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THE ROLE OF IOT IN SMART TOURISM DESTINATION DEVELOPMENT: EVIDENCE FROM PAKISTAN

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Abstract
The Internet of Things (IoT) is transforming tourism by enabling real-time connectivity, personalized services, operational efficiency, and enhanced visitor experiences. This study investigates the role of IoT in the development of smart tourism destinations in Pakistan, a country with significant tourism potential but limited digital infrastructure. Using a quantitative cross-sectional survey, data were collected from 400 respondents and analyzed with SPSS to evaluate the impact of five IoT dimensions: information and connectivity, accessibility and service efficiency, tourist experience and satisfaction, destination management and smart operations, and safety, security, and sustainability. The findings reveal that destination management and smart operations are the primary drivers of smart tourism development, while other dimensions, although positively correlated, do not independently predict outcomes. The study also identifies critical infrastructural, technological, and governance barriers to IoT adoption and provides actionable recommendations for policymakers and destination managers. These results advance the theoretical understanding of smart tourism in developing countries and offer practical guidance for the strategic implementation of IoT to enhance tourism management, service delivery, and destination competitiveness.

1. Introduction

Digital technologies have profoundly transformed the global tourism industry, reshaping destination management, service delivery, and visitor experiences. Among these, the Internet of Things (IoT) has emerged as a critical enabling technology, facilitating real-time interactions between devices, sensors, platforms, and users. In the tourism context, IoT supports smart navigation, electronic ticketing, automated information systems, personalized recommendations, environmental monitoring, and safety management. IoT-enabled tourism operates within an integrated ecosystem of smart sensors, cloud computing, artificial intelligence, wearable devices, and mobile applications, contributing to more intelligent, responsive, and experience-oriented tourism systems (Gretzel et al., 2015; Buhalis & Amaranggana, 2015; Guo et al., 2022; Rosário & Dias, 2024).

The development of smart tourism destinations is closely associated with these technological advancements. Such destinations leverage digital infrastructure and intelligent information

systems to improve tourist satisfaction, operational efficiency, competitiveness, governance, and sustainability. IoT plays a central role by enabling real-time data collection, service coordination, contextualized communication, and personalized experiences. Previous studies emphasize that destinations are not rendered "smart" merely by adopting digital tools; instead, smartness emerges from the effective integration of connectivity and data into value-creating operations for tourists, businesses, and destination managers (Gretzel et al., 2015; Boes et al., 2016; Buhalis & Leung, 2018; Ye et al., 2020).

In Pakistan, this topic is particularly significant due to the country's substantial yet underutilized tourism potential. Pakistan offers diverse tourism assets, including mountains, religious sites, archaeological heritage, cultural attractions, and eco-tourism opportunities. At the policy level, the Pakistan National Tourism Action Plan 2020–2025 prioritizes tourism as a strategic growth sector and emphasizes digital facilitation through centralized portals, mobile applications, site mapping, booking systems, feedback mechanisms, and central tourism databases (PTDC, 2020).

The economic importance of tourism further underscores the relevance of this research. According to the World Travel & Tourism Council, the sector contributed 6.1% of Pakistan's GDP in 2024 and supported approximately 4.79 million jobs, highlighting its significance for national growth and employment (WTTC, 2024). Despite broad mobile broadband coverage (81%) and smartphone ownership (68%), only 29% of the population used mobile internet in 2024 (GSMA, 2025). For IoT-based tourism systems, this connectivity gap is critical, as smart destinations depend not only on infrastructure but also on accessibility, digital literacy, and user trust.

While international scholarship on smart tourism and IoT has expanded, empirical research in Pakistan remains limited. Most studies focus on technological applications, conceptual discussions, or tourist behavior, whereas the broader developmental role of IoT in transforming destinations into integrated smart systems has received little attention (Ye et al., 2020; Rosário & Dias, 2024; Wu et al., 2024). Specifically, there is a lack of evidence regarding how IoT can strengthen destination management, improve service efficiency, support smart infrastructure, and enhance long-term competitiveness and sustainability.

This study investigates the role of IoT in developing smart tourism destinations in Pakistan. Using a quantitative approach based on questionnaire data analyzed with SPSS, it examines how IoT dimensions contribute to enhanced service delivery, improved visitor experiences, and destination development. The study aims to extend the international literature on smart tourism while providing practical insights for policymakers, tourism managers, and planners in Pakistan.

Despite policy support for digital platforms, mobile applications, mapping systems, and centralized databases, IoT-based smart tourism adoption in Pakistan remains uneven, hindered by weak infrastructure, uneven connectivity, and challenges in remote areas. Previous research has primarily focused on tourist behavioral responses, with limited emphasis on IoT's potential to improve destination management, service integration, competitiveness, and sustainability.

