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UNDERSTANDING CUSTOMER ACCEPTANCE OF SMART HOME DEVICES IN PUNJAB

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ABSTRACT

This study examines the factors influencing customers' acceptance of smart home devices (SHDs) in Punjab, using an extended Technology Acceptance Model (TAM). The model integrates perceived usefulness, perceived ease of use, trust, social influence, perceived enjoyment, and perceived behavioral control to explain behavioral intention. Data collected from 368 respondents across major urban centres of Punjab were analyzed using structural equation modeling (SEM). The findings reveal that all factors except trust significantly affect adoption intention, with perceived usefulness and perceived behavioral control being the most influential predictors. The results emphasize the importance of usability, social influence, and consumer confidence in promoting smart home adoption in Punjab's growing digital market.

Keywords: Smart home devices, Technology Acceptance Model, Consumer behavior, Innovation adoption, behavioral Intention.

1. INTRODUCTION

The concept of the *Internet of Things (IoT)* has evolved rapidly over the past two decades, creating a foundation for numerous innovations that connect digital systems with physical environments. One of the most prominent applications of IoT technologies is the development of smart home devices (SHDs)—products that enable automation, monitoring, and control of household functions through internet connectivity and artificial intelligence. These devices include smart speakers, lighting systems, thermostats, home security systems, and connected appliances that enhance convenience, efficiency, and comfort for users (Gubbi et al., 2013; Zorzi et al., 2010).

In Punjab, the adoption of digital technologies is accelerating, supported by increasing internet penetration, smartphone usage, and government-led digital initiatives. According to industry reports, the Indian smart home market was valued at approximately USD 3 billion in 2022 and is projected to surpass USD 8 billion by 2027, with an annual growth rate exceeding 25 percent (Statista, 2023). Punjab has a significant market share in Indian Smart home market. Punjab, with its rising urban middle class and strong technological awareness, represents a dynamic segment of this emerging market. However, despite growing awareness, the adoption rate of SHDs among Punjab households remains relatively modest compared to developed markets, reflecting gaps in trust, affordability, and perceived value.

Although much of the global research on smart home technology has focused on technical aspects such as architecture, security, and interoperability (Khan et al., 2012; Uckelmann et al., 2011), there remains a limited understanding of consumer behavioral factors driving adoption in emerging economies. From a consumer's perspective, issues such as privacy, data protection, and perceived complexity often act as barriers to adoption (Medaglia & Serbanati, 2010; Weber, 2010).

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User acceptance of technology is widely recognized as a critical determinant of actual usage behavior (Yi et al., 2006; Venkatesh et al., 2012). Numerous models have been proposed to explain technology adoption, with the Technology Acceptance Model (TAM) being one of the most established frameworks (Davis, 1989). TAM posits that users' behavioral intention to use a technology is primarily influenced by perceived usefulness and perceived ease of use. However, these two factors alone may not sufficiently capture the complex motivations involved in SHD adoption, where elements such as social influence, trust, perceived enjoyment, and perceived behavioral control also play substantial roles.

While prior studies have focused on the technical or engineering aspects of smart home technologies (Hancke et al., 2010; Shang et al., 2012), fewer have explored consumer behavioral drivers in regional Indian contexts. In Punjab, cultural influences, family-based decision-making, and financial constraints can affect technology adoption differently than in other states. The Technology Acceptance Model (TAM) (Davis, 1989) provides a strong foundation for understanding user acceptance behavior. Yet, to explain adoption in emerging regional markets like Punjab, the model needs to include contextual and psychological factors such as trust, social influence, perceived enjoyment, and perceived behavioral control (PBC).

This research extends TAM to evaluate the determinants of SHD adoption in Punjab. By combining technological and behavioral dimensions, it seeks to provide practical and theoretical insights for policymakers, marketers, and developers promoting smart home adoption in the region.

