consultation chatbot regardless of time, location, or type. This means that a veterinary consultation chatbot should be able to provide consultation services 24 hours a day and provide different types of consultations such as text, pictures, images, and different languages to increase the pet owners' willingness to use.

The chatbot usage intention model built in this research should be able to handle most consultation questions, e.g., using chatbots for diet consultation during weight management. After a chatbot has evaluated the user's physical condition and eating habits, in terms of accuracy, it should provide correct diet suggestions suitable for users, including the right food and the correct amount. In terms of completeness, in addition to the suitable food and the right amount, a chatbot should be able to provide supporting exercise plans and sleep suggestions to make weight management more effective. In terms of ease of use, since users must regularly evaluate their physical condition and input current eating habits, the evaluation program of a chatbot should be as simple and easy to operate as possible. As a result, accuracy, completeness, and ease of use can indeed increase user satisfaction. In terms of convenience, since users' mealtime is not fixed, the time for dietary consultation

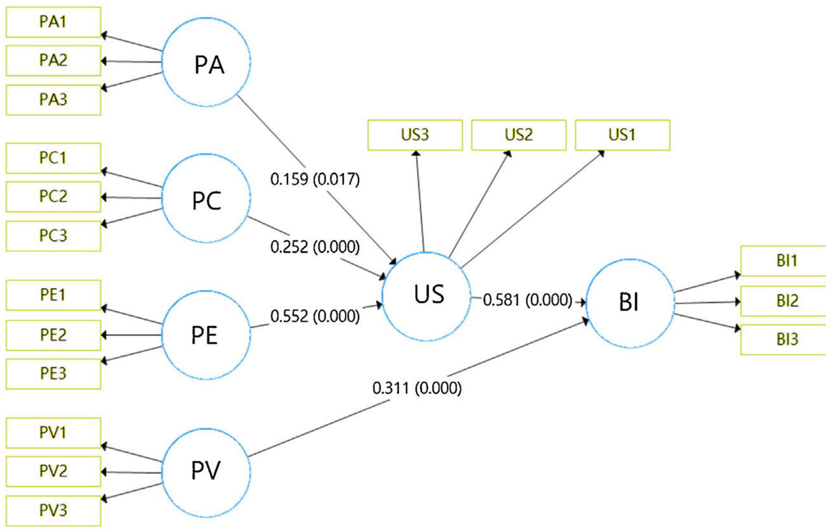

Fig. 2. Results of structural model.

Table 5
Significant testing results of the structural model path coefficients.

Hypothesis	Structural path	Path coefficient(β)	Mean	SD	T Statistics	P-value	Result
H1	PA→US	0.159	0.160	0.067	2.385	0.017	supported
H2	PC→US	0.252	0.249	0.058	4.360	0.000	supported
H3	PE→US	0.552	0.552	0.059	9.309	0.000	supported
H4	US→BI	0.581	0.584	0.063	9.214	0.000	supported
H5	PV→BI	0.311	0.309	0.064	4.865	0.000	supported

is also not fixed, and the content of meals is sometimes difficult to describe in words. Therefore, a consultation pattern that is not restricted by time or form can certainly increase users' willingness to use.

Conclusions

Digital transformations do not simply include the digitization of individual operational functions within an enterprise by integrating and applying digital technologies to change enterprise processes and innovate products, services, and business models. Moreover, digital transformations involve integrating big-data and AI technologies to drive the fundamental transformation of an enterprise' core values by exploring current products and services from a fundamental level and redefining value propositions. In this study, a chatbot prototype for consulting on pet diseases was developed by integrating AI and big data technologies to help veterinary teams provide disease consultations and reduce pet owners' costs in labor, money, and time incurred when transporting their pets to veterinary clinics.