The main objective of this study is to examine the role of the Internet of Things (IoT) in the development of smart tourism destinations in Pakistan. Specifically, it aims to assess how IoT-enabled services enhance tourism service delivery, operational efficiency, and visitor experience, identify the key infrastructural, technological, and governance barriers to IoT adoption, and provide practical recommendations for the effective implementation of IoT in smart tourism development.

This study is guided by the following research questions: How does IoT contribute to the development of smart tourism destinations in Pakistan? In what ways do IoT-enabled services improve tourist experience and destination

service delivery? What are the main infrastructural, technological, and governance barriers to IoT adoption in Pakistan's tourism sector? What measures can support the effective implementation of IoT for smart tourism development in Pakistan?

1.1 Theoretical and Conceptual Framework

This study is grounded in the smart tourism destination perspective, which views tourism destinations as socio-technical ecosystems where digital infrastructure, services, stakeholders, and tourists interact to create value. Smartness emerges not through technology adoption alone but through the integration of digital systems into service delivery, destination management, and visitor experiences (Gretzel et al., 2015; Buhalis & Amaranggana, 2015; Boes et al., 2016; Ye et al., 2020).

Within this framework, IoT is conceptualized as a key enabling mechanism, connecting physical tourism infrastructure with digital intelligence. It supports timely information, accessibility, service efficiency, tourist satisfaction, operational management, and safer, more sustainable tourism practices. The study identifies five IoT-related dimensions as independent variables:

Information and Connectivity
Accessibility and Service Efficiency
Tourist Experience and Satisfaction
Destination Management and Smart Operations
Safety, Security, and Sustainability

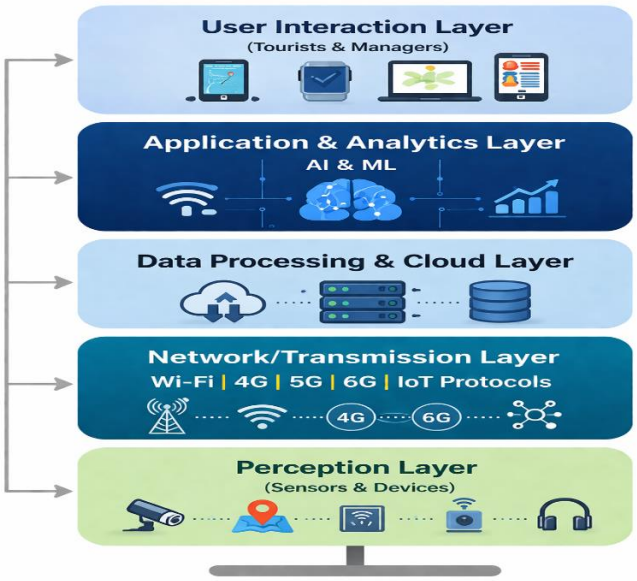
The dependent variable is smart tourism destination development.

1.1.1 IoT Architecture for Smart Tourism Destinations

The IoT architecture for smart tourism integrates physical devices, connectivity, data processing, analytics, and application layers to enable intelligent and responsive destination management. This layered architecture ensures seamless interaction among tourists, service providers, and destination managers, facilitating personalized services, operational efficiency, enhanced visitor experiences, and informed decision-making.

Key Layers of IoT Architecture:

1. Perception Layer: Sensors and devices collect real-time data on tourists, environmental conditions, and destination infrastructure.
2. Network/Transmission Layer: Ensures connectivity through Wi-Fi, 4G/5G, RFID, and IoT-specific communication protocols.
3. Data Processing & Cloud Layer: Aggregates, stores, and processes data to support real-time and predictive analytics for management and service optimization.
4. Application & Analytics Layer: Employs AI and machine learning (ML) to generate insights, personalized recommendations, and predictive alerts.
5. User Interaction Layer: Delivers information, dashboards, and services to tourists and destination managers via mobile apps, kiosks, and digital platforms.



Figue 1: IoT Architecture for Smart Tourism Destinations

1.2 Research Hypotheses

- **H1:** Information and connectivity positively influence smart tourism destination development in Pakistan.
- **H2:** Accessibility and service efficiency positively influence smart tourism destination development in Pakistan.
- **H3:** Tourist experience and satisfaction positively influence smart tourism destination development in Pakistan.
- **H4:** Destination management and smart operations positively influence smart tourism destination development in Pakistan.
- **H5:** Safety, security, and sustainability positively influence smart tourism destination development in Pakistan.
- **H6:** Collectively, the IoT-related dimensions positively influence smart tourism destination development in Pakistan.

