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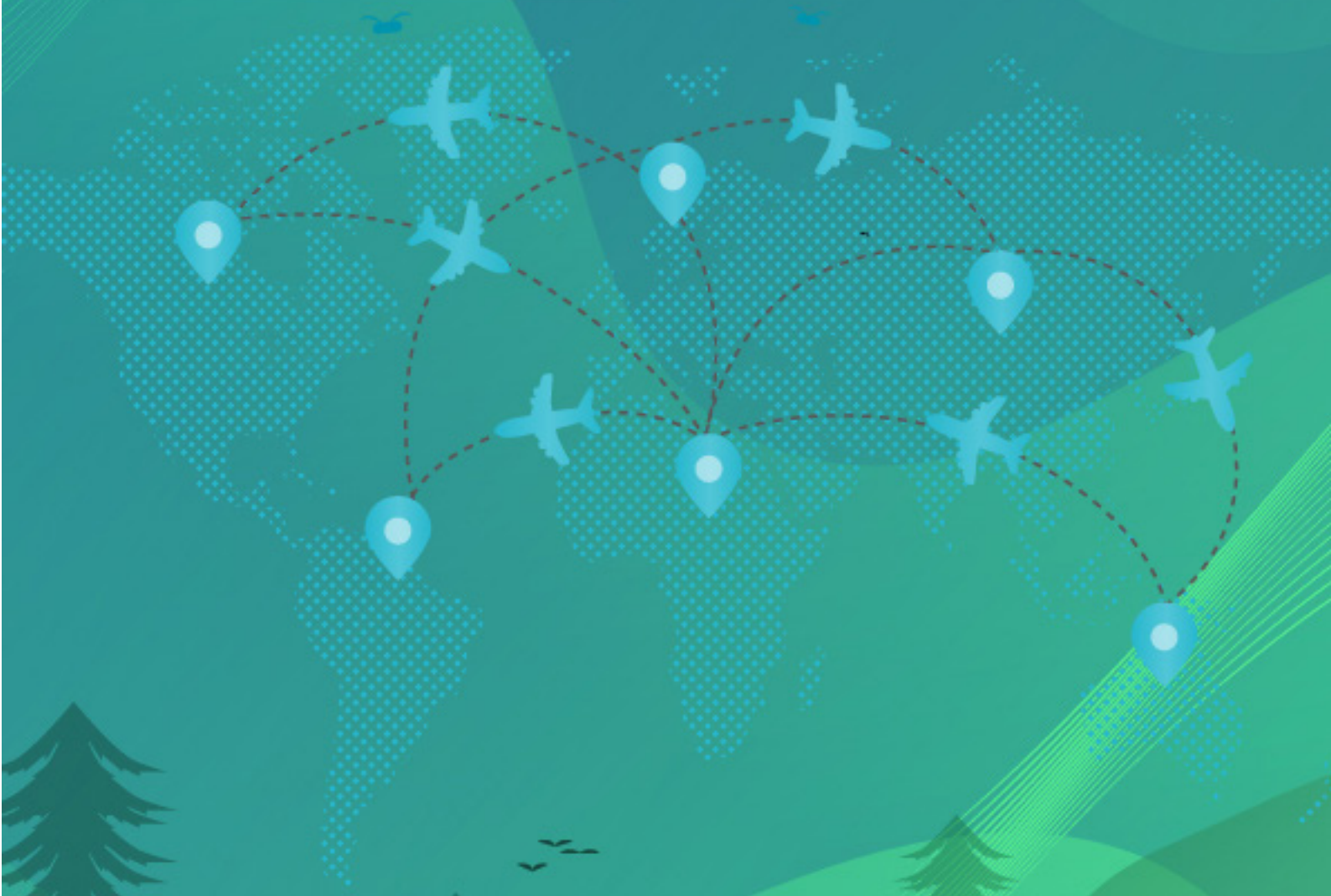

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The Application of IoT Technologies in Smart Hotels to Enhance Customer Satisfaction and Loyalty: A Structural Equation Modeling (SEM) Approach

Md. Sohan Hossain[1*], Md. Rasel[2], Md. Nafij Mondol[3], Md. Azizur Rahman[2], Fahim Hossain[3]

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Bangladesh, Customer Satisfaction Loyalty, Internet Of Things (Iot),Pls-Sem, Smart Hotel

