Big Data-Driven Innovations in Hospitality and Tourism: Enhancing Accessibility and Personalized Travel Experiences

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Abstract. The rapid advancement of data analytics has revolutionized the tourism and hospitality sectors, transforming them from labor-intensive models into insight-driven industries. While existing research emphasizes the influence of large-scale data analysis on general tourism trends, its role in addressing the needs of travelers with disabilities remains underexplored. This study investigates how intelligent data applications can enhance travel accessibility by analyzing both structured and unstructured information, including user-generated content, social me- dia discourse, booking behaviors, and sentiment analysis. Furthermore, it explores how analytics-driven insights can inform service personaliza- tion, infrastructure optimization, and policy development for inclusive tourism. As global aging populations grow and disability prevalence in- creases, identifying accessibility-focused travel patterns presents a vital opportunity for businesses and decision-makers. By leveraging predictive modeling, machine learning, and AI-powered systems, the hospitality in- dustry can better serve travelers with diverse needs, enhancing both user satisfaction and economic viability. This paper offers a novel lens on the convergence of intelligent data systems, accessibility, and tourism, and provides strategic recommendations for fostering a more inclusive travel landscape.

Keywords: Data Analytics, Inclusive Tourism, Travel Accessibility, User- Generated Content, Sentiment Analysis, Predictive Modeling, AI-Powered Systems, Hospitality Industry, Service Personalization, Policy Innovation

1 Introduction

Tourism opens the door to cultural discovery, personal growth, and unforgettable experiences. However, for many individuals living with disabilities, travel can present numerous challenges. According to a recent report by Amadeus, approximately 15% of the global population—around one billion people—live with some form of disability [3]. The United Nations has described this group as the world's largest minority, yet their needs are often overlooked within the travel and hospitality industries.

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As medical advancements improve and life expectancy continues to rise, the number of people living with disabilities is expected to increase. Many disabilities are not congenital but result from aging, illness, or accidents, making this an issue that could affect anyone at some point in life [35]. The World Health Organization projects that by 2050, over 21% of the global population will be aged 65 or older [3], reinforcing the need to prioritize accessibility in tourism planning.

Despite facing mobility and accessibility challenges, travelers with disabilities represent a significant and growing market. According to the Open Doors Organization, in the United States alone, adults with disabilities spend over $17 billion annually on travel [7]. This figure grows even larger when considering that many travel with companions, such as caregivers or family members.

Accessible tourism—also known as inclusive travel—seeks to ensure that all people, regardless of physical, sensory, or cognitive limitations, can enjoy travel experiences with dignity and independence. Achieving this goal requires more than just ramps or accessible hotel rooms. True accessibility spans the entire travel experience, including booking platforms, transportation, accommodations, attractions, and customer service [28].

The rapid advancement of technology, particularly in digital platforms and assistive devices, has created new opportunities to enhance travel accessibility. Smartphones with screen readers, text-to-speech features, and mobile apps tailored to specific needs have already improved daily life for many individuals with disabilities [32]. Moreover, the rise of user-generated content has changed how travelers plan trips and share their experiences [9], creating a wealth of data that can inform more inclusive tourism practices.

Big data and analytics are increasingly central to modern tourism strategies, yet their application in accessible tourism remains underexplored. Leveraging data from online reviews, social media, booking behavior, and travel feedback can offer valuable insights into the preferences and challenges faced by travelers with disabilities. This study aims to explore how big data applications and analytics can help tourism providers better understand and meet the needs of this important traveler segment, ultimately contributing to a more inclusive and equitable tourism landscape.

2 Data-Driven Innovation in Hospitality and Tourism

The rise of Information and Communication Technologies (ICTs) has profoundly reshaped the global hospitality and tourism sector. These advancements have transitioned the industry from a labor-intensive model to one increasingly powered by intelligent, data-driven systems [10]. Modern travelers now rely on digital ecosystems—ranging from search engines and mobile platforms to personalized recommendation tools—to plan their trips more efficiently and enrich their overall experience [12].

This digital evolution has led to the generation of massive volumes of travel-related information, including user-generated content, booking patterns, and

real-time location data. By harnessing such information through advanced analytics and machine learning, tourism stakeholders can uncover behavioral trends, optimize service delivery, and create more meaningful, tailored travel experiences.

