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IoT Deployment in the Hotel Industry for Guest Satisfaction

Moyeenudin. H.M [1], John Williams R [2], Manivel. K [3], Vijayakumar M[4]
[1, 2, 3, 4] School of Hotel & Catering Management
Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai, India.
Corresponding author's e-mail address: moyeenudin@gmail.com

Abstract: The hospitality sector is a key contributor to the global economy. In recent years, the extensive integration of new technologies within this sector has significantly transformed how services are provided and experienced. This paper examines various advanced technologies currently utilized in the hotel industry and their impact on enhancing guest experiences while altering the service delivery framework. Additionally, we anticipate potential future services in hotels as the Internet of Things (IoT) technology continues to evolve. We also address essential challenges that must be tackled to implement a sustainable and future-ready solution for the hospitality sector.

Keywords: IoT, Hotel Industry, Digital Transformation, Automation

Introduction: Domestic and international travel has experienced several years of consistent growth. The income generated from lodging, dining, and various other services provided to this influx of travelers has enabled the leisure and hospitality sector to emerge as a significant contributor to the global economy. To achieve ongoing growth in this industry, professionals highlight the necessity for substantial enhancements in the quality and type of hospitality services to meet the evolving consumption and travel habits of today's customers. Specifically, these enhancements aim to draw in the new generation of technology-savvy individuals who travel on a budget. Implementing these enhancements results in a comprehensive transformation of the service offerings and the technological infrastructure currently utilized by hospitality service providers (HSP). The objective of these enhancements should be the customization of experiences and the digitalization of services. Customization of experiences is essential for marketing services to budget-conscious travelers [1]. Personalization enables tailored guest experiences by incorporating flexibility and adjustability into the service packages offered. Presently, many of the packages marketed by HSP combine various popular services across different price levels with minimal, if any, opportunities for negotiation. Travelers often find themselves torn between opting for everything or nothing, leading them to typically choose the latter. If hospitality service providers (HSP) offer more adaptable service packages, guests can tailor their experiences to fit their preferences and financial plans. Utilizing an effective technological platform to manage interactions between guests and service providers can considerably simplify the creation of personalized value propositions for each guest [2]. To attract tech-savvy travelers, embracing the digitalization of services is essential. The aim of this digital transformation is to shift towards a digital business model by bringing hospitality services to the guest's interface. A digital service platform enables guests to explore, plan, and select activities at their convenience, thus promoting a seamless technology integration into their travel experience. Examples of digital services that attract tech-savvy guests include booking and reservation systems, location-based services, personalized messaging, and social media integration. By offering special perks such as loyalty points, coupons, and bonuses, guests can be motivated to use in-house applications rather than third-party services [3]. The ongoing growth of Internet of Things (IoT) technology is shaping the future of the hospitality management industry. IoT refers to the connection of everyday physical devices, like sensors, actuators, identification tags, and mobile devices, allowing them to communicate with each other through local networks or the Internet. Integrating IoT technology within the hospitality sector qualifies hotels as smart buildings, which are crucial components of smart cities [4]. The IoT framework creates opportunities for immediate, personalized, and localized services since HSP can more accurately assess guest behaviors and preferences. Additionally, IoT facilitates the enhancement of back-end efficiency across various departments.

(e.g. front desk, housekeeping, sales and marketing, etc.) and implement cost-reduction strategies such as intelligent energy management. IoT technology is already gaining traction in the hospitality sector with public

terminals, in-room gadgets, and mobile apps, while some promising future applications of IoT, including body area sensor networks, environmental monitoring, and augmented reality experiences, are sure to create new business opportunities [5]. Therefore, HSP should strive to make their technology framework resilient against future changes, allowing their systems to be easily updated alongside the evolving IoT technological landscape. In this paper, we provide an in-depth examination of the role technology plays in cutting-edge hospitality services. We also discuss the potential future developments in hospitality services brought about by the growing revolution of IoT technology. Next, we identify the challenges that HSP is currently encountering and highlight the importance of addressing these issues to establish a sustainable and future-ready solution for the hospitality industry [6].