ABSTRACT

The study discusses the impact of Internet of Things (IoT) technology in smart hotels on customer satisfaction and loyalty in Bangladesh. The researcher gathered 200 participants as quantitative data using a 5-point Likert scale. Partial least squares structural equation modeling (PLS-SEM) and ANOVA were used by researchers to test their research model. The hypotheses of the research (H1 to H8) imply intelligent automation, improved functionality, artificial intelligence-supported service, energy management, high-technology housekeeping, customized experiences, fast feedback, and greenery. The IoT applications lead to 58.9 percent of variation in customer happiness and loyalty ($R^2 = 0.589$). The ANOVA test demonstrates that the overall model is statistically significant ($p < 0.05$), confirming its validity and reliability. This research is relevant to the future of smart hospitality by proposing that the best application of the IoT technology is strategic, as it would optimize the visitor experience and thus happiness and loyalty, which can be valuable to hoteliers and regulators.

INTRODUCTION

The tourism and hospitality industry is a very dynamic and rapidly evolving part of the world economy, as it contributes significantly to the growth and development of the economy of a myriad of countries (Hossain *et al.*, 2025ac). The hotel industry plays an essential role in this sector and contributes significantly to the travelling experience by providing accommodation and implementing modern technologies. The combination of intelligent technologies, such as artificial intelligence (AI), online booking systems, and the Internet of Things (IoT) has become a popular trend in modern hotels, and the aim is to increase the quality of services and the satisfaction of visitors.

An example of modernization in the hospitality sector that offers significant returns to hotel clients is the concept of e-tourism that combines information technology with business management and tourism (Hossain *et al.*, 2025b). Calculated use of technology can enable the hotels to reduce operational costs and shorten the wait time, which enhances convenience and increases the overall satisfaction of the customer experience (Hossain *et al.*, 2025d). In 2019, the gross domestic product of the world witnessed about 8.9 trillion brought about by the tourism industry, which is about 10.3 percent of the total GDP (WTTC, 2020). The inclusion of the IoT technology in the hospitality sector is an essential trigger to the development of the tourism ecosystem, the growth of foreign exchange, and the GDP increase, as well as the creation of new possibilities to both developed and emerging economies (Hossain, 2025).

Internet of Things (IoT) is the system of smart devices that interact and allow communication and automation of the hotel business(Mondol *et al.*, 2026). IoT is becoming increasingly popular to enhance the customer experience, streamline internal operations, and elevate service levels (Gursoy *et al.*, 2021). Hotels in the world are adopting the latest technologies to offer AI-based concierge, smart room systems, and contactless check-in processes (Tussyadiah, 2020). With the introduction of IoT, the management of the hotel can get access to real-time data and insights, which can be used to continuously improve the experiences of guests (Buhalis & Leung, 2022). The study aims to review how the IoT technologies help to address the operational problems, meet the customer demands, and, finally, to increase the customer satisfaction and loyalty as the part of smart hotels in Bangladesh.

Research Gap

This paper addresses three major gaps in the literature on IoT in smart hotels. To address the methodological gap identified, it takes a step forward by using Structural Equation Modeling (SEM) to examine how eight applications of IoT interact with each other to examine the role of technology, instead of the single-technology-centered studies conducted before. Second, it bridges an important contextual gap, as it offers empirical data on Bangladesh, a developing economy that has little to no current role in the discussion of IoT-hospitality, where tourism development and technological use are characterized by distinct forces. Third, it closes a conceptual gap by incorporating the Technology Acceptance Model (TAM) and Customer Loyalty Theory (CLT) into one integrated framework, which explains not only the adoption of IoT but also the road to its customer loyalty.

Research Questions

RQ1: What, in their turn, are the specific implementations of the IoT, smart automation, AI-based services, and

[1] Department of Tourism and Hospitality Management, Post Graduate Student, Islamic University, Kushtia, Bangladesh
[2] Department of Tourism and Hospitality Management, Graduate Student, Islamic University, Kushtia, Bangladesh
[3] Lecturer, Department of Tourism and Hospitality Management, Rangamati Science & Technology University, Rangamati, Bangladesh
[*] Corresponding author's e-mail: mdsohanurrahman36@gmail.com

customer-oriented experiences, and how these aspects affect customer satisfaction and loyalty in smart hotels in Bangladesh?