1.3 Contribution of the Study

This study makes several novel contributions to the field of smart tourism research. It is the first empirical assessment in Pakistan to examine the influence of five IoT dimensions on smart tourism destination development. The study identifies destination management and smart operations as the primary drivers of smart tourism, providing actionable insights for operational strategies and policy interventions. In doing so, it bridges the gap between research focused on tourist behavior and destination-level outcomes, offering practical recommendations for policymakers and destination managers. Additionally, the study presents a context-specific framework that can guide future research on smart tourism in developing countries with similar infrastructural and digital constraints.

2. Literature Review

The body of research on smart tourism has expanded rapidly since the mid-2010s, reflecting the increasing importance of digital transformation in tourism. Smart tourism refers to the reliance of destinations, tourism industries, and tourists on emerging information and communication technologies that convert data into value-creating services and experiences (Gretzel et al., 2015). Buhalis and Amaranggana (2015) argue that smart tourism destinations depend on dynamic interconnections among stakeholders through technological platforms,

which enable instant information exchange and personalized services. Boes et al. (2016) conceptualize smart tourism destinations as ecosystems that enhance competitiveness, while Ye et al. (2020) demonstrate that research is strongly focused on how technology influences tourists' perceptions, behaviors, and experiences. Collectively, these studies frame smart tourism destinations as socio-technical ecosystems, where infrastructure, services, stakeholders, and user experiences are tightly integrated.

Within this framework, the Internet of Things (IoT) serves as a core enabling mechanism, connecting physical infrastructure with digital intelligence. IoT-enabled tourism expands connectivity and intelligence across tourism services, supporting operational management and visitor experiences (Guo et al., 2022). Buhalis and Leung (2018) highlight that interconnectivity and interoperability are crucial in smart hospitality ecosystems, where connected services and data sharing improve coordination across tourism sub-systems. Recent studies indicate that IoT applications include recommender systems, smart payment systems, electronic ticketing, intelligent guides, health-monitoring tools, and early-warning systems for safety and capacity management (Rosário & Dias, 2024). These applications simultaneously enhance tourist convenience, service innovation, and destination management.

IoT rarely functions in isolation. It increasingly integrates with artificial intelligence, intelligent automation, and data-driven decision systems to improve tourism accessibility, personalization, and user satisfaction. Lan et al. (2021) show that personalized smart tourism programs improve visitor experiences by addressing practical and psychological needs. Wu et al. (2024) identify smart tourism, customer satisfaction, artificial intelligence, intelligent automation, and digital service innovation as major trends in digital tourism research. Similarly, Suanpang and Pothipassa (2024) demonstrate that integrating IoT with generative AI and natural language processing enhances accessibility, multilingual communication, predictive support, personalization, and overall user satisfaction. These findings suggest that IoT should be considered as part of a broader digital transformation architecture rather than a standalone tool.

A central theme in smart tourism research concerns the relationship between technology and tourist experience. Ye et al. (2020) note that many studies examine tourists' responses to digital tools and intelligent services. Lan et al. (2021) emphasize that personalization allows destinations to meet both practical and emotional needs. Yap et al. (2025) show that smart tourism technologies influence satisfaction across multiple dimensions, including technological, social, psychological, behavioral, economic, and destination-related factors. Collectively, these studies indicate that IoT's success depends not only on technical functionality but also on tourists' perceptions of usefulness, accessibility, trustworthiness, and experience enhancement.

In the Pakistani context, emerging studies provide preliminary empirical support. Afzal et al. (2024) found that smart tourism technologies and memorable tourist experiences positively influenced destination image, engagement, satisfaction, and loyalty. Anjum and Ali (2025) reported that, in mountainous destinations, five out of six smart tourism technology dimensions positively affected perceived destination image, which subsequently strengthened trust and revisit intention. These findings suggest that Pakistani tourists are increasingly receptive to digital facilitation; however, most research remains focused on behavioral outcomes rather than the broader role of IoT in destination development and operational transformation.

Despite the potential of IoT, literature also highlights implementation barriers. Rosário and Dias (2024) identify privacy, security, software complexity, scalability, and interoperability as major challenges in deploying IoT-based smart tourism systems. Wu et al. (2024) similarly emphasize privacy and security issues, while Gong and Schroeder (2022) conclude that research has insufficiently addressed tourist information

privacy and governance, particularly in empirical and legal studies. These concerns are critical because IoT-based systems rely on continuous data collection and interconnected platforms, which may increase risks of surveillance, cyber insecurity, and misuse of personal information if governance frameworks are weak.

Barriers are particularly significant in developing countries, where digital infrastructure, standardization, policy support, and user trust may be less mature. In Pakistan, the National Tourism Action Plan 2020–2025 acknowledges these challenges by emphasizing research, information management, centralized digital platforms, customer feedback systems, mapping, and data coordination. However, GSMA (2025) notes that infrastructure availability does not automatically lead to digital adoption, particularly in remote and mountainous regions where affordability, digital literacy, trust, and governance are critical for effective IoT implementation.

