International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 3455-3466

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

A preliminary study on intention to adopt IoT-enabled smart home systems in Shanzhen of China

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Abstract

This study seeks to investigate the combined influence of perceived ease of use, perceived usefulness, and personal innovation attributes on customers' readiness to embrace IoT smart home systems in Shenzhen, offering a theoretical foundation for product optimization and market strategies. This study examines the factors affecting the intention to adopt smart home devices, grounded in the Technology Acceptance Model (TAM) and the Howard-Sheth Consumer Behavior Model. Eight study hypotheses (H1-H8) are formulated through the development of a theoretical model, concentrating on the influence of elements such as perceived ease of use, perceived usefulness, perceived price, and perceived interest on customer adoption intention and purchase intention. The research employed a questionnaire survey method to gather accurate data and performed empirical tests utilizing combination reliability, mean variance extraction, and correlation analysis. The findings demonstrate that perceived simplicity of use and perceived usefulness significantly enhance consumers' attitudes and adoption intentions, hence confirming the fundamental hypothesis of the Technology Acceptance Model (TAM). This study establishes a theoretical framework for enhancing product design, pricing tactics, and marketing plans for smart home companies, while broadening the application contexts of the Technology Acceptance Model in the smart home sector.

Keywords: Adopting intention, IoT smart home, perceived ease of use, perceived usefulness.

DOI: 10.53894/ijirss.v8i3.7255
Funding: This study received no specific financial support.
History: Received: 4 April 2025 / **Revised:** 9 May 2025 / **Accepted:** 14 May 2025 / **Published:** 21 May 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Introduction.

In the current era of rapid technological development, IoT technology is reshaping people's lifestyles at an unprecedented speed. Smart home systems, as an important application area of IoT technology, are gradually entering millions of households. Shenzhen, as the forefront of China's technological innovation [1-3], is in a leading position in the research and promotion of IoT smart home systems. However, despite the many advantages of IoT smart home systems, their market popularity has not met expectations. Exploring the factors that influence consumers' intention to adopt IoT smart home systems in depth is crucial for promoting the further development of the industry. Perceived ease of use and perceived usefulness, as key concepts in the Technology Acceptance Model (TAM), play a central role in explaining and predicting users' acceptance behavior towards information technology [4, 5]. Perceived ease of use refers to the degree to which users perceive the ease of using a technology system, while perceived usefulness reflects users' perception that the system can improve their work performance or quality of life. In the context of IoT smart home systems, perceived ease of use and perceived usefulness undoubtedly have a significant impact on consumers' adoption intentions. When consumers believe that smart home systems are easy to operate, user-friendly, and can bring them practical convenience and value, they are more likely to have the intention to adopt the system [6]. The market for IoT smart home systems has unique characteristics and a development environment. On the one hand, the smart home system market has numerous high-tech enterprises and innovative teams, providing strong support for technology research and product innovation; on the other hand, consumers generally have a high acceptance of emerging technologies, and the market potential is enormous. However, in order to fully unleash this market potential, it is necessary to have a deep understanding of consumers' psychological and behavioral characteristics, especially how factors such as perceived ease of use, perceived usefulness, and personal innovation interact and jointly influence their intention to adopt IoT smart home systems.