Moreover, these data ecosystems offer an opportunity to promote inclusivity in travel. Insights extracted from diverse traveler groups, particularly individuals with disabilities, can inform more accessible and empathetic design in tourism services. As the industry continues to evolve, the effective use of complex data infrastructures becomes crucial for both innovation and equity in global travel.

With ICTs, planning a trip has become quicker, more cost-effective, and highly personalized. From booking flights and hotels to accessing real-time reviews and travel tips, travelers can make informed decisions with just a few clicks [9]. One of the most influential outcomes of this digital evolution is the emergence of user-generated content (UGC)—photos, reviews, blog posts, and travel stories shared online. This content not only informs future tourists but also creates a feedback loop that continuously shapes the services and experiences within the hospitality industry [9].

While the term *big data* might sound technical, it's already woven deeply into everyday tourism activities. Each time a traveler makes a booking, checks into a hotel, or shares a vacation photo online, they contribute to a growing pool of digital information [29]. This data—ranging from structured booking records to unstructured social media posts—can span from terabytes to petabytes in volume [31]. Platforms like TripAdvisor, Yelp, Facebook, and Instagram are filled with ongoing conversations, recommendations, and travel experiences that are shared in real time, offering fresh insights for industry professionals and researchers alike.

Travelers today generate a continuous stream of data as they search for destinations, use travel apps, navigate cities, or share photos and experiences on social media [29]. Each interaction, whether it's writing a hotel review or uploading a travel vlog, reveals something about their preferences, motivations, and behaviors [12]. Understanding these digital footprints helps tourism professionals tailor experiences that resonate more deeply with their guests.

Previous studies have explored the diverse forms and uses of big data in hospitality and tourism [12]. Among the most impactful sources is social media. Platforms such as Facebook, Instagram, travel blogs, and review sites are now essential tools for travelers and businesses alike [39]. They function as modern forms of word-of-mouth, often referred to as electronic word-of-mouth (eWOM), which has largely replaced traditional face-to-face travel advice [9].

A notable example of big data application in hospitality is the analysis of online hotel reviews. Guo, Barnes, and Jia conducted a study analyzing over 266,000 reviews from nearly 26,000 hotels using data mining techniques [16]. Their work highlighted 19 key areas—such as value for money and check-in experience—that influence guest satisfaction and can guide service improvement.

Another fascinating area involves the analysis of travel photography. When tourists post photos on platforms like Instagram or Flickr, those images are

often geotagged and timestamped. This data can be used to map popular attractions, uncover travel patterns, and even detect unique visitor behaviors [32]. Researchers have also explored how analyzing the sequence of shared photos can help design personalized travel routes and recommendations based on traveler interests and time constraints [30].

In summary, big data is becoming an invaluable resource for the hospitality and tourism sector. Unlike traditional research methods that rely on surveys, data shared directly by travelers offers real-time and authentic insights into their journeys. Both industry professionals and researchers recognize the potential of big data to deepen our understanding of tourists' needs, enhance service delivery, and drive innovation across the tourism experience [16].

2.1 Review of Existing Frameworks in Accessible Tourism and Data-Driven Systems

Research on accessible tourism has introduced a variety of frameworks, though most remain fragmented and limited in scope. Earlier studies have investigated *online booking platforms* enhanced with accessibility features, demonstrating how analytics can streamline reservation processes for travelers with disabilities. However, these efforts often lacked consistency in implementation across providers. Similarly, *transport accessibility frameworks* have examined mobility solutions such as real-time routing and GPS-enabled travel assistance, yet few studies assessed their scalability in diverse urban contexts.

The literature also points to the growing role of *IoT-enabled assistive technologies*, where smart devices and sensors support navigation and interaction in unfamiliar environments. While promising, these systems are frequently constrained by cost, usability, and data integration challenges. In parallel, *personalized recommender systems* have been proposed to align tourism choices with users' accessibility requirements. Hybrid approaches that merge functionality profiles with user preferences highlight the potential of tailored recommendations, though practical deployments remain sparse. Another notable trend is the use of *sentiment analysis* on large volumes of travel reviews to identify service gaps and accessibility-related concerns, offering a bottom-up perspective on traveler needs.