Influence of Technology in Hotel

HSP are significantly investing in IT to overhaul their technological infrastructure. In 2016, midscale hotels had the highest IT spending (7.3%), followed by upscale hotels (6.1%) and luxury hotels (5.6%). These investments primarily focus on digitizing the service platform to benefit both parties involved in the hospitality service exchange—the guests and the providers. Advances in smart devices and IoT are driving change in technology used within the hospitality service framework. Guest interactions are increasingly shifting to on-screen and online platforms via guest-facing systems, which not only offer convenience for guests but also provide service providers with opportunities to gather valuable data and feedback [7]. The digitalization adopted by HSP through back-of-house (BoH) management systems has contributed to improved operational efficiencies, enhanced managerial effectiveness, reduced cost of goods sold, increased revenues, and bolstered sustainability. In a digital hospitality service platform, the systems that face guests are the main points of interaction between guests and the hospitality service provider (HSP). Guest-facing systems (illustrated in Figure 1) encompass hospitality service mobile apps, point-of-sale (POS) terminals, handheld devices, thin-client terminals, among others. These systems should be smoothly integrated throughout all three stages of the guest cycle: pre-sale, point of sale, and post-sale phases to deliver a comprehensive digital service experience for guests.

Guest-facing systems enhance the guest experience in various ways. To begin with, these systems ensure guest satisfaction by giving guests the ability to manage their environment. Guest-facing systems provide guests with services such as automated check-in and check-out, keyless entry, and control over in-room functionalities, etc. (as depicted in Figure 1). For instance, Hilton and Starwood hotels enable guests to check in automatically and access their rooms without keys via their mobile applications. Similarly, Telkonet's EcoSmart Mobile offers mobile applications that allow guests to manage in-room IoT devices. Peninsula Hotels is in the process of creating its own series of proprietary in-room tablets which will enable guests to order room service, communicate with the concierge, arrange transportation, make free VOIP calls, and choose TV channels and movies to stream on the hotel room television.

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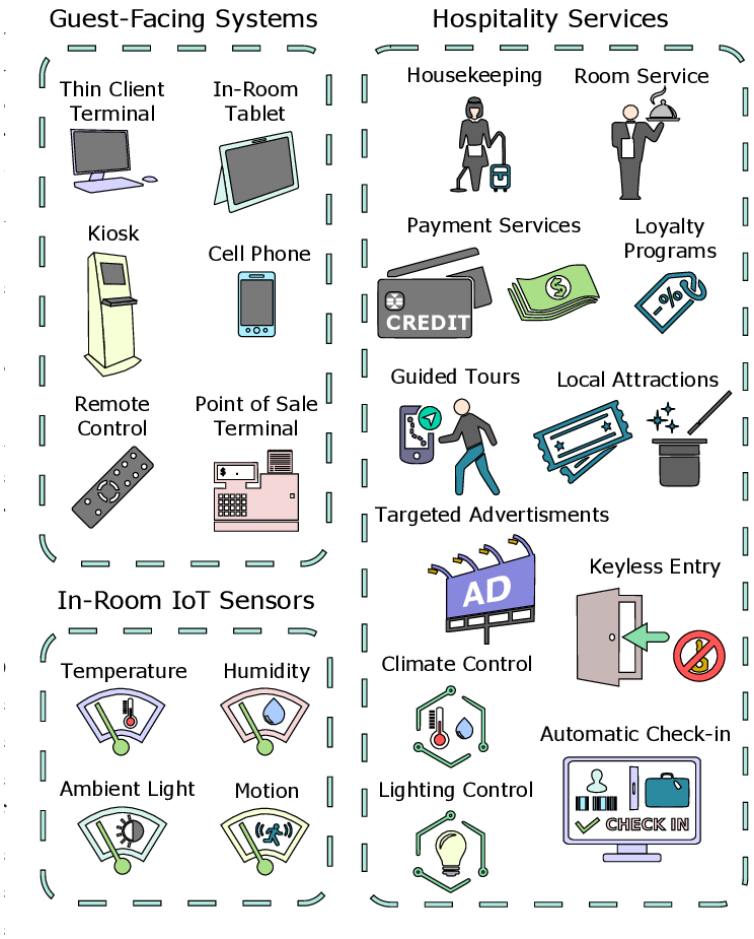

Figure.1 Sensor Based Technology

Furthermore, guest-facing systems offer location-based services, which are another essential aspect of guest satisfaction. In 2016, over 30 percent of hotels allocated budgets toward location-based technology. Guest-facing systems equipped with location-based technology provide both on-site and off-site services for guests, such as digitally guided tours, recommendations for local events and attractions, and suggestions for dining and entertainment options (as shown in Figure 1). These services not only assist guests in navigating their surroundings and exploring during their stay but also enhance their overall experience.

