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Deployment and effectiveness of emerging technologies in enhancing safety and security across selected tourist destinations in cross river state, nigeria.

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Abstract
This study examined the deployment and effectiveness of emerging technologies in enhancing safety and security across selected tourist destinations in Cross River State, Nigeria. Adopting a multi-sited exploratory sequential mixed-methods design, data were collected from 400 respondents using questionnaires and observational checklists, with analysis conducted through descriptive statistics and Independent Samples t-test. The findings revealed that CCTV surveillance systems are the most widely deployed technology (37.3%), followed by mobile security applications, biometric systems, and smart sensors, while drone usage remains limited. Despite moderate adoption, most technologies operate as isolated systems with limited integration and infrastructural support. Effectiveness ratings indicate that over half of respondents perceive these technologies as effective to extremely effective in preventing security threats, although notable proportions reported only moderate or low effectiveness due to operational constraints. The t-test results confirmed a statistically significant difference in perceived safety between destinations with and without emerging technologies ($t = 10.94$, $p < 0.05$), demonstrating their positive impact on tourist safety. The study concludes that while emerging technologies enhance surveillance, response efficiency, and visitor confidence, their full potential is constrained by poor integration, inadequate training, and infrastructural deficits. Strategic investment in smart, integrated systems is therefore essential for sustainable tourism security.

Keywords: Emerging technologies, tourist safety, security systems, smart tourism, Cross River State,

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Introduction

Globally, many tourist destinations have embraced advanced technologies to enhance safety and monitoring. Dubai in United Arab Emirate has installed over 300,000 AI-integrated CCTV cameras across its major tourism districts, while Singapore Changi Airport, uses biometric scanners and automated security gates to ensure seamless passenger safety checks (Dias, 2024). In Africa, destinations such as Victoria Falls in Zimbabwe and Cape Town in South Africa have installed smart surveillance cameras linked to central command centres to monitor high-traffic tourist zones (Ebrahim, 2021). In Nigeria, few cities like Abuja and Lagos have begun deploying smart street cameras and patrol drones in commercial hubs and airports, but most tourist destinations especially those in Cross River State still rely on manual surveillance, exposing visitors to avoidable risks (Allam, & Oboh, 2023). Identifying which technologies are currently available in Cross River's tourist sites is necessary to gauge the baseline level of safety infrastructure in the state.

The effectiveness of security technologies in reducing crime and enhancing safety has been demonstrated across various tourism hotspots worldwide. In New York City, the installation of real-time video analytics reduced incidents of theft in public parks by 42% within a year (Sung, & Park, 2021). In Africa, South Africa's Table Mountain National Park adopted drone-based monitoring and recorded a significant decline in mugging incidents targeting hikers (Duporge, 2021). In Nigeria, pilot use of AI-powered CCTV systems in Murtala Muhammed International Airport in Lagos reportedly improved response time to security alerts and reduced baggage theft incidents by 60% (Hassan, 2025). Evaluating the actual effectiveness of similar technologies in Cross River's tourist destinations will reveal whether they are genuinely enhancing safety or simply serving as symbolic installations.

In Nigeria, destinations perceived as unsafe such as parts of Northern Nigeria affected by insurgency record very low tourist traffic, while safer destinations like Obudu Mountain Resort in Cross River State attract relatively more visitors (Ugwuoke, Ajah, Akor, Ameh, Lanshima, Ngwu, & Nwokedi, 2023). Establishing how technology-driven safety improvements influence patronage in Cross River is thus crucial for positioning it as a competitive destination. Cross River State, security units at sites like Tinapa Lakeside Resort and Marina Resort operate with outdated cameras, intermittent electricity, and undertrained staff, which severely limits their capacity to deploy or maintain emerging security technologies effectively.

Despite the proliferation of studies on tourism safety and technology (Rostami, & Faghani, 2025; Rahaman, Amin, Rahman, & Amin, 2025; Achu, Enyia, Joseph, Njong, Ekene, Ereh,

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& Takim, 2024), most have focused broadly on tourism infrastructure development, destination image, and general crime prevention. None has explicitly examined the use and effectiveness of emerging technologies for enhancing safety and security at tourism destinations in Cross River State.

Objectives of the study

1. Identify the types of emerging technologies currently deployed for safety and security in selected tourist destinations in Cross River State.
2. Assess the effectiveness of these emerging technologies in preventing security threats and ensuring tourist safety.