Taken together, these frameworks underline progress but also expose a critical gap: there is still no comprehensive ecosystem that unifies booking, transport, personalization, and feedback under a data-driven accessibility model. This gap frames the novelty of the present work, which integrates these fragmented streams into a more cohesive vision of inclusive tourism.

3 Disability and Big Data in Hospitality and Tourism

Disability is a multifaceted concept, interpreted differently across organizations. A widely recognized definition is provided by the World Health Organization

(WHO) in 1976 [33], stating: "An impairment is any loss or abnormality of psychological, physiological or anatomical structure or function; a disability is any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being; a handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that prevents the fulfillment of a role that is considered normal (depending on age, gender and social and cultural factors) for that individual." Within the context of travel and hospitality, this implies that guests with disabilities may face diverse and complex challenges in accessing services and environments that others find routine. Disabilities vary in type and severity, affecting the way individuals interact with tourism infrastructure, accommodations, and experiences [33].

Given the wide range of needs among travelers with disabilities, the hospitality and tourism industry faces both challenges and opportunities in enhancing accessibility and inclusive guest experiences. Big data and disability informatics offer vital tools to understand these needs more effectively and to design services that are more accommodating [49].

Disability informatics—a field within health informatics—focuses on collecting, managing, and utilizing information relevant to people with disabilities, their caregivers, and medical professionals [33]. This data-centric approach can be extended to tourism by identifying patterns in travel behavior, accessibility requirements, and service gaps experienced by tourists with disabilities. The interconnection with public health and consumer informatics is particularly relevant for tourism destinations aiming to provide safe, inclusive, and health-conscious travel environments.

The adoption of big data analytics allows tourism stakeholders to better predict and respond to the needs of travelers with physical, sensory, or cognitive impairments. A study from the early 2000s emphasized the importance of using health data to prevent disability at multiple points along the causal chain, advocating for global, cross-context applications beyond traditional healthcare settings [52]. This broader perspective can inform destination planning, service design, and policy-making in tourism as well.

For instance, cloud-based systems such as the extended Artemis platform, initially deployed in clinical settings, demonstrate how real-time analytics of physiological data can reduce disability-related risks [47]. In a tourism context, similar frameworks could be adapted to monitor health and safety metrics in resorts, cruise ships, or smart cities. Additionally, insights from bioinformatics—particularly in relation to genetic disorders—may guide future development of specialized travel services and medical tourism offerings [33].

Assistive technologies play a central role in enhancing the travel experiences of individuals with disabilities. These technologies can be categorized into three main environments:

- **Virtual Environment:** This includes websites, mobile applications, and other digital platforms that assist travelers with disabilities in planning and navigating their journeys. Web accessibility remains a critical issue, as many

online booking systems and tourism websites still lack full compliance with accessibility standards. Nevertheless, the digital era has opened up vast possibilities for empowerment and independence among disabled travelers [33].

- **Personal Environment:** For many travelers, especially those with chronic conditions, maintaining a safe and monitored personal environment while on the move is essential. Wearable devices and mobile health applications can track vital signs and alert caregivers in case of emergencies. While ethical concerns such as privacy and autonomy are debated, these technologies are widely acknowledged as lifesaving tools, particularly in high-risk travel scenarios [42].
- **Physical Environment:** Accessibility in physical spaces remains a cornerstone of inclusive tourism. Infrastructure such as ramps, elevators, tactile paving, and accessible transportation systems directly impacts the mobility of tourists with disabilities. Despite significant progress since the passage of the Americans with Disabilities Act (ADA), issues such as the absence of curb cuts or inaccessible trails persist. Innovative solutions like MAGUS, which uses Geographic Information Systems (GIS) to inform users about wheelchair-friendly routes in cities, exemplify how technology can enhance the physical travel experience [33].

The integration of big data with inclusive design principles offers a transformative path for the tourism and hospitality industry. By leveraging disability informatics and advanced analytics, destinations can become more responsive, empathetic, and prepared to meet the diverse needs of all travelers—thereby fostering a truly inclusive global tourism ecosystem. The transformative role of big data and cloud computing is increasingly being recognized in various sectors, including healthcare, education, and most recently, the tourism and hospitality industry. These digital technologies are reshaping how travel is planned, experienced, and evaluated—particularly for individuals with disabilities. While much of the early work in this area was focused on health informatics, recent advances are revealing significant potential in applying these technologies to promote inclusive travel experiences. Despite being underexplored, this intersection of digital innovation and accessible tourism offers a promising pathway for creating smarter, more compassionate travel environments.