To understand pet owners' usage intentions when using chatbots for veterinary consultation, in this study, a chatbot usage intention model was constructed based on TAM. We use perceived accuracy and perceived completeness to replace perceived usefulness in TAM, and user satisfaction to replace user attitude. According to the results of empirical analysis, perceived accuracy and perceived completeness have positive effects on user satisfaction. Our research has also confirmed that when analyzing user's behavioral intention to use veterinary consultation chatbots, useful information must be accurate and complete as pointed out by Lee et al. Our research has further confirmed that the convenience that users perceived from veterinary consultation chatbots is indeed in line with the transmission velocity, parallelism, and other media capabilities that Dennis et al. hypothesized.

In addition to being an evaluation basis for research on veterinary consultation, the results of this study can become an evaluation reference for the efficacy of using information and communication technology in human health care. Bibault et al. (2019) proposed a chatbot to provide information for patients with breast cancer; the authors demonstrated that the effects of information provided by the chatbot were similar to those of information provided by doctors, and the chatbot-provided information could reduce the number of patients with mild health concerns seeking medical attention at hospitals, thereby conserving medical resources. Medical consultation chatbots also enable physicians to spend more time treating patients with the highest needs.

In addition to reducing patients' physical discomfort from traveling while sick, using chatbots for disease consultations can reduce the risk of additional contamination if a pandemic occurs. For example, since the first patients with the new coronavirus (2019-nCoV) were discovered in Wuhan, China on December 1, 2019, more than 80,000 cases and 2700 deaths from the disease have been confirmed globally (as of mid-February 2020). The main transmission pathways that have been discovered for the new coronavirus are droplets, contact, and animal contact. Because no vaccine is currently available to prevent this coronavirus infection, suggested preventive measures include wearing surgical or medical face masks, frequently washing hands, frequently measuring body temperature, and avoiding crowded and non-ventilated public spaces or hospitals with a high risk of infection. The new coronavirus is highly infectious, and in addition to those in China, hospital-acquired infections have been reported in Japan, Korea, and Italy. Under these circumstances, the effective application of chatbots for human healthcare, disease management, and medical information may reduce the risk of infection from visiting medical institutions, thereby preventing hospital-acquired infections and controlling the spread of the epidemic.

Presently, since the veterinary consultation chatbot developed in this study is only a prototype, it can only extract keywords from users' medical consultation questions, and provide users with the best information based on the reaction rules of the database. For future practical applications, including in human healthcare, there are still technical problems, such as natural language processing and semantic analysis that need to be addressed. Besides, this chatbot prototype is not yet able to accept consultations in the form of pictures, images, and voices. To enhance the ease of use of chatbots and to make them popular and applicable, the combination of image, voice processing, and recognition technology needs more research.

Finally, we predict the future development direction of innovative technology in pet health and management based on the development trend of innovative technology in other related industries.

Innovative technologies applied to pet health: In recent years, personalized nutrition for humans has become increasingly popular. As a result, some companies have begun to pay attention to personalized nutrition technologies for pets. Through blood and genetic tests, specific diets, supplements, probiotics, exercise methods, or lifestyle adjustments can be recommended to customers. With the successful application of this technology to humans, it may also be available for pets in the future, such as providing personalized nutrition services for pets with sensitive stomachs or specific dietary restrictions (Aghmiuni, Siyal, Wang, & Duand, 2020; Groves, 2019; Johnson, Lee, & Swanson, 2020; Medialdea et al., 2018).

Innovative technology applied to pet behavior: Thanks to AI technologies (Lakshmi & Bahli, 2020; Lee & Trimi, 2018), face recognition has been used to analyze human facial expressions and behaviors. In the future, we might see this technology becoming available to pets. Using face recognition technology can analyze a pet's body posture and facial expressions to determine a pet's mood or pain level. It can also be used to construct a pet's personalized behavior based on its unique behavior, quirks, and likes or dislikes.

In the future, there are many possible innovative technologies for pet health and pet behavior. Not only will innovative technology benefit from the progress of pet industries, but it can also stimulate innovation in neighboring industries. Open innovation can play a key role in sharing innovation between industries to create affordable technology, thereby improve the lives of us and our pets.

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