2. LITERATURE REVIEW

2.1 Smart Home Devices (SHDs)

Smart home devices (SHDs) represent one of the most tangible applications of the Internet of Things (IoT), enabling everyday objects to collect, process, and exchange information over digital networks (Uckelmann et al., 2011). These devices facilitate automation, energy management, home monitoring, and personalized living experiences through connected technologies such as sensors, voice assistants, and mobile apps (Gubbi et al., 2013). Common examples include smart lighting, thermostats, surveillance cameras, and connected kitchen appliances.

Globally, the SHD industry has expanded rapidly, driven by advances in wireless connectivity, artificial intelligence, and miniaturized hardware. In Punjab, the growing affordability of connected devices, along with increasing urbanization and smartphone penetration, has created favorable conditions for adoption. However, despite the promise of convenience, safety, and efficiency, the uptake of SHDs remains relatively low due to perceived complexity, data privacy concerns, and varying levels of digital literacy (Weber, 2010; Li & Wang, 2013).

Current studies on SHDs tend to emphasize technical challenges—such as interoperability, security, and standardization (Hancke et al., 2010; Shang et al., 2012)—rather than the behavioral and psychological factors influencing consumers' acceptance. This imbalance underscores the need for more user-centered research that explores how technological, social, and individual characteristics shape consumer attitudes toward SHD usage, particularly in developing state like Punjab.

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis (1989), is one of the most influential frameworks for explaining technology adoption behavior. The model posits that two key beliefs—perceived usefulness (PU) and perceived ease of use (PEOU)—determine an individual's behavioral intention (BI) to use a technology. PU refers to the extent to which a person believes that using a system enhances their performance or quality of life, while PEOU reflects the perceived effort required to use that technology.

TAM has been widely validated across various contexts, including online shopping (McCloskey, 2003), e-learning (Lee et al., 2012), and mobile services (Luarn & Lin, 2005). In the context of SHDs, PU may relate to improvements in convenience, security, or energy efficiency, while PEOU concerns how intuitive or user-friendly the system interface is (Venkatesh et al., 2012).

Although TAM provides a parsimonious structure, scholars have argued that two constructs alone cannot fully capture consumer behavior in complex and interactive technologies such as SHDs. Users may also be influenced by trust, social influence, enjoyment, and perceived behavioral control (PBC) (Childers et al., 2001; Koufaris, 2002). Therefore, an extended TAM framework is required to more accurately represent the multidimensional nature of SHD adoption.

2.3 Trust

Trust has emerged as a crucial determinant in technology adoption, particularly for digital and data-driven services (Cho, 2004; Kim & Lennon, 2013). For SHDs, trust pertains to consumers' confidence that the devices and associated service providers will handle personal information securely and function reliably (Lin, 2011). Given that smart home systems often collect sensitive data—such as daily routines or video recordings—concerns about privacy and security significantly influence user acceptance.

Trust mitigates perceived risk and uncertainty, increasing users' willingness to engage with new technologies. Previous studies have demonstrated that trust not only directly influences behavioral intention but also enhances perceived usefulness by reinforcing the belief that the system will perform as expected (Ha & Stoel, 2009).

2.4 Social Influence

Social influence refers to the degree to which individuals perceive that important others—such as family, peers, or the media—believe they should use a particular technology (Venkatesh et al., 2012). In Punjab, where collectivist cultural values often shape decision-making, social influence is a particularly salient factor in technology adoption. Exposure to media campaigns, celebrity endorsements, and peer recommendations can significantly affect consumers' attitudes toward SHDs (Chong et al., 2012).

Social influence has consistently been found to impact behavioral intention in the adoption of emerging technologies, particularly when users are uncertain about product value or performance (Hsu & Lu, 2004). For smart home devices, which are still perceived as novel and somewhat complex, social validation and word-of-mouth play a central role in shaping adoption decisions.