Organizations like the Data-Pop Alliance have pioneered research at the intersection of big data and disability inclusion, identifying how data-driven approaches can be harnessed to improve quality of life and accessibility [49]. They categorize big data into three primary types that are particularly useful for accessibility research:

- **Exhaust data** – passive data generated from mobile usage, transportation systems, financial transactions, and GPS traces.
- **Digital content** – information from social media, online reviews, and crowdsourced platforms.
- **Sensing data** – collected via physical sensors or remote technologies such as IoT devices.

These data streams can be leveraged to understand travel behavior, identify service gaps, and inform decision-making in the tourism industry. For example, transaction data may help researchers compare spending trends across accessible and non-accessible lodging options, while crowd-sourced reviews on platforms like TripAdvisor or Google Maps can spotlight which tourist attractions are truly accessible versus those that only claim to be.

The same study also outlined four essential functions that big data can serve within the domain of disability and accessibility:

- **Descriptive:** Capturing and presenting current realities, such as mapping accessible transportation routes or identifying regions lacking inclusive lodging.
- **Predictive:** Using existing patterns to forecast future trends, such as anticipating the demand for accessible tours in emerging destinations.
- **Diagnostic:** Exploring root causes behind accessibility gaps—why, for instance, certain tourism zones lag in inclusive design.
- **Engagement:** Facilitating conversations among travelers, tourism boards, advocacy groups, and policymakers through transparent sharing of data insights.

Together, these functions empower a more dynamic and evidence-based approach to inclusive tourism development [49].

Cloud computing, when paired with big data, brings a new dimension of flexibility, scalability, and accessibility to digital services [41]. Broadly defined, cloud computing refers to the delivery of computing resources—applications, storage, and processing power—via the internet [45]. For the tourism industry, this means that stakeholders can access and manage critical information anytime, anywhere, without the need for expensive local infrastructure. Businesses can host dynamic booking platforms, while travelers—especially those with disabilities—can access personalized travel tools through cloud-integrated devices [47].

Projects like *WebAnywhere*, a cloud-based web accessibility solution for visually impaired users, illustrate how cloud technology can power inclusive travel research and user interfaces [45]. Such platforms can be integrated into hotel websites, airline booking portals, and travel itinerary apps, allowing travelers with impairments to independently plan and navigate their journeys with greater ease and confidence.

Cloud platforms also enable real-time monitoring solutions, which are particularly relevant for travelers with chronic conditions. For instance, the *Artemis Project* introduced a cloud-based health analytics platform to monitor vital health data in real time [47]. Similarly, researchers have developed mobile apps that collect motion data from Parkinson's disease patients using smartphone accelerometers, then upload this data to the cloud for analysis and personalized feedback. Though primarily designed for health monitoring, such systems can be extended to assist in travel settings—enabling caregivers, family members, or service providers to receive alerts or recommendations when needed.

Another innovative solution is the *CloudCast* platform, a cloud-based speech recognition system designed to support individuals with speech and hearing im-

pairments [42]. Unlike generic voice assistants, CloudCast allows for high levels of customization, making it ideal for tourism applications like check-in kiosks, voice-guided museum tours, or multilingual interpretation services that are inclusive of those with communication challenges. This is a powerful example of how merging cloud computing with machine learning and assistive technology can eliminate long-standing barriers in travel.

In summary, the integration of big data and cloud computing opens up a world of possibilities for enhancing accessibility in tourism. These technologies allow for better understanding of the diverse needs of travelers, support the development of inclusive digital infrastructure, and promote informed, ethical decision-making across the tourism value chain. As travel continues to be a vital aspect of personal freedom, identity, and well-being, ensuring that it is inclusive for all—especially for people with disabilities—is both a moral and strategic imperative.

This study aims to further investigate how digital innovations can support inclusive travel planning, experience, and evaluation. It explores the strategic use of big data and cloud-based tools in creating a more accessible world for all travelers, as illustrated in Figure 1.