To provide data support for promoting the construction of smart cities and the implementation of digital home policies, and to promote the coordinated development of the regional economy and technological innovation, numerous relevant scholars have conducted research. Zhao et al. [7] explored how the perceived agency and social role positioning of smart home products interact and influence consumers' evaluation of product empathy and their attitudes towards the product. Through two experiments, this study found that when smart home products play a servant role, the difference in perceived agency of the product has no significant impact on consumers' attitudes towards the product; When smart home products play a friendly role, high perceived agency (compared to low perceived agency) significantly improves consumer attitudes towards the product; Perceived empathy plays a mediating role between product perceived agency and product social role types, thereby influencing consumers' evaluation attitudes. This process reveals the complex mechanism of how emotional resonance shapes consumers' emotional responses under different product positioning. However, if "friend type" products appear to be "out of bounds" due to excessive agency, it may cause resentment, but the boundary issue of agency threshold has not been explored in the research. Kholoud et al. [8] proposed an SHT framework that extends the Unified Theory of Technology Acceptance and Use (UTAUT) model to investigate the determinants of behavioral intention (BI) in elderly people using smart home technology. This study used quantitative methods to investigate elderly people and applied partial least squares structural equation modeling (PLS-SEM) technology for data analysis. The research results indicate that cultural influence and technological awareness are important factors determining the use of SHT by older adults. The study also found that attitude mediates the relationship between performance expectations, effort expectations, and behavioral intentions. Research has found that regions and education moderate the relationship between cultural influence, technological awareness, and behavioral intentions. This study theoretically extends the UTAUT theory to include external factors such as cultural influence, technological awareness, attitudes, education, and region. However, the operational definition of "technical awareness" in the study is not clear - does it include awareness of privacy risks? This may affect the explanatory power of attitude mediation effects. Gordana et al. [9] collected qualitative data through semi-structured interviews and focus groups to understand the perspectives of older adults. The thematic analysis of interviews and focus group records has been completed. The Elder adopt model is a conceptual framework used to analyze research results. There are several factors that affect the willingness of elderly people (N=19) in the community to adopt smart home technology. Five qualitative themes have been identified: knowledge, health and safety, independence, safety, and cost. Conclusion: Despite some concerns about security and privacy loss, elderly residents in the community are open to adopting smart home technology to support independence. We need to increase opportunities to share information on smart home technology to raise awareness and demand. However, privacy concerns may be underestimated - older adults may avoid negative evaluations in interviews due to social politeness, and cross-validation with behavioral data (such as actual usage logs) is needed. Wang et al. [10] based on immersion theory and existing related research, starting from the dual perspectives of smart home product characteristics and individual consumer traits, based on the process experience of consumers choosing to use smart home products, divided the experience process of consumers choosing to use smart home products into three stages: immersion experience characteristics, immersion experience state, and immersion experience results, and constructed a structural equation model of smart home product usage intention. The results indicate that reflecting the perceived usefulness and perceived ease of use of smart home products has a positive effect on consumer acceptance; However, individual level self-efficacy also promotes this acceptance, and personal innovation has not shown a significant impact on usage intention; The consumer's attitude towards using the product significantly enhances their willingness to use it; The recommendation of acquaintances plays a positive moderating role in enhancing consumers' attitudes towards use and stimulating their willingness to use. The performance of perceived ease of use in the elderly population may be influenced by cognitive abilities, however, age was not set as a control variable in this study.

Based on the above research, this study aims to deeply analyze the impact mechanism of perceived ease of use, perceived usefulness, and personal innovation on the adoption intention of Shenzhen's IoT smart home system. Through theoretical analysis and empirical research, it reveals the inherent connections between various factors, provides a scientific basis for smart home enterprises to formulate effective market promotion strategies, helps the booming development of the Shenzhen IoT smart home system market, promotes the better integration of smart home technology into people's daily lives, and improves people's quality of life.

2. Theoretical Basis and Practice of Smart Home Construction

2.1. Artificial Intelligent Theory

Artificial Intelligence (AI) has a development history of over 60 years and is more complex than other technologies. As early as 1948, Turing proposed the concept of "machine intelligence", laying the theoretical foundation for the development of "intelligence". After being studied and deepened by scholars in later generations, AI is defined as science, objects, machines, or systems, and the concept of AI is finally condensed: AI is a computer science technology that is built through the infrastructure layer, algorithm layer, and technology layer of storage, operation, and control modes, and then obtains and applies data for deep learning or machine learning [11-13] so that it can solve various practical problems in the development of human society by imitating human physical and intellectual abilities. Artificial intelligence (AI) is of great significance in promoting China's economic development. PwC's model predicts that AI will drive up to 14% of global economic growth in the next five years. AI can promote China's economic growth mainly based on the following points:

(1) Promote economic growth through alternative labor, human-machine integration, and the expansion of the AI industry chain.

(2) Indirectly promoting economic growth through improving scientific and technological innovation, market efficiency, and government governance capabilities.

(3) Strengthening the construction of AI infrastructure and talent cultivation can help promote economic growth.

Artificial intelligence has brought disruptive impacts to people's production and lifestyle, and people are increasingly aware that the greater the role of science and technology, the more ethical support or regulation is needed. Therefore, the development of artificial intelligence is also accompanied by certain risks. Smart home products are a concrete manifestation of artificial intelligence. At the level of smart home products, their promotion of the economy and the ethical risks they bring have been well validated in their development. The role of smart homes in promoting the economy goes without saying, but the privacy risks and personal information leakage risks associated with products have become one of the main concerns affecting customer purchases [14].

2.2. Concept and Development of Smart Home

Smart home, with residential areas as its core carrier, integrates technologies such as the Internet of Things, comprehensive cabling, network communication, security protection, automation control, audio, and video to build an integrated management system. Its aim is to optimize the operational efficiency of residential facilities, achieve intelligent daily household management, and enhance the energy-saving and environmental protection performance of the living environment, ensuring the synchronous improvement of safety, convenience, comfort, and aesthetic value. The evolution of smart homes can be divided into three stages: initial exploration (researchers focus on understanding product mechanisms and concepts and have not yet formed specialized manufacturers and departments), growth ups and downs (turning to independent design and entering the field of smart homes with software and hardware integration), and integration stage (research, design, and large-scale production enter the commercial track, and the prices of smart home products gradually become more affordable and accepted by the public). At present, the market for smart home products in China is still in the development stage, and compared with entering the mature stage, there is still a long path that needs to be gradually promoted [15-17].