Overall, the literature establishes that IoT is central to smart tourism, enabling real-time connectivity, personalized service delivery, operational efficiency, and improved destination management. While Pakistan's tourism sector is economically significant and policy attention to digital facilitation is increasing, digital readiness remains uneven, and empirical research is fragmented. Current studies show positive outcomes for destination image, trust, satisfaction, loyalty, and revisit intention but do not fully explain how IoT contributes to destination intelligence, service coordination, infrastructure modernization, and long-term competitiveness. This gap provides the rationale for the present study, which examines the role of IoT in the development of smart tourism destinations in Pakistan through a quantitative, questionnaire-based approach.

3. Research Methodology

This study employed a quantitative cross-sectional survey design to investigate the role of the Internet of Things (IoT) in the development of smart tourism destinations in Pakistan. A quantitative approach was selected to systematically measure respondents' perceptions across multiple IoT-related dimensions and evaluate their effects on smart tourism destination development through statistical analysis.

Data were collected from 400 respondents across Pakistan using a structured questionnaire administered through convenience sampling. The questionnaire consisted of two sections: demographic information and 23 items measuring perceptions of IoT-related constructs on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The items were grouped into six constructs: information and connectivity, accessibility and service efficiency, tourist experience and satisfaction, destination management and smart operations, safety, security, and sustainability, and smart tourism destination development.

The reliability of the instrument was assessed using Cronbach's alpha, yielding a value of 0.699. While slightly below the conventional threshold of 0.70, this value is acceptable for exploratory research, confirming the internal consistency of the constructs. All data were coded and analyzed using SPSS.

The analysis followed a four-step procedure. First, descriptive statistics summarized respondents' demographics and perceptions of IoT constructs. Second, a Chi-square test examined the association between visiting tourist destinations and the use of digital tourism services. Third, Pearson correlation assessed the relationships among IoT dimensions and smart tourism destination development. Finally, multiple regression analysis evaluated the predictive effects of the five IoT dimensions on smart tourism development. Multicollinearity was checked using tolerance and variance inflation factor (VIF) values, confirming no serious multicollinearity issues. Statistical significance was set at $p < 0.05$.

This methodology provides a rigorous and systematic framework for examining the contribution of IoT-related factors to smart tourism destination development in Pakistan,

ensuring reliability, interpretability, and generalizability of the findings.

4. ANALYSIS & RESULTS

Descriptive Analysis

Table 1 Demographic characteristics of respondents

Demographics	Category	n	%
Age Group	18–25 years	122	30.5
	26–35 years	140	35.0
	36–45 years	89	22.3
	46+ years	49	12.3
Gender	Male	176	44.0
	Female	181	45.3
	Other	43	10.8
Education Level	Undergraduate	120	30.0
	Graduate	136	34.0
	MPhil/MS	86	21.5
	PhD	58	14.5
Occupation	Student	82	20.5
	Government employee	116	29.0
	Private employee	134	33.5
	Business / Self-employed	37	9.3
	Unemployed	31	7.8

presents the demographic profile of the respondents. Most participants were aged 18–35 years, indicating a relatively young sample. Gender distribution was balanced, and the majority held undergraduate or graduate qualifications. In terms of occupation, private employees and government employees formed the largest groups. Overall, the sample appears diverse and appropriate for examining perceptions of IoT-enabled smart tourism destinations in Pakistan.

Table 2. Distribution of Respondents by Province/Region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Punjab	142	35.5	35.5	35.5
	Sindh	52	13.0	13.0	48.5
	Khyber Pakhtunkhwa	122	30.5	30.5	79.0
	Balochistan	18	4.5	4.5	83.5

	Gilgit-Baltistan	22	5.5	5.5	89.0
	AJK	17	4.3	4.3	93.3
	Islamabad Capital Territory	27	6.8	6.8	100.0
	Total	400	100.0	100.0	

Table 2 shows the regional distribution of respondents. Most participants were from Punjab and Khyber Pakhtunkhwa, followed by Sindh, while the remaining respondents were drawn from Islamabad Capital Territory, Gilgit-Baltistan, Balochistan, and AJK. Overall, the sample reflects representation from multiple regions of Pakistan.

Table 3. Respondents Who Visited a Tourist Destination in Pakistan During the Last Two Years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	175	43.8	43.8	43.8
	No	225	56.3	56.3	100.0
	Total	400	100.0	100.0	

Table 3 shows that more than half of the respondents had not visited a tourist destination in Pakistan during the last two years, while a smaller proportion reported recent travel experience. This suggests relatively limited direct tourism exposure within the sample.