Literature review

Types of emerging technologies for safety and security in tourist destinations

Tiwari, Mishra, and Tiwari, (2024), evaluated the role of data safety and perceived privacy for acceptance of IoT-enabled technologies at smart tourism destinations. Smart tourism with the Internet of Things (IoT)-enabled technologies is the future of global tourism. This study examines smart tourism adoption based on trust and risk theories integrated with the technology adoption model (TAM). Perceived privacy and safety-security risks are discussed as key issues that affect the tourists' level of trust in the technology, which influences perceived usefulness, perceived ease of use, attitudes, and behavioural intention. The study involved collecting data scientifically from 427 tourists to validate the proposed hypotheses using structural equation modelling. All the hypotheses were supported. This work provides a hierarchical model that highlights the intermediary role of trust contingent on perceived safety and security risk and perceived privacy risk, as well as that of ease of use, usefulness, and attitudes as a pathway for shaping the behavioural intention for IoT-enabled technologies at a smart destination. The findings can help develop smart tourism solutions optimized for IoT devices to enthuse trust and in turn, make visitor experiences rewarding.

Dziurakh, Kulyniak, Sarkisian, Zhygalo, Chepil, and Vaskovych, (2024), examined the intrusion detection systems for smart tourism platforms, argued that the rapid evolution of smart tourism platforms has transformed the travel and hospitality industry, enhancing user experiences through personalized services and real-time data access. However, this technological advancement also raises significant concerns regarding food safety and user privacy. By detecting and reacting to malicious activity and unauthorized access, Intrusion Detection Systems (IDS) are essential in reducing these risks. This article examines IDS's current status in relation to smart tourism platforms, emphasizing its technical

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implementations, efficacy, and difficulties. The study highlights the necessity of flexible, machine learning-based strategies to improve security measures and offers a thorough framework for incorporating IDS into smart tourism systems. The results highlight how crucial strong IDS are to protecting private user information and guaranteeing food safety in a world that is becoming more networked by the day.

Ma, (2024), enhancing tourists' satisfaction: Leveraging artificial intelligence in the tourism sector., argued that tourism industry plays a pivotal role in global economic growth and development, significantly contributing to GDP, job creation, and cultural exchange. However, delivering exceptional tourist experiences remains challenging due to factors such as overcrowding, inadequate infrastructure, language barriers, and cultural insensitivity. The integration of artificial intelligence (AI) technologies offers a promising solution to these challenges. AI can enhance personalization, streamline operations, and improve resource allocation, thereby elevating the overall quality of the tourist experience. AI-driven technologies, such as machine learning algorithms, virtual assistants, augmented reality (AR), and virtual reality (VR) applications, can provide tailored recommendations, multilingual support, and immersive experiences. Moreover, AI can enhance safety and security through predictive analytics and real-time monitoring. While the potential of AI to revolutionize the tourism industry is immense, responsible and ethical implementation is crucial to ensure that these innovations benefit all stakeholders and mitigate potential risks. Embracing transparency, privacy, and fairness in AI practices will foster trust and create more inclusive, sustainable, and enriching travel experiences globally.

Effectiveness of emerging technologies in preventing security in tourist destinations

The rapid growth of global tourism has increased the need for advanced security measures to protect travelers from evolving threats. Emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), biometric systems, and big data analytics have been widely adopted to enhance tourist safety. Empirical evidence suggests that these technologies significantly improve threat detection, risk management, and emergency response. Artificial intelligence has proven particularly effective in predictive security. AI-powered surveillance systems can analyze large volumes of real-time data to identify suspicious behaviors and potential threats. For instance, studies show that machine learning algorithms used in airport security and public surveillance systems can detect anomalies with higher accuracy than traditional monitoring methods (Chen et al., 2021). This reduces response times and enables authorities to act proactively rather than reactively.

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Similarly, IoT devices play a crucial role in improving situational awareness. Smart sensors, GPS tracking, and connected infrastructure allow for continuous monitoring of tourist environments. Empirical research indicates that IoT-enabled systems in smart tourism destinations can significantly reduce crime rates and improve emergency response efficiency by providing real-time data to authorities (Gretzel et al., 2020). For example, smart city initiatives often integrate IoT networks to monitor crowd density, environmental hazards, and unusual activities. Biometric technologies, including facial recognition and fingerprint scanning, have enhanced identity verification processes in tourism hubs such as airports, hotels, and border checkpoints. Evidence suggests that biometric systems reduce identity fraud and unauthorized access, thereby strengthening overall security (Jain et al., 2019). However, concerns about privacy and data protection remain significant challenges that may affect user acceptance and implementation.