The smart home industry chain can generally be divided into upstream, midstream, and downstream industry chains:

The upstream industry chain is also the source of the smart home industry chain, including various hardware, software, and technical support. Among them, chips, sensors, and supporting software are the core, and the development of the upstream industry chain directly affects the possible technological routes and product performance in the later stages. Famous companies in the upstream industry chain include Intel, Qualcomm, and some domestic brands such as Shanghai Qingke and Crystal Optoelectronics.

The midstream industrial chain is the control platform and application of smart home products. For example, Apple's HomeKit and Xiaomi Technology's Mi Home. The midstream industrial chain is mainly represented by the smart home gateway, which includes the LAN integration of smart home products and the information exchange between the integrated network and the Internet. The integration of internal local area networks means the exchange of information and data between smart home products and gateways. Single-function smart home products such as temperature sensors and humidity sensors often have one-way data transmission from the product to the gateway; multifunctional smart home products such as smart cameras and smart speakers often involve bidirectional real-time data exchange between the product and the gateway [18].

The downstream industry chain is reflected in the user interface, which is the specific manifestation of the concept of "smart home" and the most direct contact of users with smart home products. At present, according to the degree of control concentration of smart home products, they can be divided into two categories: smart home whole house systems and smart home single products. As shown in Figure 1, the specific details are as follows:

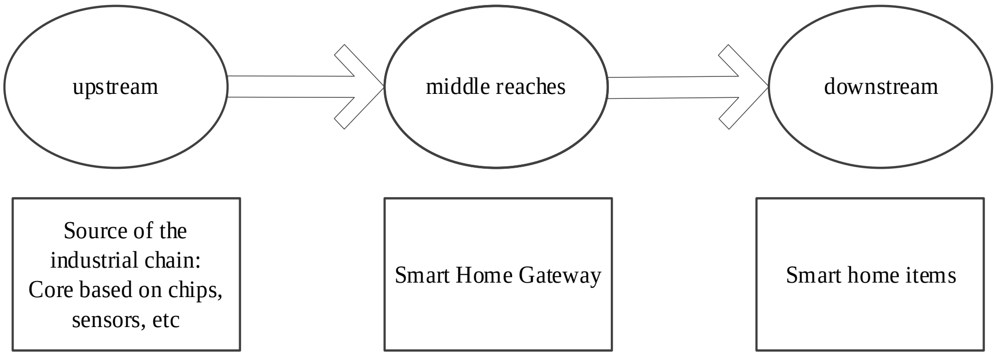

Figure 1.
Smart Home Industry Chain.

2.3. Categories and Classifications of Smart Home Indoor Products

Smart home products are diverse and complex, generally classified into smart single items and system products, with layouts divided into outdoor and indoor. This article focuses on the indoor products of smart home system products, which have strong personalization and differentiated requirements. Therefore, representative common configurations were compiled, and the main indoor products of smart homes were classified [19, 20] as shown in Table 1:

Table 1.
Smart Home Equipment Facilities and Functions.

Smart Home Category	Name	Function	Position
Security and prevention category	Intelligent Cat Eye	Equipped with video surveillance, facial recognition, motion detection, and remote intercom functions, it can real-time view the situation outside the door	gate
	Intelligent anti-lock door	Support fingerprint, password, NFC, Remote unlocking with mobile phone, equipped with anti-pry alarm, temporary password, and other functions	Entrance doors
	Gas detector	Detect natural gas and liquefied gas leaks, trigger alarms and automatically close gas valves	kitchen
	Wireless door sensor	Monitor the opening and closing status of doors and windows, and trigger an alarm when they open abnormally	Edge of doors and windows
	Emergency alarm button	One click triggering of alarm, linking with security system or notifying emergency contacts	Bedroom headboard, bathroom and other easily accessible locations
Entertainment and audiovisual category	smart tv	Support voice control, AI recommendation, and multi-screen interaction	Living room/bedroom
	VR Games	Provide an immersive gaming experience and support somatosensory interaction	Living room/game room
	Smart speaker	Voice assistant, music playback, smart home control center	Living room/bedroom
Switch control class	intelligent lighting	Remote/voice control of lighting, adjusting color temperature and brightness	Ceiling/Wall
	Smart socket	Remote control of electrical switches, power monitoring, scheduled tasks	Wall socket
	intelligent switch	Replace traditional switches and support voice/APP control of lights or devices	wall
Kitchen and bathroom appliances	Intelligent rice cooker	Mobile reservation cooking, remote control, intelligent recipe recommendation	Kitchen countertop
	Intelligent range hood	Automatic suction adjustment, smoke sensing linkage, supporting voice control	On the kitchen stove
	toto	Automatic flip cover, seat heating, deodorization and sterilization	toilet
	Intelligent dishwasher	Remote control, automatic selection of washing mode	Embedded kitchen cabinets