and businesses that benefit the HSP. For instance, Fontainebleau Miami customizes their pre-arrival and checkout offers based on the location data of their guests. The services provided to guests through guest-oriented systems are powered by advanced BoH management systems. These BoH management systems encompass property management systems, customer relationship management, revenue and sales management, and housekeeping maintenance software. Advances in guest-oriented systems and IoT technology are greatly improving the efficiency of BoH management systems [8]. For instance, in-room IoT devices such as thermostats, motion sensors, and ambient light sensors can manage temperature and lighting in hotel rooms that are empty or unsold, potentially lowering energy costs by 20 to 45%. Starwood Hotels and Resorts has implemented a "daylight harvesting" initiative, an energy-efficient program that conserves energy and enhances indoor lighting uniformity by automatically adjusting energy-efficient LED lighting based on the amount of natural light entering the hotel room.

The advancements in guest-oriented systems are also transforming the relationship dynamics between guests and HSP. Guest-facing systems allow service providers to closely track the guest experience by gathering data on individual guest preferences, behaviors, and locations. Service providers and BoH systems utilize this

information to create personalized guest profiles that help tailor service offers for returning customers. These custom guest profiles can be disseminated across a vast network of partner service providers, ensuring that the services offered to guests remain highly tailored. Another essential managerial responsibility linked to BoH management systems is enhancing the online brand presence of HSP. This involves fostering and sustaining positive customer relations via effective utilization of social media platforms and encouraging guests to provide ratings and reviews on online portals [9]. The online reputation of a company is directly related to its revenue generation. Approximately 90% of today's tech-savvy travelers rely on online reviews when selecting hospitality services. Consequently, a single unfavorable review can lead to significant customer loss. Therefore, it is essential for Back of House (BoH) management systems to monitor online platforms for negative reviews and ratings and implement necessary measures to lessen their impact. BoH management systems also contribute to increased revenue per available room (RevPAR) by streamlining housekeeping and maintenance tasks. By utilizing in-room technologies and guest preference data, these systems can effectively schedule housekeeping services. This optimization decreases the downtime of hotel rooms, enhances the allocation of labor resources, and greatly boosts guest satisfaction [10]. The implementation of housekeeping management systems and applications can result in a reduction of payroll expenses by 10% to 20%. Furthermore, BoH management systems assist in managing the smart systems found in rooms and throughout the property. These systems can identify faults and malfunctions in real-time, leading to quicker maintenance responses.

FUTURE PROSPECTS IN HOSPITALITY SERVICES

As the Internet of Things (IoT) expands and integrates into various aspects of daily life, we can anticipate a future where every physical device we use collects and examines our data to automatically deliver services [11]. This section explores some potential services and use cases that the evolving IoT ecosystem may offer to the hospitality industry in the future. Figure 2 illustrates examples of IoT sensors and devices along with the various service categories in which they can be utilized. Body Area Sensors: Smart and wearable technologies are leading the way in the IoT revolution. The sales of devices like smartphones and smartwatches are increasing rapidly, and smart technology is beginning to be incorporated into other wearable items such as smart clothing and smart shoes. These devices collect user information, including body temperature, heart rate, location, and fitness activities. Wireless medical sensor technology broadens the range of data collection by offering comprehensive information about various organs and systems within the body. Through thorough analysis of the data collected via body area sensor networks, HSP can deliver numerous new services to guests, such as automatically adjusting room temperature in response to body temperature, altering room lighting according to a guest's sleep cycle, and suggesting meals aligned with a guest's fitness objectives, among others [12]. HSP can also cater to guests' specific needs based on the medical devices they utilize. For instance, service providers can eliminate high-carb and sugary meal options for diabetic guests and restrict high-cholesterol meal choices for those with heart issues, etc. Augmented reality and beacon technology are being utilized by HSP to enhance their on-property systems in innovative ways. These technologies can facilitate services like digitally guided tours, previews of the in-room environment (such as decor, facilities, and amenities), immediate translation services for signs and other printed materials, interactive menus featuring dishes, critical reviews, and food allergy details, in addition to engaging trivia games centered around points of interest on the property [13]. These offerings can be packaged as part of in-house loyalty applications.