Table 4. Respondents' Use of Digital Tourism Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	328	82.0	82.0	82.0
	No	72	18.0	18.0	100.0
	Total	400	100.0	100.0	

Table 4 shows that the majority of respondents had used digital tourism services, while a smaller proportion had not. This indicates a high level of familiarity with digital tourism tools among the sample.

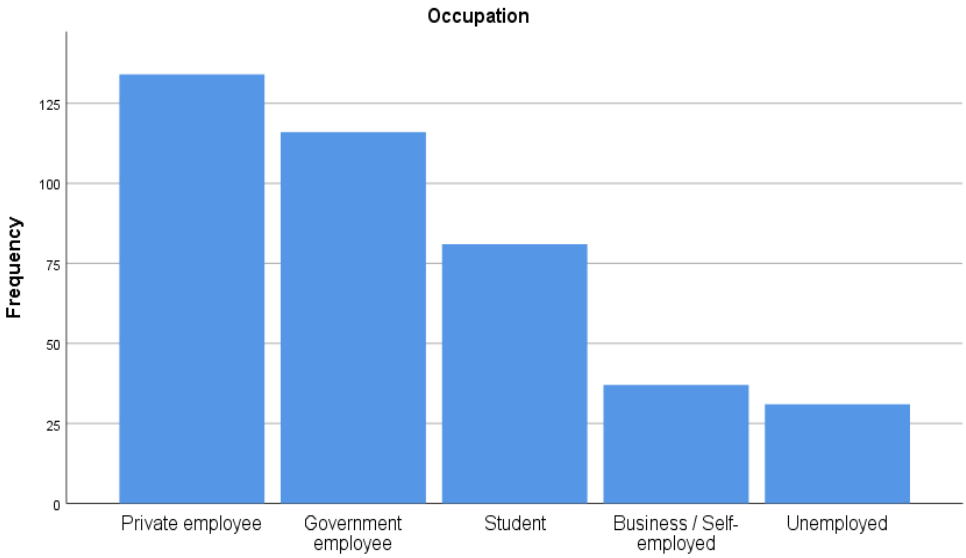


Figure 1. Distribution of Respondents by Occupation

Figure 1 shows the occupational distribution of respondents. Private employees constituted the largest group, followed by government employees and students, while business/self-employed and unemployed respondents represented smaller proportions of the sample.

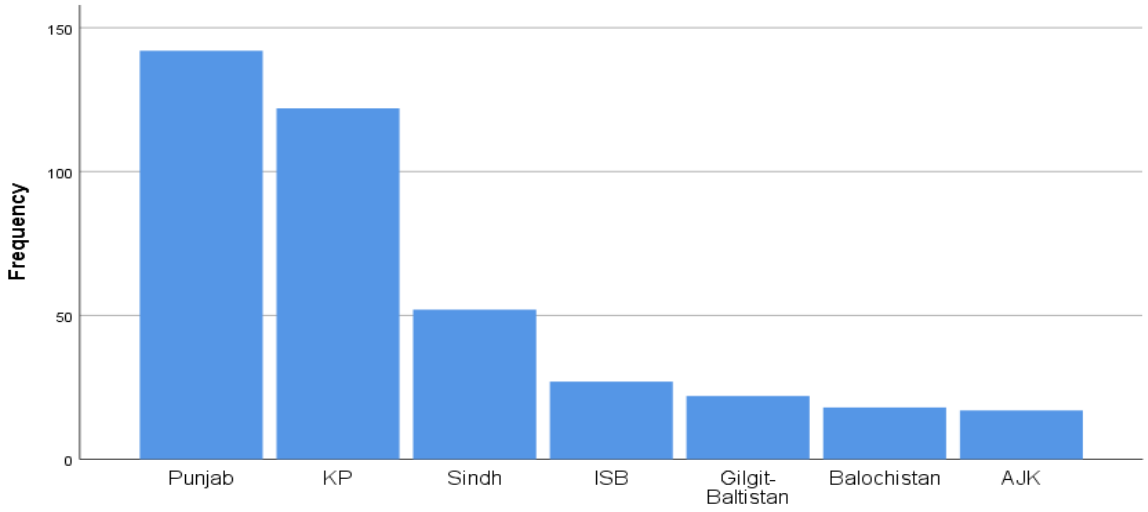


Figure 2. Distribution of Respondents by Province/Region

Figure 2 shows the regional distribution of respondents. Most participants were from Punjab and Khyber Pakhtunkhwa, followed by Sindh, while the remaining regions contributed smaller shares. Overall, the figure indicates a geographically diverse sample across Pakistan.