Indoor environment category	Home temperature control	Intelligent adjustment of air conditioning/underfloor heating temperature, energy-saving optimization	Living room/bedroom
	Home cleaning	Automatic path planning, vacuum cleaning, and floor mopping for robotic vacuum cleaners	ground
	air purification	Monitor PM2.5, formaldehyde, etc., automatically purify the air	Living room/bedroom
	Intelligent curtains	Timed opening and closing, light sensing, voice/phone control	Above the window
	Indoor environmental monitoring	Detect temperature and humidity, CO2, VOC and other data	Living room/bedroom
Health and medical category	Intelligent blood pressure monitor	Measure blood pressure/heart rate, synchronize data to mobile phone	Living room/bedroom
	Intelligent water cup	Record water intake, remind to drink water, and display water temperature	Desktop/Portable
	Intelligent body fat scale	Measure weight, body fat percentage, muscles, etc	Bathroom/Bedroom

3. Analysis of Consumer Behavior Patterns

Consumer behavior patterns are the fundamental model architecture and methods for studying consumer behavior. The research on consumer behavior patterns has a long history, among which the more famous consumer behavior patterns include the Nicosia model, E.K.B. model, and the Howard-Sheth model. The Howard and Sheth [21] is a classic theoretical framework in consumer behavior research, mainly used to explain the purchasing decision process of consumers in uncertain environments. Compared to other consumer behavior patterns such as the Nicosia model and E.K.B. model, the Howard-Sheth model not only focuses on consumers' psychological cognition (such as perception and attitude) but also incorporates social influences (such as group norms) and situational factors (such as time pressure and information ambiguity), forming a more comprehensive decision interpretation framework.

The Howard Shays model divides the consumer purchasing decision process into four key dimensions: input variables, external factors, internal factors, and response factors. In this context, input variables and external factors are regarded as the driving forces behind purchasing behavior, and the two work together to form a purchasing driving force, establish decision-making benchmarks for consumers, and enable their psychological activities, such as exploration and cognition to unfold, ultimately leading to purchasing decisions. This series of cognitive activities constitutes the acquisition and perception mechanism of consumers. This series of psychological activities is encompassed within internal factors. Ultimately, endogenous factors trigger response variables, prompting consumers to form specific purchase intentions, which in turn guide actual purchasing behavior. As shown in Figure 2:

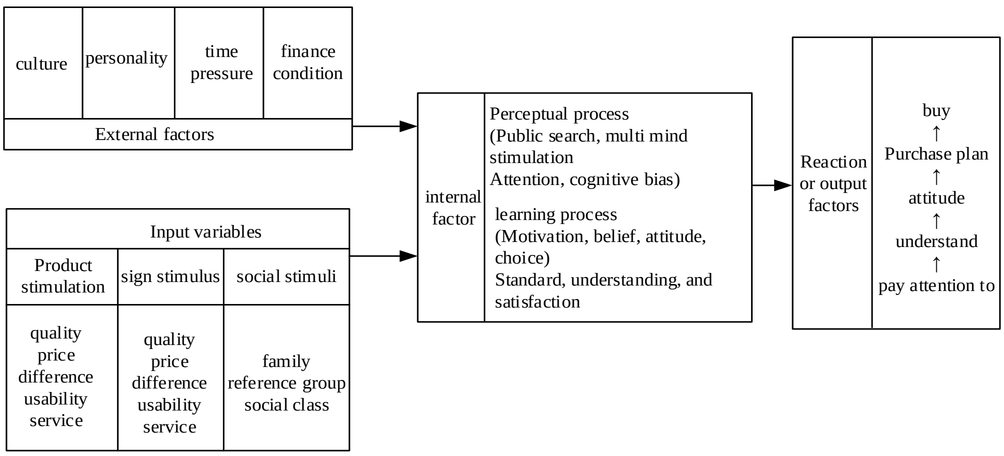

Figure 2.
Howard Scheer model.

Based on the above model, conduct in-depth analysis of consumer behavior to provide basic information and assistance for the influencing factors of adoption intention in the future.

4. Identification of Factors Influencing Intentions and Model Construction for Building Smart Home Systems

4.1. Construction of the Original Structure for Perceived Ease of Use and Perceived Usefulness

The Technology Acceptance Model (TAM) is one of the most widely used theories in the field of information systems, used to explain users' acceptance behavior towards new technologies. Its core is to predict users' behavioral intention (BI) and actual usage behavior (Actual Usage) through perceived ease of use (PEOU) and perceived usefulness (PU). Davis [22] based on the Theory of Rational Behavior (TRA), emphasizing the driving role of user attitudes on behavior.

The four important components of the initial technology acceptance model are perceived usefulness, perceived ease of use, desired attitude, and behavioral intention. The technology acceptance model has been proven by many scholars to be a useful theoretical model for exploring information or intelligent services. Therefore, based on the original technology acceptance model, this article proposes the following theory:

H_1: Consumers' willingness to purchase smart home products has a significant positive effect on their adoption behavior.