RQ2: How does Internet of Things systems integration enhance the relationship and customer loyalty in the Bangladeshi hospitality industry?

RQ3: What are the differences between the various dimensions of IoT (automation, sustainability, personalization, and AI integration) in terms of relative importance to forecasting customer loyalty at smart hotels using an SEM framework?

Research Objectives

RO1: To study the combined impact of IoT applications (H1-H8) on customer satisfaction and loyalty by introducing the Partial Least Squares Structural Equation Modeling (PLS-SEM).

RO2: To check the moderation impact of AI integration on the improvement of the relationship between IoT applications and customer loyalty by using a multi-group analysis.

RO3: To establish and rank the most important IoT variables that affect customer loyalty in smart hotels in Bangladesh using path coefficient analysis and importance-performance mapping.

LITERATURE REVIEW

Conceptual Foundations of IoT in Hospitality

The Internet of Things (IoT) consists of a technological paradigm that consists of interconnected physical devices that can collect, transmit, and analyze the data through embedded sensors and network connections and enable intelligent automation and informed decision-making (Atzori, Iera, and Morabito, 2010). In the hospitality industry, IoT allows creating intelligent hotel ecosystem, where the management of activities, services provided to guests and management of the facilities are interconnected through digital networks (Gretzel *et al.*, 2015). This digital revolution can help hotels streamline resource allocation, improve responsiveness of their services, and design a unique environment for guests with data-driven insights (Buhalis & Leung, 2018).

The conceptual grounding in the acceptance of technology in the hospitality industry is often explained with the help of the Technology Acceptance Model (TAM), which suggests that perceived usefulness and ease of use are some of the most important factors that significantly influence the acceptance of hospitality technology by its users (Davis, 1989). At smart hotels, IoT applications should demonstrate quantifiable benefits with regard to convenience, efficiency, and general attitudes of the visitors so as to gain acceptance and satisfaction of the visitors (Morosan & DeFranco, 2016). Likewise, the Service-Dominant Logic (SDL) approach emphasizes the role of co-creation of value between the service-producing organizations and consumers, where IoT allows creating value in real-time and personalizing the service experience, which enhances the overall service experience (Vargo & Lusch, 2004).

H_1: Intelligent automation such as smart check-in and automated processes leads to higher satisfaction with hotel services.

H_2: The use of IoT for operations and other functions (e.g., smart locks, sensors) leads to more efficient operations and better guest experience.

IoT Applications in Guest Service Enhancement

IoT technologies enable room automation, enabling environmental regulation, entertainment, and other room-related services to be tailored to the traveler through mobile apps or voice, which significantly enhances traveler comfort and convenience (Neuhofer, Buhalis, and Ladkin, 2015). Studies have indicated that the guests are increasingly demanding smooth digital experiences during their stay, including the aspect of contactless check-in and in-room automation, where the Internet of Things serves as the technological pillar of their expectations (Tussyadiah, 2020).

Another critical IoT implementation type in smart hotels is AI-based service interfaces, including chatbots and Internet-based concierge services. These systems provide 24/7 service, immediate response to requests, customized recommendations, and reduced delays in services and ensure customer satisfaction (Ivanov & Webster, 2019). In addition to that, proactive maintenance and immediate feedback to visitors' needs based on real-time monitoring of the services provided by IoT sensors can be used to create a more responsive service environment (Xiang, Schwartz, Gerdes, & Uysal, 2015).

IoT implementation in housekeeping processes through sensor-based detecting of room occupancy and cleaning requirements positively affects the efficiency of staff scheduling and ensures an immediate room preparation, which directly affects the way the guests rate the quality of the services provided (Murphy, Hofacker, & Gretzel, 2016).

H_3: The use of AI-driven customer service such as chatbots and voice assistants enhances the hotel experience as a whole.

H_4: The use of energy-efficient technologies, such as the smart regulation of lighting and temperature, increases the comfort of hotel guests.

H_5: The use of smart housekeeping systems, like the automation of cleaning alerts, improves the hotel stay experience.

H_6: The use of personalized experiences, such as the adjustment of rooms and the provision of recommendations, enhances one's feelings of hotel satisfaction.