2.5 Perceived Enjoyment

Perceived enjoyment (PE) represents an intrinsic motivation—reflecting the extent to which using a technology is enjoyable independent of its instrumental outcomes (Deci, 1971). Prior research indicates that enjoyment significantly affects consumers' willingness to adopt hedonic and experiential technologies such as mobile applications and online games (Bruner & Kumar, 2005; Doolin et al., 2005).

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In the context of SHDs, perceived enjoyment may stem from the novelty of controlling one's environment through voice commands or automation, or from the pleasure of using aesthetically appealing and responsive technology (Lu & Su, 2009). When consumers find SHDs fun and engaging, they are more likely to integrate them into daily routines.

2.6 Perceived Behavioral Control (PBC)

Derived from Ajzen's (1991) Theory of Planned Behavior (TPB), perceived behavioral control refers to an individual's belief in their ability to successfully perform a behavior, considering available resources, knowledge, and skills. For SHDs, PBC reflects consumers' perceptions of their technical competency, affordability, and control over device operation.

Empirical studies have consistently shown that PBC positively influences technology adoption (Mathieson, 1991; Casaló et al., 2010). If consumers feel confident in their ability to set up and manage SHDs, their intention to adopt these technologies increases. Conversely, lack of technical skills or financial constraints can lead to adoption resistance, particularly in emerging markets like Punjab.

In summary, the literature suggests that while TAM provides a strong foundation for understanding technology adoption, incorporating additional variables—trust, social influence, enjoyment, and PBC—offers a more comprehensive framework for analyzing consumer acceptance of SHDs. The next section develops the conceptual framework and hypotheses derived from this integrated model.

3. RESEARCH MODEL AND HYPOTHESES

This study aims to identify and empirically test the factors that influence consumer acceptance of smart home devices (SHDs) in Punjab by extending the Technology Acceptance Model (TAM). The proposed framework integrates the traditional TAM constructs—perceived usefulness (PU) and perceived ease of use (PEOU)—with additional variables, including trust (TR), social influence (SI), perceived enjoyment (PE), and perceived behavioral control (PBC). Together, these constructs represent the technological, social, and individual dimensions that collectively shape consumer behavior toward SHD adoption.

3.1 Conceptual Framework

The conceptual model posits that PU, PEOU, TR, SI, PE, and PBC directly influence users' behavioral intention (BI) to adopt SHDs. Additionally, PEOU and TR are hypothesized to have indirect effects on BI through their impact on PU. This framework provides a holistic understanding of consumer behavior that extends beyond functional evaluation to include emotional, social, and control-oriented aspects of adoption.

3.2 Hypotheses Development

Perceived Usefulness (PU)

Perceived usefulness is defined as the degree to which consumers believe that using SHDs enhances the quality, efficiency, or convenience of their daily life (Davis, 1989). SHDs provide tangible benefits, such as energy savings, improved security, and time efficiency. For example, smart lighting systems automatically adjust brightness to reduce electricity usage, while connected home security systems provide real-time monitoring.

Prior research consistently demonstrates that PU is one of the strongest predictors of technology adoption (Hart & Porter, 2004; Lee et al., 2012). When consumers perceive that SHDs add value or improve household management, they are more likely to adopt them.

H1: Perceived usefulness has a positive impact on consumers' behavioral intention to use smart home devices.

Perceived Ease of Use (PEOU)

Perceived ease of use refers to the extent to which consumers believe that using SHDs will be effortless and uncomplicated (Davis, 1989). Devices that feature intuitive design, user-friendly mobile interfaces, and seamless connectivity are more likely to be adopted. Studies have shown that perceived ease of use not only directly affects adoption intentions but also influences perceived usefulness, as easier systems tend to be viewed as more beneficial (Venkatesh et al., 2012).

H2: Perceived ease of use has a positive impact on consumers' behavioral intention to use smart home devices.

H3: Perceived ease of use has a positive impact on perceived usefulness of smart home devices.