H_2: Consumers' attitudes towards smart home products have a significant positive effect on their willingness to adopt them.

H_3: The perceived ease of use of smart home products by consumers has a significant positive effect on their attitude towards using them.

H_5: Consumers' perceived usefulness of smart home products has a significant positive effect on their attitude towards using them.

H_4: Consumers' perceived ease of use of smart home items has a significant positive effect on their perceived usefulness.

H_6: Consumers' perceived usefulness of smart home products has a significant positive effect on their willingness to adopt them.

Among them, perceived usefulness refers to consumers' perception of the maximum benefits that using smart home products can bring in social life; Perceived ease of use refers to the level of difficulty that consumers perceive when using smart home products; Attitude refers to the degree to which consumers expect to use smart home products.

Figure 3 shows the original structural equation model proposed in this article based on the technology acceptance model and the theoretical foundation of consumer purchase intention research introduced in the previous section.

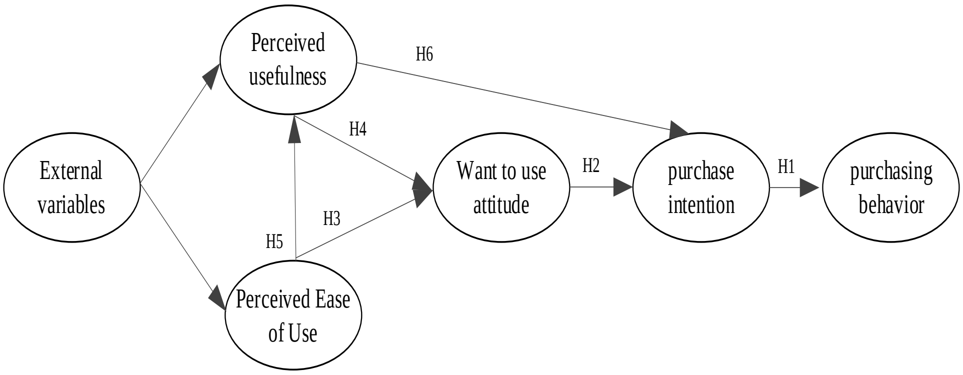

Figure 3.
The original structural equation based on TAM.

Further proposing extended hypotheses based on the initial structural equation model (TAM's original hypotheses H1-H6) is an inevitable requirement for deepening research and situational adaptation. Based on the initial structural equation, further assumptions are made in conjunction with the research of relevant scholars.

4.2. Research on the Influence of Perceived Price on Attitude towards Use

An analysis of the response or output factors in the Howard Scherz model reveals that the process from "attention" to "understanding" and then to "attitude" is based on internal factors. The perceptual and learning processes within internal factors are actually the processes of perceiving, understanding, and interpreting stimuli from external factors and input variables. That is to say, consumers' perception of smart home items will affect their attitude towards purchasing smart home items. Additionally, consumers' perception is conducted from multiple dimensions, so it can be said that the perceived value of these dimensions will affect their attitude towards purchasing behavior. Research has found that consumers perceive prices as significant to them when choosing products, such as "expensive" or "cheap".

The impact of the Monroe and Dodds brands and prices on purchase intention is significant. The basic definition of price information is explained in the article, and through analysis, it is shown that price has a positive impact on the perception of quality, while its impact on the perception of value and purchase intention is the opposite. On the other hand, brand information enhances the price effect, which in turn affects purchase intention.

From the above research, it can be seen that the impact of perceived price on consumer purchase intention may vary for different products, but the main effect is still negative. Therefore, this article proposes that perceived price should be considered an important factor that may affect consumers' purchase intention in the perceived value system of smart home products and proposes the following hypothesis through the mediating variable of attitude:

H_7: Consumers' perceived price of smart home items has a significant negative effect on their attitude towards using them.

The perceived price referred to in this article specifically refers to the amount that consumers need to pay to purchase the target smart home item that they have learned from various channels.

4.3. Research on the Influence of Perceived Interest on Perceived Usefulness

Through literature research, the initial technology acceptance model was examined and it was found that perceived interest is a noteworthy influencing factor.

Davis, Bagozzi, and Warshaw explored the external and internal dynamics of the technology acceptance model and found a significant relationship between enjoyment and the two moderating variables of the technology acceptance model. The definition of perceived fun in this article is that "users experience or use smart home items in a pleasant and enjoyable manner."

Chung and Tan pointed out that the entertainment perceived from information-based services plays an irreplaceable role in shaping user experience.

Therefore, the following assumptions are introduced:

H_8: Consumers' perceived interest in smart home products has a significant positive effect on their perceived usefulness.