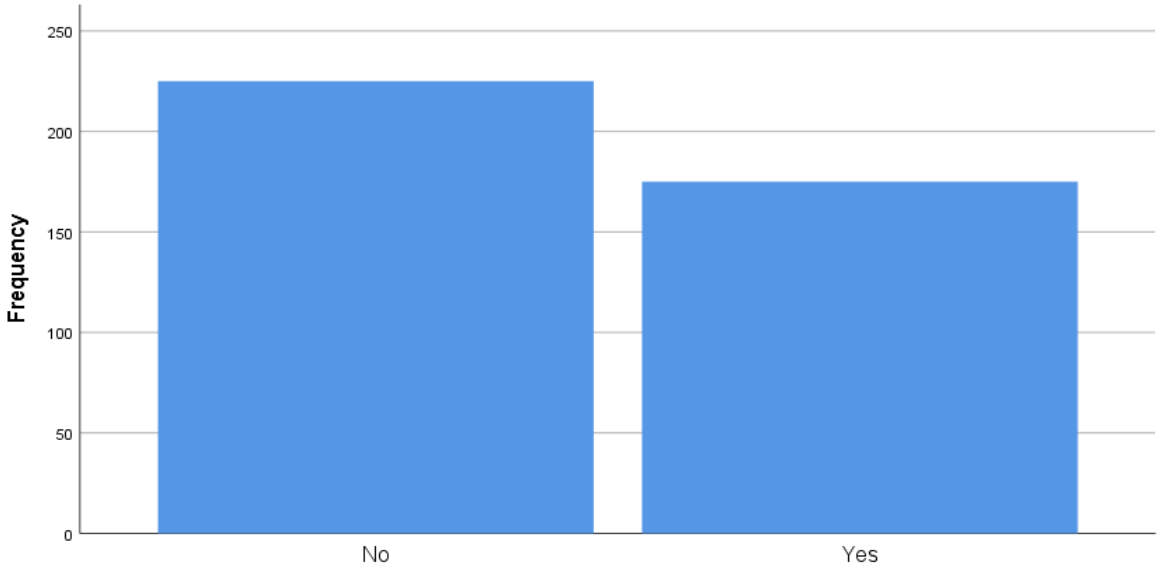


Figure 3. Respondents Who Visited a Tourist Destination in Pakistan During the Last Two Years

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Figure 3 shows that a larger proportion of respondents had not visited a tourist destination in Pakistan during the last two years, while a smaller proportion reported recent travel experience. This indicates relatively limited direct tourism exposure within the sample.

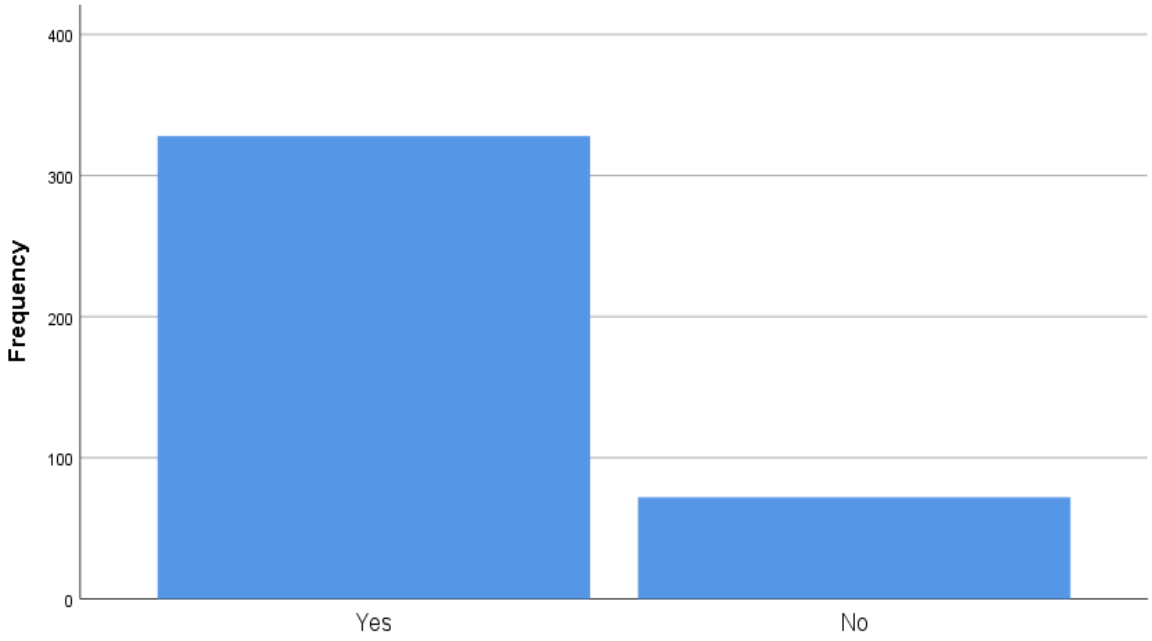

Figure 4. Respondents' Use of Digital Tourism Services

Figure 4 shows that most respondents had used digital tourism services, while a smaller

proportion had not. This indicates a high level of familiarity with digital tourism tools among the sample.