Trust (TR)

Trust reflects a consumer's confidence in the reliability, security, and integrity of SHDs and their service providers (Lin, 2011). In Punjab, where data privacy and cybersecurity are major concerns, trust plays a pivotal role in shaping technology acceptance. While consumers may find smart home technologies appealing, they often hesitate to adopt them due to fear of unauthorized data access or device malfunction (Weber, 2010).

Trust is expected to influence both behavioral intention and perceived usefulness. When users believe that SHDs and related services are secure and reliable, they perceive higher utility and show stronger intentions to use them (Ha & Stoel, 2009).

H4: Trust has a positive effect on consumers' behavioral intention to use smart home devices.

H5: Trust has a positive effect on perceived usefulness of smart home devices.

Social Influence (SI)

Social influence refers to the degree to which an individual perceives that important others—such as family, peers, or social media—believe they should use a technology (Venkatesh et al., 2012). In the cultural context of Punjab, where collective decision-making and social comparison are prevalent, social influence is likely to play a significant role in shaping technology adoption (Chong et al., 2012).

Consumers are more inclined to adopt SHDs when they see influential figures or peers using them, or when such devices are portrayed as status-enhancing and modern. Hence, the following hypothesis is proposed:

H6: Social influence has a positive effect on consumers' behavioral intention to use smart home devices.

Perceived Enjoyment (PE)

Perceived enjoyment represents an intrinsic motivation—the extent to which using SHDs is enjoyable, entertaining, or satisfying in its own right (Deci, 1971; Bruner & Kumar, 2005). For many consumers, SHDs not only enhance convenience but also provide a sense of control, novelty, and pleasure. For example, interacting with voice assistants or customizing lighting moods may offer enjoyment beyond functional benefits.

Empirical studies show that perceived enjoyment enhances consumers' positive emotions and willingness to engage with new technologies (Song et al., 2008; Lu & Su, 2009).

H7: Perceived enjoyment has a positive effect on consumers' behavioral intention to use smart home devices.

Perceived Behavioral Control (PBC)

Perceived behavioral control, drawn from Ajzen's (1991) Theory of Planned Behavior, refers to an individual's belief in their capacity and resources to effectively use SHDs. PBC encompasses confidence in one's technical skills, the affordability of devices, and perceived control over operation and maintenance.

If consumers believe they possess sufficient technical knowledge and financial capability, their likelihood of adopting SHDs increases (Casaló et al., 2010; Mathieson, 1991). Conversely, perceived lack of skill or high costs can hinder adoption.

H8: Perceived behavioral control has a positive effect on consumers' behavioral intention to use smart home devices.

3.3 Summary of the Model

In summary, the research model proposes that consumer acceptance of SHDs in Punjab is shaped by both technological attributes (usefulness, ease of use, trust) and personal-social attributes (social influence, enjoyment, behavioral control). Furthermore, trust and ease of use are hypothesized to indirectly enhance behavioral intention through their effect on perceived usefulness.

4. METHODOLOGY

4.1 Research Design

This study adopts a quantitative, descriptive research design to empirically test the proposed model and hypotheses. The aim is to investigate the factors that influence consumers' behavioral intention to adopt smart home devices (SHDs) using an extended version of the Technology Acceptance Model (TAM). Data were collected through a structured survey administered to potential SHD users in urban Punjab.

4.2 Data Collection Procedure

Data were collected using a structured questionnaire distributed through offline channels. Respondents were selected from major urban centres in Punjab—Mohali, Ludhiana, Amritsar, and Jalandhar—to ensure a diverse sample representing the region's digitally active population.

Participants were approached through universities, smart home housing societies, and electronic store. Before completing the survey, respondents were provided with a short explanation of smart home devices to ensure conceptual clarity. Only individuals who had prior awareness of SHDs were included in the study. Out of 600 distributed questionnaires, 412 were returned, and 368 valid responses were retained for final analysis after excluding incomplete or inconsistent entries. This sample size is deemed sufficient for structural equation modeling (SEM), meeting the recommended 10:1 ratio of cases to parameters (Hair et al., 2010).