H_7: The use of real-time feedback systems, such as digital and service- and customer-response-based surveys, improves the hotel experience.

Sustainability, Customer Loyalty, and Theoretical Integration

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H_8: The use of sustainability initiatives, such as the use of IoT to decrease energy use, increases one's satisfaction with their choice of hotel.

X : Application of IoT Technologies in Smart Hotels to Enhance Customer Satisfaction and Loyalty.

MATERIALS AND METHODS

Research Design

The research uses mixed-methods design. The quantitative data is gathered through surveys to gauge the perceptions and the connections between the different variables through measuring. On the other hand, the qualitative data is collected from secondary sources to provide the necessary context and support theoretically.

The target population

The target population consists of those who, either directly or indirectly, partake in the tourism and hospitality sector in Bangladesh, such as local tourists, hospitality workers, business owners, and management students. Besides, the researchers send it out randomly so as to maximize feedback.

Sampling Method and Size

Data are collected through a probability (random) sampling method from the respondents. The researchers have recruited 200 participants for conducting the research.

Data Collection

Data collection was done by the researcher using Google Forms as the online medium.

Survey Instrument

The primary data was founded on a structured questionnaire. The questionnaire was prepared to meet the purpose of the study using a five (5)-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) and

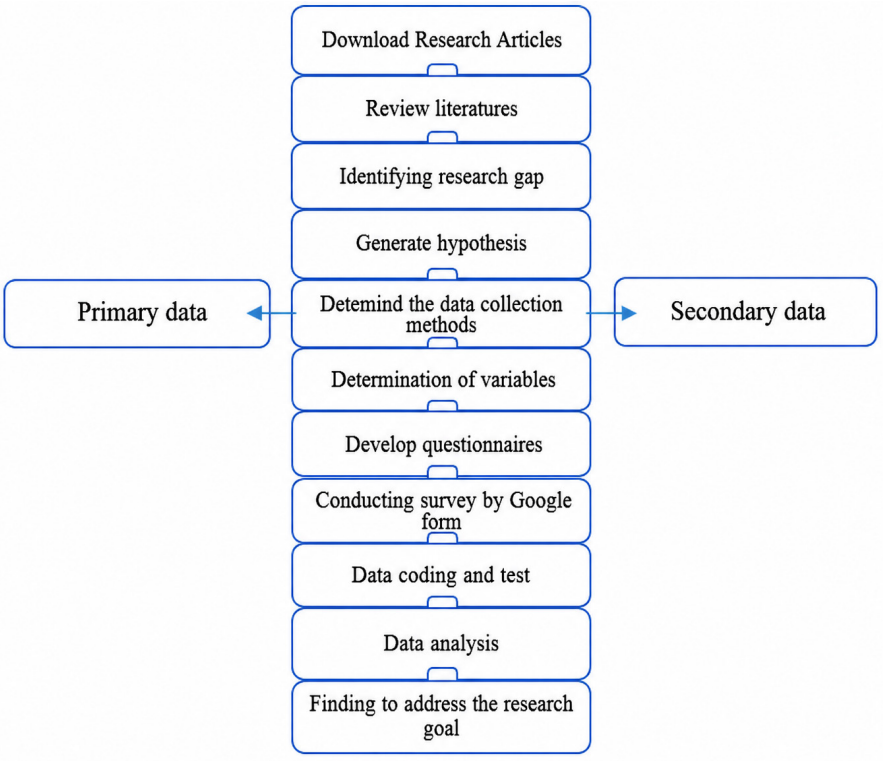

Figure 1: Steps followed in data sourcing and analysis
Developed by corresponding author's

perceptions regarding the issue were measured using it.

Data Analysis

The researcher data was coded by MS Excel 2019 and then analyzed using SPSS (Version 25) and SmartPLS 4. The primary data analysis methods applied mainly Partial Least Squares Structural Equation Modeling and analysis of variance (ANOVA).

A strict process is followed to gather and examine the data. The overall research methodology is depicted in Figure 1. An extensive review of the literature has been conducted for this research on application of IoT Technologies in Smart Hotels.

RESULTS AND DISCUSSIONS

Demographic Profile

A summary of the demographic profiles of the respondents is presented in the following tables.