4.4. Construction of Intentional Influencing Factors Model for Smart Home

Based on the above research on smart home items and consumer purchase intention, as well as the understanding and analysis of the technology acceptance model, a research model for consumer purchase intention of smart home items is constructed below (as shown in Figure 4), and this is used as a framework to study the influencing factors of smart home adoption intention.

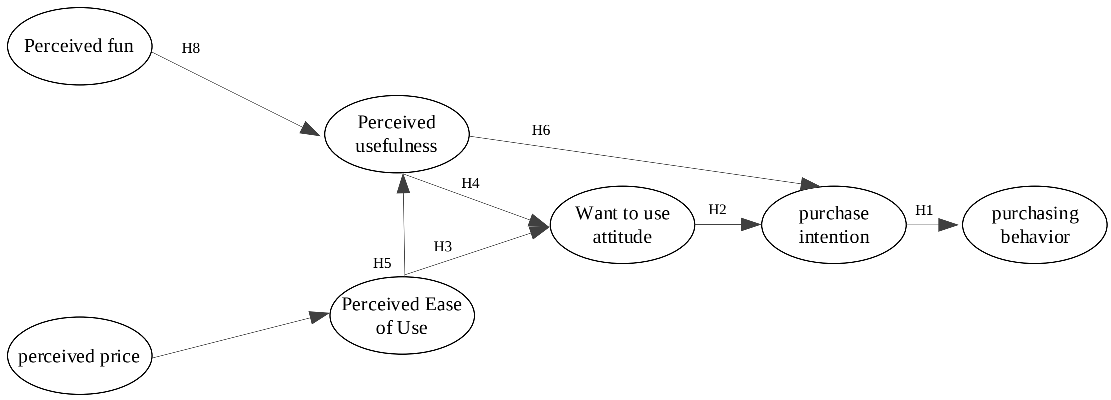

Figure 4.
Intentional influencing factor model for smart home adoption.

5. Questionnaire Design and Data Collection

5.1. Questionnaire Design

This study aims to explore the influencing factors of the intention to adopt smart home systems. To gain a deeper understanding of the real needs and user experience of the user group, this study collected user data through a questionnaire survey. The survey questionnaire is divided into two parts. The first part is a background investigation of the respondents, including gender, age group, employment situation, education, annual household income, household population, housing location, housing type, etc. The second and third parts are the main body of the survey, which investigates the adoption of IoT smart home products and applications by users. All variables in the two-part measurement model include intention to adopt (ITA), perceived ease of adoption (PEA), perceived pleasure (PEC), perceived economic value (PECI), purchase intention (PI), perceived usefulness in adoption (PUIA), and contextualized perceived usefulness (PUIC), totaling 7 variables. All items in the second part are measured using the Likert 5-point scale, which is divided into 7 levels of perception from 1 representing completely disagree to 5 representing completely agree. There are a total of 54 questions, and these 54 descriptive items are classified according to different factor terms. The classification results are shown in Table 2:

Table 2.
Description items and corresponding factor items.

Description item	Factor term
Intention to Adopt (ITA)	I feel very comfortable using tools and applications related to IoT smart home systems in traditional home environments.
	In the future, I plan to continue using IoT smart home systems.
	Overall, using smart home systems is worthwhile.
	I plan to frequently use IoT smart home systems in the future.
	I strongly recommend others to use IoT smart home systems.
	I have found that adopting IoT smart home systems is very compatible with my lifestyle.
Perceived ease of adoption (PEA)	I have found that IoT smart home systems can interact flexibly.
	When using Chinese, IoT smart home systems are easier to interact with.
	Learning to use IoT smart home systems is very attractive to me.
	I am easily proficient in using IoT smart home systems.
	IoT smart home systems always provide features that I find attractive.
Perceived Pleasure (PEC)	I can maintain consistent control over each electrical device in smart home applications through simple operations.
	The functionality of smart home technology enables households to consistently use it.
	The functions of smart home technology can continuously improve the quality of life for families.
	The design of smart homes enables households to consistently use them.
	The consistency of smart home technology plays a crucial role in assisting users in home management.
Perceived Economic Value (PECI)	The Internet of Things enables me to easily control my smart home applications.
	The Internet of Things is very useful for interacting with the interface of smart home applications.
	My interaction with the IoT smart home system interface is easy to understand.
	The interface of the IoT smart home system is excellent, with various icons.
	By using the interface of smart home technology, I will be able to learn more.
Purchase intention (PI)	The IoT smart home system provides valuable input for generating new ideas.
	You can rely on IoT smart home systems to discover new uses for existing devices.
	IoT smart home systems can facilitate connections with people outside of my home.
	IoT smart home systems can assist in managing resources to achieve better work-life balance.
	The IoT smart home system demonstrates innovation and originality.
	Personal innovation ability affects the adoption of IoT smart home systems.
	I am willing to try emerging smart home products.
Perceived usefulness in adoption (PUIA)	I find it easy to search for information using IoT smart home systems.
	Smart home technology provides automatic control for retrieving information.
	Smart home technology can achieve automated information management with minimal manual control.
	I think IoT smart home systems may be frustrating to use.
	I think that due to the issue of information accuracy, IoT smart home systems may be very troublesome.
Situational Perceived Usefulness (PUIC)	Smart home technology is very convenient because it allows information to be managed from a single location.
	Smart home technology has improved the quality of information related to home life.
	The use of smart home technology will improve the quality of information available to users.
	The use of smart home technology will improve the integrity of information.
	The mass media has claimed that smart home technology provides users with comprehensive and useful information.