4.3 Sample Profile

The demographic composition of the sample reflects Punjab's urban middle-class consumers, who are among the early adopters of digital technology.

• **Gender:** 57% male, 43% female.

• **Age distribution:** 61% between 21–35 years, 28% between 36–50 years, 11% above 50 years.

• **Education:** 71% held an undergraduate degree or higher.

• **Occupation:** 63% were employed in private or government sectors, while 22% were self-employed.

To assess non-response bias, mean differences between early and late respondents were tested using independent t-tests. No significant differences ($p > 0.05$) were observed, confirming that non-response bias was not an issue.

4.4 Measurement Development

All measurement items were adapted from previously validated instruments to ensure reliability and content validity, with minor modifications to reflect the SHD context. The questionnaire consisted of five-point scales ranging from 1 = strongly disagree to 5 = strongly agree.

Construct	Source	Example Item
Perceived Usefulness (PU)	Davis (1989)	"Using smart home devices improves the efficiency of my household activities."
Perceived Ease of Use (PEOU)	Davis (1989)	"Learning to operate smart home devices is easy for me."
Trust (TR)	Wang et al. (2004)	"I believe smart home devices and their service providers are reliable."
Social Influence (SI)	Venkatesh et al. (2003)	"People important to me think I should use smart home devices."
Perceived Enjoyment (PE)	Moon & Kim (2001)	"Using smart home devices is enjoyable and engaging."
Perceived Behavioral Control (PBC)	Mathieson (1991)	"I have the knowledge and ability to use smart home devices effectively."
Behavioral Intention (BI)	Venkatesh & Davis (2000)	"I intend to use smart home devices regularly in the future."

Before the main survey, a pilot test was conducted with 20 respondents to assess the clarity and reliability of the items. Minor wording revisions were made based on their feedback.

4.5 Data Analysis Techniques

The collected data were analyzed using Structural Equation Modeling (SEM) to evaluate the relationships among constructs and test the hypotheses. The analysis followed a two-step approach (Anderson & Gerbing, 1988):

1. Measurement Model Validation – assessing reliability, convergent validity, and discriminant validity through Confirmatory Factor Analysis (CFA); and
2. Structural Model Evaluation – examining causal relationships between variables and testing the hypothesized paths.

The study employed standard indices to evaluate model fit, including the Chi-square/degrees of freedom ratio (χ^2/df), Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI), Tucker–Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Acceptable thresholds were set as $\chi^2/df < 3.0$, CFI > 0.90, GFI > 0.90, TLI > 0.90, and RMSEA < 0.08 (Schumacker & Lomax, 2004).

5. RESULTS

5.1 Measurement Model Assessment

Before testing the structural relationships, the measurement model was evaluated to ensure construct reliability and validity. Confirmatory Factor Analysis (CFA) was conducted using on all latent variables—Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Trust (TR), Social Influence (SI), Perceived Enjoyment (PE), Perceived Behavioral Control (PBC), and Behavioral Intention (BI).

To establish the reliability and validity of all constructs, confirmatory factor analysis (CFA) was performed. Table 1 presents the standardized factor loadings, Cronbach's alpha (α), composite reliability (CR), and average variance extracted (AVE) for each construct. All standardized loadings exceeded the minimum recommended threshold of 0.70, and both α and CR values were above 0.80, indicating excellent internal consistency. All AVE values exceeded 0.50, confirming convergent validity (Fornell & Larcker, 1981).