Big data analytics further contributes to tourist safety by enabling the analysis of large datasets from various sources, including social media, travel patterns, and historical incident reports. Empirical findings indicate that predictive analytics can identify high-risk areas and periods, allowing authorities to allocate resources more effectively (Li et al., 2022). This data-driven approach supports better decision-making and enhances preparedness for potential threats.

Methodology

Research Design

This study adopted the multi-sited exploratory sequential design which was proposed by Creswell and Clark (2007) as part of their framework for mixed methods research designs to enhance the novelty and depth of the research. Data were source from both primary and secondary for the study.

The Study Area

Cross River State, located in the South-South geopolitical zone of Nigeria, serves as the study area and lies approximately between latitudes 4°45′N and 6°30′N and longitudes 7°50′E and 9°30′E. The state is administratively divided into three senatorial districts, Cross River North, Cross River Central and Cross River South, comprising a total of 18 Local Government Areas (LGAs). The Cross River North Senatorial District encompasses the LGAs of Ogoja, Yala, Bekwarra, Obudu, and Obanliku, spanning the northern highlands characterized by rugged terrain and cooler climate. The Cross River Central Senatorial District includes Ikom, Etung, Boki, Abi, and Yakurr LGAs, forming the state's midsection with undulating hills and rich agricultural land. The Cross River South Senatorial District covers Biase, Akamkpa,

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Odukpani, Calabar Municipality, Calabar South, Akpabuyo, and Bakassi LGAs, stretching towards the Atlantic coastline with low-lying plains, tropical rainforests, and extensive river networks. This geographic diversity across the three senatorial districts provides a unique spatial framework for comprehensive field investigations within the state.