5.2. Basic Information Statistics of Questionnaire Respondents

This section conducts descriptive statistical analysis on the collected survey data to understand the demographic characteristics of the surveyed population, such as gender, age, education level, job nature, and savings. The actual sample distribution is shown in the table.

Table 3.
Statistical Table of Population Information.

Items	**Categories**	**N**	**Percent (%)**	**Cumulative Percent (%)**
gender	Male	194	51.73	51.73
	Female	181	48.27	100
age group	Under 18	71	18.93	18.93
	18-25	79	21.07	40
	26-30	77	20.53	60.53
	31-40	83	22.13	82.67
	Over 40	65	17.33	100
employment status	Private sector employees	96	25.6	25.6
	Public Sector Employee	94	25.07	50.67
	Self-employed	93	24.8	75.47
	Other	92	24.53	100
education level	Primary school	2	0.53	0.53
	Junior high school	37	9.87	10.4
	Senior high school	81	21.6	32
	Undergraduate	161	42.93	74.93
	Postgraduate	94	25.07	100
annual household income	50000	19	5.07	5.07
	100000	88	23.47	28.53
	150000	117	31.2	59.73
	200000	90	24	83.73
	200000and above	61	16.27	100
The number of people in the family	1	14	3.73	3.73
	2	100	26.67	30.4
	3	116	30.93	61.33
	4	71	18.93	80.27
	5	74	19.73	100
home location	Guangming	41	10.93	10.93
	Longhua	43	11.47	22.4
	Bao’an	33	8.8	31.2
	Futian	37	9.87	41.07
	Nanshan	36	9.6	50.67
	Longgang	36	9.6	60.27
	Luohu	37	9.87	70.13
	Pingshan	33	8.8	78.93
	Yatian	34	9.07	88
	Dapeng	45	12	100
type of property	Apartment	93	24.8	24.8
	Detached house	91	24.27	49.07
	Bungalow	93	24.8	73.87
	Other	98	26.13	100
Duration of residence	1	56	14.93	14.93
	2	44	11.73	26.67
	3	41	10.93	37.6
	4	47	12.53	50.13
	5	74	19.73	69.87
	6	45	12	81.87
	7	40	10.67	92.53
	8	16	4.27	96.8
	9	9	2.4	99.2
	10	3	0.8	100
current status of smart home ownership	Own lease	320	85.33	85.33
	Renting	17	4.53	89.87
	Others	38	10.13	100
usage frequency	Not using	22	5.87	5.87
	Rarely used	51	13.6	19.47
	used	110	29.33	48.8

	Used frequently	148	39.47	88.27
	Used all the time	44	11.73	100
importance	Extremely important	108	28.8	28.8
	Very important	99	26.4	55.2
	Moderately important	116	30.93	86.13
	Not very important	35	9.33	95.47
	Not important at all	17	4.53	100

From Table 3, it can be seen that 51.73% of the gender sample will choose "Male", while the proportion of the female sample is 48.27%. More than 20% of the samples in the age group choose "31-40". 25.60% of the employment status sample would choose 'Private sector employees'. 42.93% of the education level samples are 'Undergraduate'. The proportion of "150,000" is 31.20%. 30.93% of the number of people in the family sample would choose "3". 12.00% of the home location samples are 'Dapeng'. 26.13% of the type of property samples are "Other". From the distribution of duration of residence, the majority of the samples are "5", with a total of 74, accounting for 19.73%. From the current status of smart home ownership distribution, the majority of the samples are 'Own lease', accounting for 85.33%. In terms of usage frequency distribution, the majority of the samples are "Used frequently", with a total of 148, accounting for 39.47%. From the importance distribution, the majority of the samples are "Moderately important", accounting for 30.93%.

5.3. Combination Reliability (CR) and Average Variance Extraction (AVE) Analysis

Composite reliability (CR) is one of the criteria for determining the intrinsic quality of a model, reflecting whether all measures in each latent variable consistently explain the latent variable. As shown in the table, CR is greater than 0.7, indicating that all measures in each latent variable can consistently explain the latent variable. The convergence validity of each dimension is reflected by the average variance extracted (AVE), which is usually used to reflect the convergence validity of the scale. It can directly display how much of the variance explained by the latent variable comes from measurement error. The larger the AVE value, the greater the percentage of variance explained by the latent variable, and the smaller the relative measurement error. Generally, the value requirement is above 0.5.