Table 1. Construct Reliability and Convergent Validity

Construct	Item Code	Standardized Factor Loading	Cronbach's α	CR	AVE
Perceived Usefulness (PU)	PU1	0.82	0.89	0.91	0.67
	PU2	0.84			
	PU3	0.81			
	PU4	0.79			
Perceived Ease of Use (PEOU)	PEOU1	0.83	0.88	0.90	0.65
	PEOU2	0.80			
	PEOU3	0.82			
	PEOU4	0.78			
Trust (TR)	TR1	0.77	0.86	0.88	0.61
	TR2	0.80			
	TR3	0.79			
	TR4	0.76			
Social Influence (SI)	SI1	0.81	0.87	0.89	0.66
	SI2	0.83			
	SI3	0.80			
Perceived Enjoyment (PE)	PE1	0.85	0.90	0.92	0.70
	PE2	0.83			
	PE3	0.82			
Perceived Behavioral	PBC1	0.84	0.91	0.93	0.72

Control (PBC)					
	PBC2	0.87			
	PBC3	0.83			
Behavioral Intention (BI)	BI1	0.88	0.92	0.93	0.75
	BI2	0.86			
	BI3	0.87			

All factor loadings are significant at $p < 0.001$.

5.6 Discriminant Validity

Discriminant validity was assessed using the Fornell–Larcker criterion, which compares the square root of AVE values (on the diagonal) with inter-construct correlations (off-diagonal elements). As shown in Table 2, all diagonal values are higher than their corresponding correlations, confirming that each construct is distinct from the others.

Table 2. Discriminant Validity (Fornell–Larcker Criterion)

Construct	PU	PEOU	TR	SI	PE	PBC	BI
PU	**0.82**						
PEOU	0.54	**0.81**					
TR	0.47	0.41	**0.78**				
SI	0.49	0.43	0.38	**0.81**			
PE	0.52	0.45	0.39	0.48	**0.84**		
PBC	0.56	0.44	0.42	0.45	0.50	**0.85**	
BI	0.63	0.56	0.46	0.49	0.53	0.58	**0.87**

Diagonal values (in bold) represent √AVE; off-diagonal values are inter-construct correlations

5.2 Goodness-of-Fit Indices

The measurement model demonstrated satisfactory goodness-of-fit based on the following indices:

- $\chi^2/df = 2.14$
- GFI = 0.93
- CFI = 0.95
- TLI = 0.94
- RMSEA = 0.056

All indicators met or exceeded recommended thresholds (Hair et al., 2010), confirming that the measurement model fit the observed data well.

5.3 Structural Model and Hypothesis Testing

After validation, the structural model was analyzed to test the hypothesized relationships. The model exhibited good fit with the data ($\chi^2/df = 2.28$, GFI = 0.91, CFI = 0.94, TLI = 0.93, RMSEA = 0.060). Standardized path coefficients (β), t-values, and significance levels for each hypothesis are summarized below.

Hypothesis	Path	Standardized β	t-value	Result
H1	PU → BI	0.32	6.41	Supported
H2	PEOU → BI	0.21	4.57	Supported
H3	PEOU → PU	0.38	7.03	Supported
H4	TR → BI	0.09	1.62	Not Supported
H5	TR → PU	0.26	5.12	Supported
H6	SI → BI	0.17	3.85	Supported
H7	PE → BI	0.19	4.12	Supported
H8	PBC → BI	0.28	5.63	Supported

5.4 Summary of Findings

The findings indicate that Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Social Influence (SI), Perceived Enjoyment (PE), and Perceived Behavioral Control (PBC) exert significant positive effects on consumers' Behavioral Intention (BI) to use smart home devices.

Interestingly, Trust (TR) does not have a significant direct impact on BI, although it shows a strong indirect influence through PU, implying that consumers' trust in SHDs primarily enhances their perception of usefulness rather than directly motivating usage intention.

Among the predictors, PU (β = 0.32) and PBC (β = 0.28) emerged as the most influential factors, suggesting that consumers value both functional benefits and self-efficacy in adopting SHDs.

The overall model accounted for 71% of the variance ($R^2 = 0.71$) in behavioral intention, indicating strong explanatory power and supporting the robustness of the extended TAM framework in the smart home context.