Energy Management: HSP can implement various cost-reduction strategies and achieve environmentally-friendly operation of on-site systems by utilizing IoT technology. Currently, numerous hotel properties have adopted energy-efficient systems such as intelligent lighting and climate control systems, in addition to using low-energy devices like compact fluorescent bulbs and LED lights [14]. IoT technology can greatly enhance the effectiveness of energy-saving systems. For instance, IoT-enabled power outlets and smart devices can notify housekeeping and maintenance staff if a specific outlet surpasses a predetermined limit for power usage over a specified time frame. This enables the service staff to determine whether guests are being cautious with power consumption or if there is an issue with malfunctioning devices. Furthermore, IoT technology can be

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utilized to restrict water usage. This can be accomplished through IoT-enabled smart bathrooms featuring smart showerheads, smart sinks, and flow-regulated toilets.

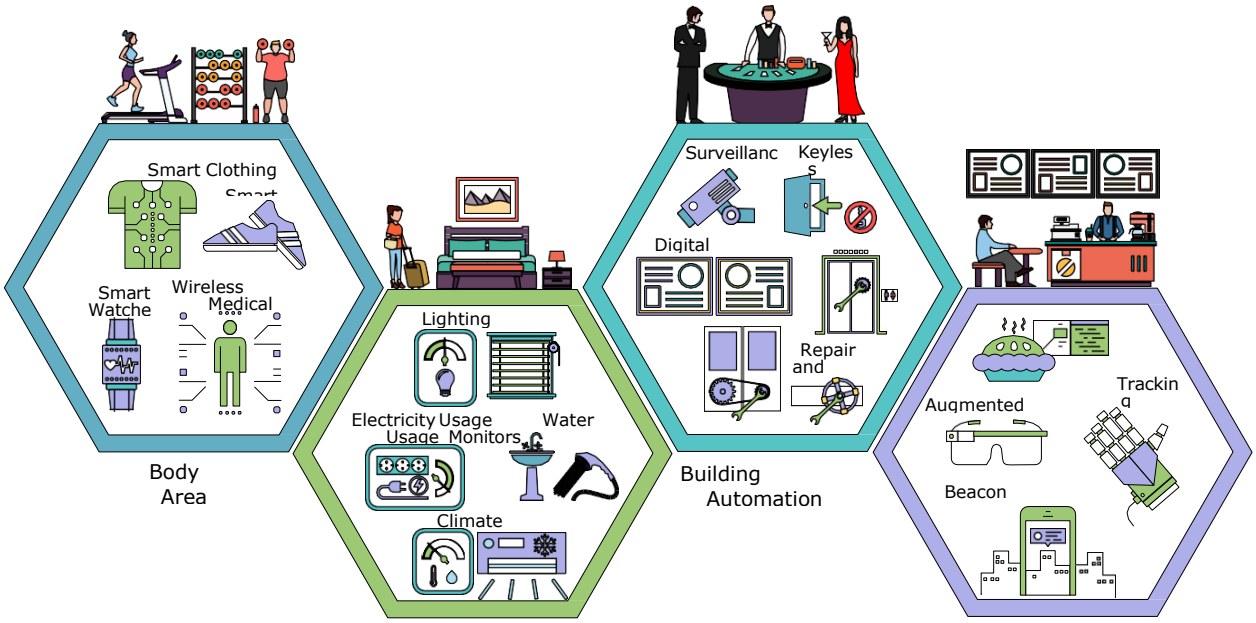

Figure 2 Technology with IoT in Hotel

Building Automation and Monitoring: Both guests and service providers gain advantages from building automation and monitoring. This automation enhances the operational and managerial efficiency for HSP. For example, in-room monitoring systems can identify whether a room is occupied or not, allowing for the efficient scheduling of housekeeping services [15]. IoT-enabled systems accessible to guests, as well as other utility networks like elevators, automated doors and windows, power lines, and pipelines, can report issues and malfunctions, scheduling preventive maintenance before any problems arise from routine physical inspections. This section outlines four key challenges linked to successful IoT integration within the hospitality sector. Addressing these challenges is crucial for the new technological systems being embraced by hospitality service providers (HSP) to maintain ongoing growth.