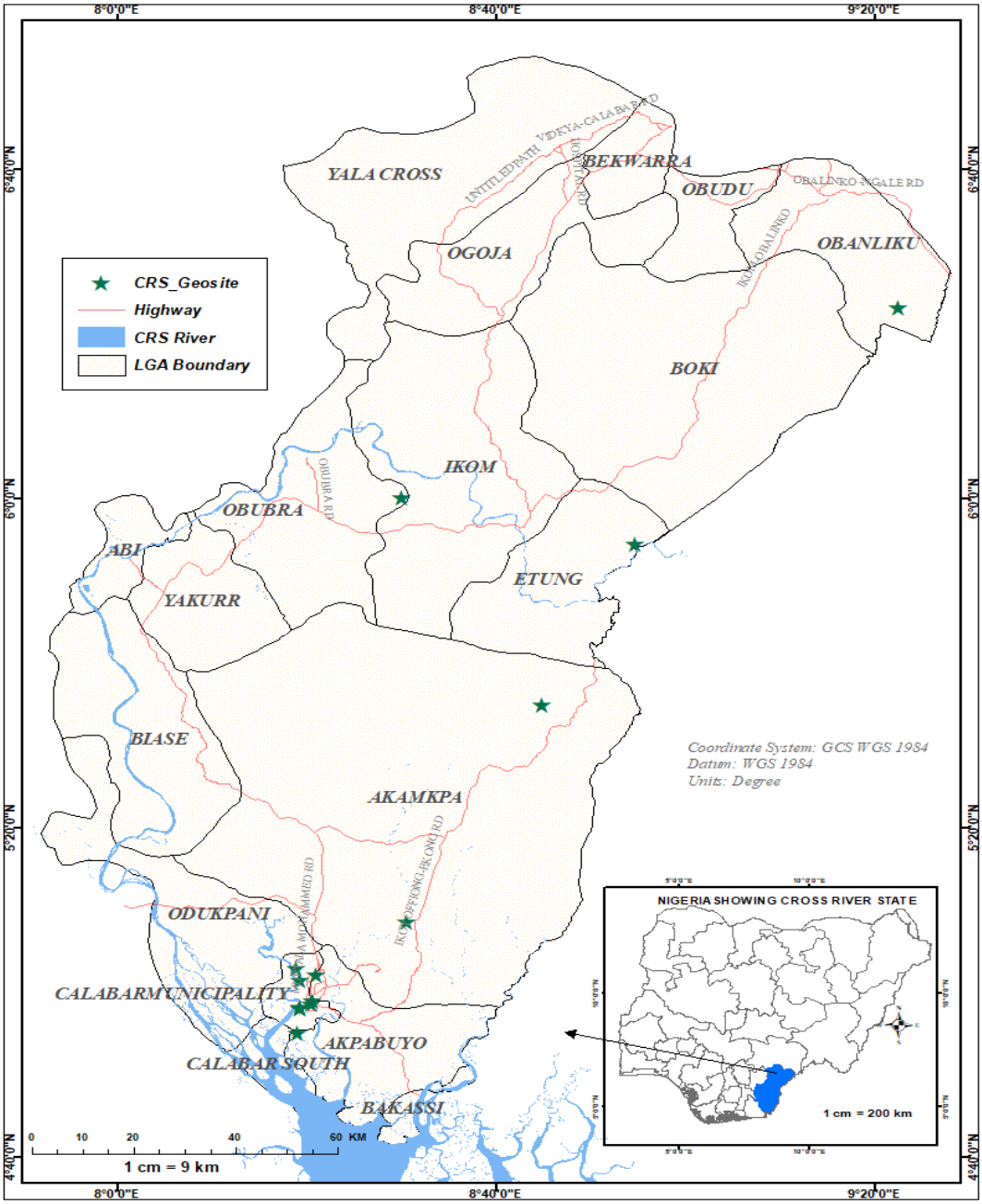

Fig 1: Cross River State showing tourists destinations

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Source: GIS Unit, Department of Geography, University of Calabar

Population and sample size of the study

The population of this study comprised a total of 600 respondents drawn from selected tourist destinations across Cross River State, where tourism activities are most concentrated. While sample size was drawn using a Composite Entropy–Proportional Allocation *(CEPA)* to derive the target sample of 400 respondents across the selected tourism LGAs in Cross River State. The study adopted a multi-stage sampling technique which combines stratified, purposive, and simple random sampling approaches.

Methods of data collection and analysis

Data for the study were collected using a combination of quantitative and qualitative methods to provide a detailed and well-rounded understanding of the subject. The instruments include questionnaire and checklist. While data collected were analysed using simple frequency and percentage with the hypothesis tested using Independent Samples t-Test.

Result and discussion

Demographic characteristics of respondents

The gender composition of respondents shows a moderate male dominance, with males accounting for 56.8 percent (227 respondents) and females constituting 43.2 percent (173 respondents). This distribution suggests that participation in tourism activities and tourism-related work within the study area is slightly skewed towards males. While the dominant age group was 26–35 years, representing 34.8 percent of respondents, followed by those aged 18–25 years at 24.3 percent and 36–45 years at 20.3 percent. Collectively, these age categories account for over 79 percent of the sample, indicating that tourism participation in the study area is driven primarily by young and middle-aged adults. Meanwhile, the occupational and user-category distribution of respondents highlights the multi-stakeholder nature of the study. Domestic tourists formed the largest group at 40.3 percent, underscoring the importance of local tourism patronage in sustaining destinations within Cross River State. Tourism workers accounted for 23.3 percent, while security personnel and site management staff represented 11.8 percent and 10.3 percent respectively. International tourists constituted only 7.3 percent of the respondents. Whereas, Educational attainment and visitation patterns further provide insight into respondent behaviour and engagement levels. Respondents with secondary education formed the largest group at 34.3 percent, followed by those with bachelor's degrees at 18.3 percent and diploma or NCE holders at 17.3 percent. This suggests a moderately educated respondent.

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Table 1: Demographic Characteristics of Respondents

Demography	Category	Frequency	Percentage (%)
Gender	Male	227	56.8
	Female	173	43.2
	Total	400	100.0
Age Group	Below 18 years	21	5.3
	18–25 years	97	24.3
	26–35 years	139	34.8
	36–45 years	81	20.3
	46–55 years	43	10.8
	56 years and above	19	4.8
	Total	400	100.0
Category	Domestic tourist	161	40.3
	International tourist	29	7.3
	Tourism worker	93	23.3
	Security personnel	47	11.8
	Site management staff	41	10.3
	Other	29	7.3
	Total	400	100.0
Educational Level	No formal education	31	7.8
	Primary education	61	15.3
	Secondary education	137	34.3
	Diploma/NCE	69	17.3
	Bachelor's degree	73	18.3
	Postgraduate degree	29	7.3
	Total	400	100.0