Table 5 Descriptive Statistics for IoT-Based Information and Connectivity

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
IoT-based technologies provide tourists with timely information during travel.	400	1	5	1189	2.97	1.122
Smart tourism applications make it easier to obtain destination-related information.	400	1	5	1165	2.91	1.108
IoT improves communication between tourists and tourism service providers.	400	1	5	1197	2.99	1.149
Real-time digital information helps tourists make better travel decisions.	400	1	5	1153	2.88	1.112
Valid N (listwise)	400					

Table 5 presents the descriptive statistics for four items related to IoT-based information and connectivity in tourism. The mean scores ranged from 2.88 to 2.99, indicating generally neutral responses among respondents. This suggests that participants neither clearly agreed nor disagreed that IoT-based technologies provide timely information, improve access to destination-related information, enhance communication between tourists and tourism service providers, or support better travel decision-making. The standard deviations indicate moderate variation in responses.

Table 6. Chi-Square Test of Association Between Visiting Tourist Destinations and Use of Digital Tourism Services

Test	Value	df	p-value
Pearson Chi-Square	0.843	1	0.359
Likelihood Ratio	0.850	1	0.357
Linear-by-Linear Association	0.841	1	0.359
N of Valid Cases	400		

Note: No cells had expected counts less than 5; therefore, the assumptions of the Chi-square test were met.

Table 6 shows no significant association between visiting tourist destinations and the use of digital tourism services, $\chi^2(1, N = 400) = 0.843$, $p = .359$. This indicates that recent travel experience was not significantly related to digital tourism service use among respondents.

Table 7 Correlations

		Information and Connectivity	Accessibility and Service Efficiency	Tourist Experience and Satisfaction	Destination Management and Smart Operations	Safety, Security, and Sustainability	Smart Tourism Destination Development
Information and Connectivity	Pearson Correlation	1	.326**	.242**	.301**	.029	.152**
	Sig. (2-tailed)		.000	.000	.000	.567	.002
	N	400	400	400	400	400	400
Accessibility and Service Efficiency	Pearson Correlation	.326**	1	.460**	.420**	.048	.264**
	Sig. (2-tailed)	.000		.000	.000	.339	.000
	N	400	400	400	400	400	400
Tourist Experience and Satisfaction	Pearson Correlation	.242**	.460**	1	.377**	.208**	.267**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	400	400	400	400	400	400
Destination Management and Smart Operations	Pearson Correlation	.301**	.420**	.377**	1	.021	.555**
	Sig. (2-tailed)	.000	.000	.000		.669	.000
	N	400	400	400	400	400	400
Safety, Security, and Sustainability	Pearson Correlation	.029	.048	.208**	.021	1	-.038
	Sig. (2-tailed)	.567	.339	.000	.669		.445
	N	400	400	400	400	400	400
Smart Tourism Destination Development	Pearson Correlation	.152**	.264**	.267**	.555**	-.038	1
	Sig. (2-tailed)	.002	.000	.000	.000	.445	
	N	400	400	400	400	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 \shows that information and connectivity, accessibility and service efficiency, tourist experience and satisfaction, and destination management and smart operations were all positively and significantly associated with smart tourism destination development. Among these, destination management and smart operations showed the strongest relationship ($r = .555$, $p < .01$). In contrast, safety, security, and sustainability was not significantly associated with smart tourism destination development ($r = -.038$, $p = .445$).

Table 8. Reliability Statistics

Cronbach's Alpha	N of Items

	.699	8

Table 8. The Cronbach's Alpha value of 0.699 indicates moderate and near-acceptable reliability for the eight-item scale. Although slightly below the recommended threshold of 0.70, it is acceptable for exploratory research.