Interoperability: The hospitality sector is characterized by a lack of standardization. Numerous HSP are creating their own proprietary technologies based on individualized metrics and methodologies to meet the technological demands of contemporary guests [16]. This has resulted in a wide array of implementations, each primarily aimed at delivering a similar range of services. While these systems function effectively within a single establishment, they do not possess the capability to be expanded to intra-organization or inter-organization applications. HSP must guarantee that guest data is utilized and stored appropriately to safeguard guests against physical, financial, and societal hazards. The systems that engage directly with guests, as well as point-of-sale terminals, are particularly vulnerable to security breaches in hotels. It is crucial that these systems secure interactions with guests by implementing stringent security protocols to prevent data breaches and theft. Additional security measures should be integrated into the hotel network to enhance protection in interfaces with personal guest devices and IoT devices within the rooms and across the property. A fortified hotel network helps to keep hackers from accessing guest data through attacks on personal devices connected to the network. Furthermore, it also stops hackers from reprogramming the hotel's IoT systems for disruptive or harmful objectives. Implementing robust security protocols for every guest interaction and active connection on the hotel network is essential [17].

restricts the effectiveness of guest preference profiles on a larger scale due to the absence of a universal platform for sharing guest information among various businesses. This may result in lost revenue opportunities for hospitality service providers (HSP) as they struggle to deliver tailored services to their patrons. Issues with

interoperability also affect the guest experience, creating frustrations and inconveniences that detract from the seamless experience guests seek [18]. Different hotels' non-standardized systems can lead to unnecessary adjustment periods for guests during their stay. Additionally, these systems might face challenges in connecting with and utilizing data from guests' personal devices. These issues highlight the need for standardized, vendor-agnostic systems and solutions within the hospitality sector.

Data Management: The collection and evaluation of guest information are essential components of the hospitality service ecosystem. With the emergence of new technologies and service platforms in the hospitality field, the volume of data is set to increase dramatically. Customizing the guest experience significantly drives the rise in data volume. To offer personalized services, back-of-house (BoH) management systems must analyze guest preference profiles alongside data concerning the surrounding environment gathered from IoT devices and sensors. This demands a substantial computational workload on BoH management systems, which can only be managed through the implementation of specialized technological infrastructure.

Security and Privacy: To deliver highly personalized services to guests, it is essential for HSP to monitor guest preferences, behaviors, and locations.essential computing resources. Responsiveness: HSP needs to guarantee quick acknowledgment of guest requests and the swift provision of services. This can be accomplished by digitizing interactions between guests and HSP. By directing guest interactions to systems that are customer-facing and implementing automated controls via IoT sensors and devices, HSP can reduce the necessity for human interaction and involvement when addressing guest needs [19]. These systems minimize the potential for miscommunication and misunderstanding in interpreting guests' requests. Additionally, they can fulfill guests' needs more rapidly than any devoted hotel staff. This significantly enhances the responsiveness to guest inquiries and contributes to the seamless experience that guests seek. Responsiveness is also vital for the maintenance and upkeep of the hotel. A lack of or slow reaction to repair and maintenance demands can decrease the hotel’s revenue per available room (RevPAR). For instance, a room cannot be rented out if something as minor as the room's phone is malfunctioning. In hotels with extensive IoT implementations, maintenance and repair requests can be handled quickly, as most IoT sensors and devices are capable of detecting and diagnosing issues independently [20]. Timely maintenance and repairs ensure that hotel rooms are made available for guests promptly, thereby lessening revenue loss due to maintenance delays. To enhance the responsiveness of hotel systems, they should be outfitted with enhanced computing resources and unrestricted access to both guest and back-of-house (BoH) management data, necessitating a decentralized approach to computing and data management.

CONCLUSIONS

In this paper, we discuss numerous essential improvements that should be adopted within the hospitality sector to realign its service framework with the current technological environment. We highlighted personalization of services and digital transformation as the two primary areas where these improvements should be concentrated. Various hospitality service providers have taken significant steps to redesign their offerings, and we explore some of these cutting-edge hospitality services they provide. Additionally, we anticipate several innovative services that the hospitality industry may introduce as advanced technologies, such as body area sensors and augmented reality, reach full development. We also point out key challenges, including interoperability, data management, security and privacy, and responsiveness, that must be addressed to establish a robust and future-ready solution for the hospitality sector.

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