Table1indicates the frequency and percentage of occupations, marital status, gender, age, age group, education levels and ages of the respondents. The table has 15 (7.5%) under 20, 77 (38.5) in 21-25, 44 (22) in 26-30 and 27 (13.5) in 35+. Males are 135 (67.5%), and females are 65 (32.5%). Table analysis indicates also that 85 (42.5) are married and 115 (57.5) are single. The education data shows that SSC is 20 (10%), HSC is 47 (23.5%), university is 61 (30.5%), and other is 72 (36%). Based on occupation

Table 1: Demographic profile of respondents

Sections	Categories	Frequency	Percentage (%)	Total Participants
Age	Under 20	15	7.5	N=200
	21-25	77	38.5	
	26-30	44	22	
	31-35	37	18.5	
	35+	27	13.5	
Gender	Male	135	67.5	N=200
	Female	65	32.5	
Marital Status	Single	115	57.5	N=200
	Married	85	42.5	
Education	SSC	20	10	N=200
	HSC	47	23.5	
	University	61	30.5	
	Other	72	36	
Occupation	Student	127	63.5	N=200
	Job Holder	32	16	
	Service Provider	17	8.5	
	Other	24	12	

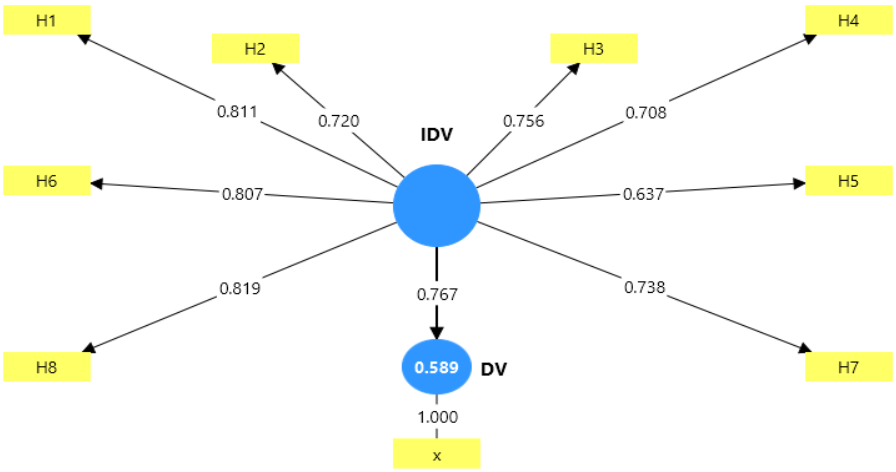

Figure 2*:* Structural Equation Modeling (SEM)
Source: Developed by corresponding author's with SmartPLS 4.

Table 2*:* Partial Least Squares Structural Equation Modeling table (PLS-SEM)

Variable	Outer loading	rho_a	rho_c	CA	AVE	R-squre	Decison
H1	0.811	0.900	0.912	0.889	0.565	0.589	Accepted
H2	0.720						
H3	0.756						
H4	0.708						
H5	0.637						
H6	0.807						
H7	0.738						
H8	0.819						
X	0.767						

Notes: rho_a= Dijkstra-Henseler's rho_A; CA = Cronbach's alpha; rho_c = Composite Reliability; AVE = Average Variance Extracted

Table 3*:*ANOVAa test

ANOVAa						
1	Regression	60.220	8	7.528	44.966	.000b
	Residual	31.975	191	.167		
	Total	92.195	199			
a. Dependent Variable: X						
b. Predictors: (Constant), H1, H2, H5, H7, H4, H8, H6, H3						

Source: SPSS 25.

information, they include 17 (8.5) service providers, 32 (16) job holders, 24 (12) other and 127 (63.5) students. There are 200 responders in all.

Partial Least Squares Structural Equation Modeling (PLS-SEM) (Path Coefficients)

The intensity and direction of the associations between the latent variables (constructs) in the structural equation model are represented by the path coefficients in PLS-SEM.

In the measurement model (**Fig. 2**), every one of the constructs is captured by its respective observed indicators. That is captured by H1 (loading = 0.811) and H2 (loading = 0.720), while H3 is captured by (loading = 0.756) and H4 (loading = 0.708). In addition, H5 is captured by (loading = 0.637) and H6 (loading = 0.807). Moreover, H7 is captured by (loading = 0.838) and H8 (loading = 0.819). According to Hair *et al.*, (2019), they are considered (0.70) acceptable since they reflect sufficient indicator reliability. The dependent variable (DV) is (X) with a loading of 1.000.