Table 4.
Results of Combined Reliability (CR) and Average Variance Extracted (AVE).

Convergent Validity				
Factor	**Title**	**Factor loadings**	**CR**	**AVE**
ITA	ITA1	0.828	0.921	0.66
	ITA2	0.815		
	ITA3	0.811		
	ITA4	0.777		
	ITA5	0.823		
	ITA6	0.82		
PEA	PEA1	0.826	0.911	0.671
	PEA2	0.826		
	PEA3	0.812		
	PEA4	0.807		
	PEA5	0.822		
PEC	PEC1	0.85	0.919	0.695
	PEC2	0.873		
	PEC3	0.822		
	PEC4	0.813		
	PEC5	0.81		
PECI	PECI1	0.833	0.921	0.7
	PECI2	0.828		
	PECI3	0.861		
	PECI4	0.816		
	PECI5	0.844		
PI	PI1	0.873	0.955	0.752
	PI2	0.858		
	PI3	0.868		
	PI4	0.876		
	PI5	0.854		
	PI6	0.867		
	PI7	0.876		
PUIA	PUIA1	0.859	0.916	0.685
	PUIA2	0.822		

	PUIA3	0.836		
	PUIA4	0.818		
	PUIA5	0.802		
PUIC	PUIC1	0.86	0.91	0.669
	PUIC2	0.795		
	PUIC3	0.825		
	PUIC4	0.79		
	PUIC5	0.816		

From the Table 4, it can be seen that all AVE values are greater than 0.5, and all CR values are higher than 0.7. The questionnaire structure model has good convergent validity.

5.4. Correlation Analysis

Correlation analysis refers to the process of describing and analyzing the nature and degree of correlation between two or more variables. Mark an asterisk in the upper right corner of the correlation coefficient to indicate a relationship; on the contrary, it doesn't matter. When the correlation coefficient is greater than 0, it indicates a positive correlation between two variables; when it is less than 0, it indicates a negative correlation between two variables.

Table 5.
Relevant analysis results.

Pearson Correlation									
	Mean	**SD**	**PECI**	**PEC**	**PEA**	**PUIA**	**PUIC**	**PI**	**ITA**
PECI	3.405	0.894	1						
PEC	3.394	0.861	0.285**	1					
PEA	3.471	0.811	0.237**	0.302**	1				
PUIA	3.413	0.849	0.423**	0.329**	0.314**	1			
PUIC	3.441	0.821	0.350**	0.445**	0.283**	0.340**	1		
PI	3.275	1.18	-0.169**	-0.116*	-0.254**	-0.183**	-0.175**	1	
ITA	3.428	0.812	0.527**	0.540**	0.427**	0.501**	0.523**	-0.176**	1

Note: * $p<0.05$ ** $p<0.01$.

From the Table 5, it can be seen that Pearson correlation coefficient is used to represent the strength of the correlation relationship. Specific analysis shows that:

According to the statistical analysis results, the correlation coefficient between ITA and PECI is 0.527, which reaches statistical significance at the 0.01 level. This strongly proves the significant positive linear relationship between ITA and PECI. According to the calculation results, the Pearson correlation coefficient between ITA and PEC was determined to be 0.540, which reached a statistical significance level of 0.01, strongly supporting the conclusion that there is a significant positive correlation between ITA and PEC. According to this study, the Pearson correlation coefficient between ITA and PEA was determined to be 0.427, which reached a statistical significance level of 0.01, strongly indicating a significant positive linear correlation between ITA and PEA. In statistical analysis, it was found that the Pearson correlation coefficient evaluation value between ITA and PUIA was 0.501, which reached the significance threshold of 0.01 level in statistics. Based on this, it can be inferred that there is a significant positive linear correlation between ITA and PUIA. According to the statistical analysis results, the correlation coefficient between ITA and PUIC is 0.523, which shows statistical significance at the 0.01 level. Therefore, it can be inferred that there is a significant positive linear relationship between ITA and PUIC. In the analysis, the linear relationship between ITA and PI indicators was examined, and the results showed a Pearson correlation coefficient of -0.176 between the two, which is statistically significant ($P<0.01$). Based on this, it is inferred that there is a significant negative correlation between ITA and PI.

6. Conclusion

As an important application of the integration of artificial intelligence and IoT technology, the market popularity of smart homes not only relies on technological innovation but also requires a deep understanding of consumer behavior patterns. This study systematically analyzes the key factors that influence consumers' adoption of smart homes by combining TAM and the Howard-Shah model. The empirical results reveal the core roles of perceived ease of use, usefulness, price, and enjoyment. This provides valuable references for industry practice and academic exploration and helps to promote the maturity and popularization of the smart home ecosystem. Future research can further explore the differences in consumer acceptance of smart homes in different regions, helping to mature and popularize the smart home ecosystem.

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