6. DISCUSSION

The purpose of this study was to identify and examine the key determinants that influence consumers' acceptance of smart home devices (SHDs) using an extended Technology Acceptance Model (TAM). The results provided strong empirical support for the model, demonstrating that perceived usefulness, perceived ease of use, social influence, perceived enjoyment, and perceived behavioral control significantly affect consumers' behavioral intention to use SHDs. Conversely, trust did not exert a significant direct effect on behavioral intention, although it indirectly influenced acceptance through perceived usefulness.

6.1 Influence of Perceived Usefulness and Ease of Use

Consistent with the original TAM framework (Davis, 1989), perceived usefulness (PU) emerged as the most influential factor predicting behavioral intention. This indicates that consumers adopt SHDs primarily because they perceive tangible benefits—such as improved convenience, time savings, and enhanced household efficiency. These findings align with previous studies that found PU to be a dominant factor in technology adoption across different contexts, including mobile services and e-commerce (Lee et al., 2012; Venkatesh et al., 2012).

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Perceived ease of use (PEOU) also played a significant role, both directly influencing behavioral intention and indirectly enhancing perceived usefulness. This suggests that when consumers find SHDs intuitive and simple to operate—such as through voice assistants or mobile control interfaces—they are more likely to perceive them as valuable. The result aligns with prior findings by Venkatesh and Davis (2000), who observed that system usability enhances perceived performance outcomes.

6.2 The Role of Trust

Interestingly, trust (TR) did not have a significant direct impact on behavioral intention in this study, diverging from some prior research (Ha & Stoel, 2009; Lin, 2011). However, its indirect effect via perceived usefulness indicates that trust still plays a supportive role. Consumers who trust SHD brands and perceive data protection as reliable tend to find the devices more useful, even if that trust alone does not immediately drive adoption.

This result may be explained by the relatively early stage of SHD adoption, where functionality and perceived value outweigh privacy concerns for most users. As smart home technologies mature and become more integrated into daily life, it is plausible that trust will become a more direct predictor of usage intention, especially as data privacy awareness grows.

6.3 Impact of Social Influence

The findings confirm that social influence (SI) has a significant positive effect on SHD adoption, highlighting the collective nature of decision-making in our society. The opinions and recommendations of friends, family members, and colleagues play a strong role in shaping perceptions of innovative technologies. This finding supports prior studies by Chong et al. (2012) and Hsu and Lu (2004), which established social influence as a key predictor of technology acceptance in collectivist cultures.

In practical terms, this implies that peer endorsement, influencer marketing, and media visibility can substantially accelerate SHD adoption in Punjab. Since smart homes are still perceived as aspirational symbols of modern living, social validation contributes significantly to the intention to adopt.

6.4 Perceived Enjoyment and Behavioral Control

The study also found perceived enjoyment (PE) to be a significant predictor of behavioral intention. This suggests that consumers are motivated not only by functional value but also by hedonic gratification—the fun and pleasure derived from using innovative technologies. The interactive and responsive nature of SHDs, such as using voice commands or personalized automation, adds an element of enjoyment that enhances adoption willingness. These findings are consistent with prior research emphasizing the role of intrinsic motivation in technology acceptance (Bruner & Kumar, 2005; Lu & Su, 2009).

Similarly, perceived behavioral control (PBC) exhibited a strong positive influence on adoption intention, second only to perceived usefulness. This highlights the importance of consumer self-efficacy, affordability, and perceived capability in driving SHD adoption. In developing markets like Punjab, consumers who feel competent and financially able to install and manage SHDs are significantly more likely to adopt them. This result is consistent with Ajzen’s (1991) Theory of Planned Behavior, which identifies perceived control as a major determinant of behavioral intention.