Table 9. Model Summary for Multiple Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F Change	df1	df2	Sig. F Change
1	.563	.316	.308	.59512	36.485	5	394	.000

Table 9 shows that the regression model was statistically significant, explaining 31.6% of the variance in smart tourism destination development (R^2 = .316; Adjusted R^2 = .308), F(5, 394) = 36.485, p < .001. This indicates that the selected IoT-related predictors jointly made a meaningful contribution to smart tourism destination development in Pakistan

Table 10. ANOVA for Multiple Regression Model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	64.610	5	12.922	36.485	< .001
Residual	139.543	394	0.354		
Total	204.152	399			

Table 10 shows that the overall regression model was statistically significant, F(5, 394) = 36.485, p < .001, indicating that the set of IoT-related predictors jointly explained a significant proportion of the variance in smart tourism destination development

Table 11. Multiple Regression Coefficients for Smart Tourism Destination Development

Predictor	B	Std. Error	Beta	t	p	Tolerance	VIF
Constant	1.579	0.204		7.753	< .001		
Information and Connectivity	-0.032	0.049	-0.030	-0.668	.504	0.857	1.167
Accessibility and Service Efficiency	0.020	0.053	0.019	0.374	.709	0.690	1.450
Tourist Experience and Satisfaction	0.087	0.053	0.080	1.627	.105	0.709	1.410
Destination Management and Smart Operations	0.489	0.044	0.527	10.995	< .001	0.756	1.323
Safety, Security, and Sustainability	-0.058	0.038	-0.066	-1.554	.121	0.952	1.051

Table 11 shows that only destination management and smart operations had a significant positive effect on smart tourism destination development (B = 0.489, β = 0.527, t = 10.995, p < .001). The other predictors were not statistically significant, and the tolerance and VIF values indicated no multicollinearity concerns.

Discussion

The results indicate that IoT-related dimensions collectively influence the development of smart tourism destinations in Pakistan, with the regression model explaining 31.6% of the variance. Among the five dimensions, destination management and smart operations emerged as the only significant predictor, highlighting the critical role of effective operational coordination and governance in smart tourism development (Gretzel et al., 2015; Boes et al., 2016; Buhalis & Leung, 2018).

Although information and connectivity, accessibility and service efficiency, and tourist experience and satisfaction were positively correlated with smart tourism outcomes, they did not independently predict development. This suggests that, in Pakistan, the benefits of these dimensions are contingent upon robust destination management systems, emphasizing that technology alone is insufficient without operational integration.

Safety, security, and sustainability did not significantly impact smart tourism development, possibly reflecting early-stage adoption and limited awareness of IoT applications in these areas. These findings align with prior research highlighting governance, privacy, and infrastructure constraints in emerging smart tourism systems (Gong & Schroeder, 2022; Wu et al., 2024).

Overall, the study confirms that the value of IoT lies in its integration into operational and managerial systems rather than in isolated technological adoption. For Pakistan, successful smart tourism development depends on prioritizing IoT applications that enhance destination intelligence, service coordination, and managerial efficiency.

In hypothesis terms, the study supports H4 (destination management and smart operations) and partially supports H6 (overall IoT influence), while other hypotheses (H1, H2, H3, H5) were not supported. This distinction underscores that only certain IoT dimensions translate into measurable operational outcomes for smart tourism destinations.

Limitations and Future Research

Despite providing valuable insights into the role of IoT in developing smart tourism destinations in Pakistan, this study has several limitations. First, the use of convenience sampling may limit the generalizability of the findings to all tourist segments and regions. Second, the cross-sectional design captures perceptions at a single point in time, restricting the ability to infer causal relationships or assess long-term impacts of IoT adoption. Third, reliance on self-reported data may introduce response biases or inaccuracies.

Future research could address these limitations by employing probability-based sampling and longitudinal designs to capture temporal changes in IoT adoption and smart tourism development. Additionally, qualitative methods, such as interviews or case studies, could provide deeper insights into operational challenges, governance issues, and contextual factors affecting IoT implementation. Subsequent studies could also investigate the integration of emerging technologies—including artificial intelligence, predictive analytics, and machine learning—to enhance smart tourism outcomes. Expanding this research to other regions or countries would further validate the framework and provide comparative insights for global smart tourism development.

Conclusion

This study investigated the role of the Internet of Things (IoT) in the development of smart tourism destinations in Pakistan, examining five key dimensions: information and connectivity, accessibility and service efficiency, tourist

experience and satisfaction, destination management and smart operations, and safety, security, and sustainability. The findings indicate that destination management and smart operations are the primary drivers of smart tourism development, emphasizing the critical importance of operational coordination, managerial oversight, and the strategic integration of IoT into destination management systems. While other dimensions were positively correlated with development outcomes, they did not independently predict smart tourism advancement, suggesting that the effectiveness of IoT depends on its operational and strategic application rather than mere adoption. The study contributes both theoretically and practically by extending the smart tourism destination framework in a developing country context and by providing actionable insights for policymakers and tourism managers, highlighting that IoT investments should focus on operational efficiency, service coordination, and governance integration to achieve tangible outcomes. In conclusion, IoT has significant potential to transform tourism destinations, but its success relies on strategic deployment, operational integration, and governance oversight, and future research should explore the integration of emerging technologies, longitudinal analyses, and cross-regional validation to generalize the framework globally.

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