The structural model shows that the independent variables (H1 to H8) account for 58.9% of the variance in the dependent variable (DV) (R^2 = 0.589). According to standards provided by Hair *et al.* (2019), an R^2 equal to 0.25 is weak, 0.50 moderate, and 0.75 substantial for social and behavioral sciences. Therefore, the estimated value of R^2 is a moderate to substantial fit and even indicates that the model is both theoretically and practically significant.

ANOVAa test

a. Dependent Variable: IoT application enhance customer satisfaction and loyalty.

b. Predictors: (Constant*), H1: automation such as smart check-in; H2: operations and other functions (e.g., smart locks, sensors) H3: customer service such as chatbots and voice assistants; H4: The use of energy-efficient technologies; H5: The use of smart housekeeping systems; H6: The use of personalized experiences; H7: The use of real-time feedback systems; H8: The use of sustainability initiatives.*

Table 3 will further attempt to establish whether there exists any relation between the independent and dependent variables by performing a variance test on variables in the model. The significance of the model is proved by the statistical evidence at 95% confidence level (p-value =.000). Moreover, the model is significant (greater than p = 0.05) and it means that the independent variable (H1 to H8) is significantly correlated with the dependent variable (X).

Discussion

The findings of the research show robust evidence for

the postulates given, which show that IoT technologies are a key driver of enhanced customer experience in the hospitality industry. Constructs like smart automation (H_1), personal experiences (H_6), and sustainability efforts (H_8) have significant exterior loadings, showing how much they contribute to influencing how customers perceive them. According to conventional social scientific standards, the moderate-to-substantial explanatory power of the model ($R^2 = 0.589$) validates that the aforementioned IoT factors are significant predictors of customer happiness and loyalty (Hair *et al.*, 2019). This supports previous research that names IoT as essential in producing efficient and smooth service environments, i.e., Gursoy *et al.* (2021) and Bujari *et al.* (2021). The Customer Loyalty Theory (Fatima *et al.*, 2021) is supported by the relevance of customized experiences (H_6), which infers that customized services are central to building long-term client relationships. Second, as Okot *et al.* (2023) point out, the empirically supported impact of sustainability measures (H_8) via IoT portrays an increasing consumer choice for sustainable companies. As per the findings, the Technology Acceptance Model (TAM) was successfully applied, as seen with the value yielded by these IoT implementations being both utilitarian and well-pertained to by visitors, thus compelling their adoption and fulfillment.

Contribution

This study significantly advances industry practice and research wisdom across a number of areas. By empirically testing the Customer Loyalty Theory (CLT) and the Technology Acceptance Model (TAM) in a unified, IoT-based model, it theoretically advances both theories in smart hotels. It offers a unified model that connects some particular technical applications (H_1 to H_8) to the fundaments of findings of loyalty and happiness, offering a mature understanding which had not been as broadly researched before, particularly in a developing environment.

Methodologically, this study fills a gap in that it utilizes Structural Equation Modeling (SEM), which provides for in-depth examination of intricate interactions among multiple variables at once. More importantly, it fills a very significant contextual gap in that it offers an insight from Bangladesh, a nation whose rapidly expanding tourism industry is not well represented in the current IoT and smart hotel literature.

Practically, the research provides worthwhile insights to hotel managers and investors. The report provides a ranked order of IoT investments likely to increase consumer satisfaction and loyalty, emphasizing strong drivers from automation, sustainability, and personalization. For hotels planning to manage digital transformation, minimize operating expenses, and achieve competitive edge in today's travel landscape, this is a strategic guide.

CONCLUSIONS

In summary, this study demonstrates a direct and intense connection between customer satisfaction and loyalty improvement and the use of IoT technology in smart hotels. Guests enjoy the convenience, personalization, comfort, and sustainability facilitated by an interconnected hotel environment, according to scientific literature. Adopting IoT is today a strategic necessity for the growth, competitiveness, and customer loyalty of the hotel industry, especially in developing economies like Bangladesh. Knowing and adopting these technology solutions that directly meet the needs and wants of the guests is crucial to the effective digital transformation of the hotel industry.

Disclosure Statement

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