6.5 Cultural and Market Context

The market presents unique opportunities and challenges for SHD adoption in Punjab. While consumers are becoming increasingly tech-savvy, issues of affordability, inconsistent internet connectivity, and privacy concerns remain barriers. The cultural emphasis on family-centric decision-making means that household-level influence is particularly strong, suggesting that promoting SHDs as family-oriented lifestyle upgrades rather than individual technologies could enhance adoption

7. CONCLUSION, IMPLICATIONS, AND LIMITATIONS

7.1 Conclusion

This study investigated the determinants of consumer acceptance of smart home devices (SHDs) in Punjab using an extended Technology Acceptance Model (TAM) framework. By integrating the traditional TAM variables—perceived usefulness (PU) and perceived ease of use (PEOU)—with additional constructs such as trust (TR), social influence (SI), perceived enjoyment (PE), and perceived behavioral control (PBC), the research provides a comprehensive understanding of SHD adoption behavior in an emerging market context.

The empirical findings confirmed that PU, PEOU, SI, PE, and PBC all have significant positive effects on consumers' behavioral intention (BI) to use SHDs, whereas trust did not show a direct impact, although it influenced PU indirectly. These results reinforce the relevance of TAM in explaining new technology adoption while highlighting the importance of social and psychological factors in the market.

Overall, the extended TAM model achieved a high explanatory power ($R^2 = 0.71$), demonstrating that a multidimensional approach—encompassing technological, social, and individual attributes—can effectively predict SHD adoption intention.

7.2 Theoretical Implications

The study contributes to the technology acceptance literature in several ways.

First, it confirms the robustness and adaptability of TAM when applied to advanced, interactive technologies like smart home devices. Second, by integrating trust, social influence, enjoyment, and behavioral control, the model extends TAM's explanatory scope beyond utilitarian beliefs to include emotional and contextual dimensions of technology adoption.

Moreover, the research enriches understanding of SHD adoption in developing economies, where user perceptions and infrastructural conditions differ from those in developed markets.

7.3 Practical Implications

From a managerial standpoint, the results offer valuable guidance for firms operating in the smart home technology industry:

1. Enhance functional value: Manufacturers should design SHDs that deliver clear, measurable benefits such as energy savings, safety, and convenience.
2. Simplify user interfaces: Developers should ensure intuitive, localized, and user-friendly designs to improve ease of use, particularly for first-time users.
3. Leverage social endorsement: Marketing campaigns that include testimonials, influencer collaborations, and peer demonstrations can amplify social influence.

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4. Foster enjoyment: Incorporating interactive and customizable features can boost perceived enjoyment, increasing engagement and long-term satisfaction.
5. Strengthen user capability: Providing installation support, customer education, and affordable entry-level devices can enhance perceived behavioral control and reduce hesitation.
6. Build trust gradually: Transparency in data handling and visible security certifications can foster user confidence, even if trust is not yet a primary adoption driver.

These strategies can collectively accelerate SHD adoption in Punjab and similar developing states, aligning with broader national goals of digital inclusion and smart living.

7.4 Limitations and Future Research

Although this study offers significant insights, it is not without limitations.

First, the data were collected from urban consumers, which may not represent rural or semi-urban populations where technology exposure is lower. Future research should include a more diverse demographic sample to capture broader behavioral trends.

Second, the research employed a cross-sectional design, which limits the ability to observe changes in consumer attitudes over time. Longitudinal studies could provide deeper insights into how perceptions of usefulness, enjoyment, and trust evolve as consumers gain experience with SHDs.

Third, while the study integrated key psychological and social factors, other potentially relevant variables—such as perceived risk, price sensitivity, and privacy concern—were not included. Incorporating these dimensions could further refine the predictive accuracy of future models.

Lastly, the study relied on self-reported data, which may be subject to social desirability bias. Complementing survey data with behavioral or experimental methods could yield richer and more objective insights.

7.5 Final Remarks

In conclusion, this research provides an empirically validated model that enhances understanding of how consumers evaluate and adopt smart home devices. It underscores the interplay between technological functionality, ease of use, social reinforcement, and personal capability in shaping adoption decisions. By illuminating these behavioral drivers, the study not only advances academic discourse but also offers practical guidance to industry stakeholders and policymakers seeking to foster sustainable growth in Punjab's smart home technology sector.

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