Source: Researcher's fieldwork, 2025

The findings in Figure 2, reveal that CCTV surveillance systems are the most commonly adopted emerging security technology in tourist destinations within Cross River State, with 37.3% of respondents reporting their presence. This is followed by mobile security applications (16.8%), biometric access control systems (15.3%), and smart alarms or sensors

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(13.3%), while drone surveillance was observed in only 9.3% of the sites. Notably, 8.3% of respondents indicated that no emerging security technologies were observed at certain locations. These results suggest a moderate integration of technological tools in enhancing safety, with a clear reliance on conventional surveillance methods, particularly in well-established destinations such as Obudu Cattle Ranch, Tinapa Resort, and the Calabar Municipal tourist sites.

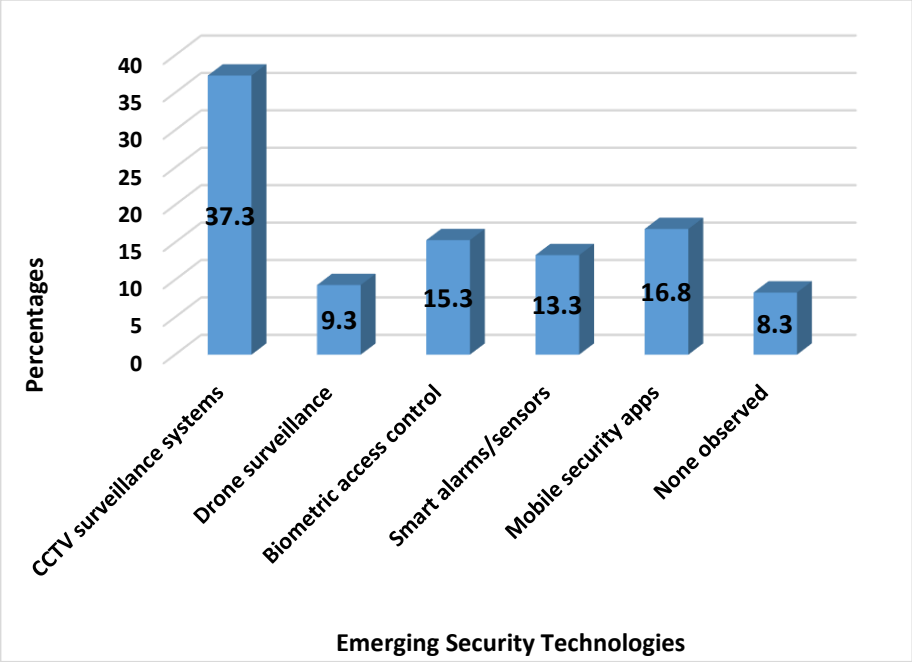

FIG. 2: Emerging Security Technologies Observed at Tourist Destinations

Source: Researcher's fieldwork, 2025

The data presented in Figure 3, indicates that video surveillance remains the predominant technology employed for tourist safety across destinations in Cross River State, with 39.3% of respondents identifying it as the most commonly used system. Communication and alert systems follow at 17.8%, while digital access control and automated lighting systems account for 14.8% and 11.8% respectively. Integrated security platforms are less frequently adopted, representing only 9.8% of observed cases, and 6.8% of sites still rely solely on traditional security measures without technological support. These findings demonstrate a clear preference for visual monitoring tools.

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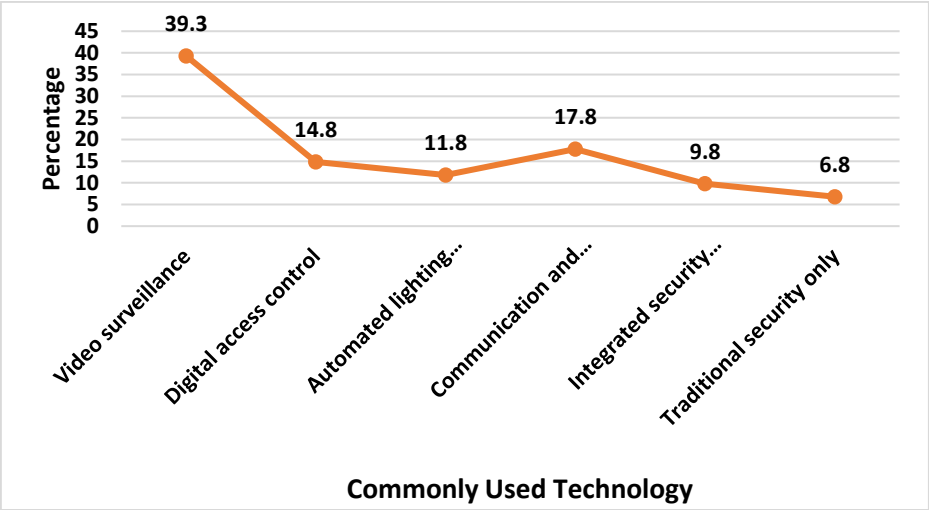

FIG. 3: Most Commonly Used Technology for Tourist Safety
Source: Researcher's fieldwork, 2025

The analysis of Table 2 reveals that the effectiveness of emerging security technologies in preventing security threats at tourist destinations in Cross River State varies considerably. A substantial proportion of respondents, 29.3%, rated the technologies as "effective," while 19.8% considered them "very effective," and 7.8% deemed them "extremely effective," indicating that over half of the participants acknowledge the positive role of these tools in enhancing safety. However, 23.3% described the technologies as only "moderately effective," and a combined 20.1% perceived them as "slightly effective" (12.3%) or "not effective" (7.8%), reflecting ongoing operational and infrastructural limitations.

Table 2: Effectiveness of Emerging Technologies in Preventing Security Threats

Effectiveness	**Frequency**	**Percentage (%)**
Not effective	31	7.8
Slightly effective	49	12.3
Moderately effective	93	23.3
Effective	117	29.3

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Effectiveness	**Frequency**	**Percentage (%)**
Very effective	79	19.8
Extremely effective	31	7.8
Total	400	100

Source: Researcher's fieldwork, 2025

The Independent Samples t-Test results in Table 3 demonstrate a highly significant difference in tourist safety scores between the two groups. The calculated t-value of 10.94 with 398 degrees of freedom and a p-value of 0.000 indicates a statistically significant difference. The mean difference of 1.23, with a 95% confidence interval ranging from 1.14 to 1.32, confirms that tourists perceive destinations with emerging security technologies as substantially safer than those without. These results support the alternative hypothesis (H1), showing that emerging security technologies significantly enhance the safety and security of tourists.

Table 3: Independent Samples t-Test Results

T	**df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of Difference**
10.94	398	0.000	1.23	1.14 – 1.32

Discussion

The findings reveal that the deployment of security and digital management technologies in tourism destinations across Cross River State has substantially enhanced destination safety, operational efficiency, and stakeholder confidence. Technologies such as CCTV surveillance, biometric access systems, digital visitor tracking, and mobile-based security communication platforms have strengthened real-time monitoring and rapid response to security threats. These improvements align with studies that emphasize the role of smart technologies in improving destination resilience, governance efficiency, and risk mitigation within tourism environments (Ghaderi et al., 2025; Idrus et al., 2025).

And also indicates that most tourists visiting destinations in Cross River State generally feel more relaxed and confident when they encounter visible and well-managed security

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technologies. Many tourists associate surveillance cameras, controlled entry points, and organized security checks with professionalism and care, which enhances their overall experience and satisfaction. Feeling safe allows visitors to focus on enjoying attractions, engaging with local culture, and spending more time and money within the destination. This observation aligns with studies showing that perceived safety strongly influences tourist satisfaction, loyalty, and willingness to revisit a destination (Al Mahruqi et al., 2025; Grigoriadis et al., 2025). For tourists unfamiliar with the region, security technologies help reduce anxiety linked to media narratives about insecurity in Nigeria.

Conclusion

The study therefore, concluded that although a range of emerging security technologies has been introduced across selected destinations, their deployment remains largely basic, isolated, and poorly integrated. Most installations function as stand-alone systems with limited interoperability, restricting their capacity for real-time intelligence sharing and coordinated response. The minimal presence of advanced tools such as smart surveillance, automated access control, and data-driven monitoring indicates that the tourism sector in Cross River State is still at an early stage of technological evolution in safety and security management. This fragmented adoption limits the strategic value of technology as a proactive security tool.

Recommendations

Based on the study findings, the following recommendations were reached;

1. Destination managers should prioritize the adoption of integrated and smart security systems, including real-time monitoring and data-driven surveillance tools.
2. Regular training programmes should be organized for security personnel and tourism workers to improve technical competence in operating and maintaining security technologies.

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