4 Enhancing Travel Accessibility in Hospitality and Tourism through Big Data

Improving accessibility in the hospitality and tourism sector requires a holistic understanding of the complex barriers that travelers, particularly those with disabilities, face throughout their journey. Accessibility goes beyond just transportation from one point to another—it includes the seamless access to tourism services such as hotel bookings, local transportation, attractions, and overall destination experience [5]. For travelers with disabilities, the ability to make online reservations, secure accessible accommodations, and receive inclusive services is essential to making travel truly feasible and enjoyable.

This section explores how big data applications and analytics are being leveraged across various domains within the travel and hospitality ecosystem including booking systems, airline services, and local mobility to identify gaps, improve accessibility, and create more inclusive tourism experiences.

4.1 Big Data in Online Reservation Systems for Inclusive Tourism

In the digital age, most travelers begin their journey online—searching, comparing, and booking through tourism websites, travel search engines, and reservation platforms. Online activities extend far beyond pre-trip planning; they continue throughout the travel experience and afterward as users share reviews, upload photos, report issues, or contribute to real-time traffic and service information through apps and social media platforms [31]. While these actions may appear routine, they often present significant challenges to travelers with disabilities due to design and accessibility shortcomings.

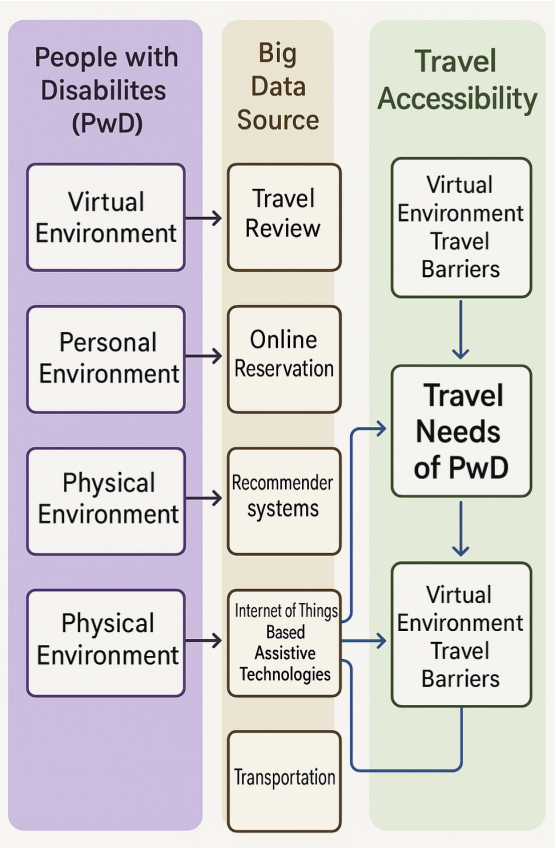

Fig. 1. A Conceptual Model of How Big Data Enhances Travel Accessibility for People with Disabilities.

Digital technologies have undeniably enhanced autonomy for people with disabilities. Research in disability informatics underscores how digital tools have empowered users with mobility, sensory, and cognitive impairments to engage with the travel industry in ways that were previously difficult or impossible [33]. However, despite early commitments to inclusion—such as the World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI) and the Web Content Accessibility Guidelines—web accessibility remains uneven and often inadequate [33].

To bridge these gaps, various assistive technologies have been developed. For instance, the BBC's Education Text to Speech Internet Enhancer (BESTIE) helps simplify web content by removing complex scripts, thereby improving accessibility for text-to-speech users [40]. However, its functionality is limited to specific domains. More flexible tools like Personalizable Accessible Navigation

(PAN) offer tailored web experiences by allowing users to choose accessibility profiles compatible with both desktop and mobile platforms.

Within the tourism sector, major industry players have embraced big data analytics to enhance user experience and personalize services. Online travel agencies (e.g., Expedia), information-sharing platforms (e.g., TripAdvisor), and metasearch engines (e.g., Google) use data insights to predict traveler needs and optimize booking systems [30]. Companies like Amadeus, known for its global distribution services, have launched data-driven tools like "Amadeus Airline Cloud Availability" to deliver faster and more tailored search results [29].

Hospitality and transportation brands—including Marriott, Southwest Airlines, and Amtrak—have taken steps to develop inclusive websites equipped with assistive features. These tools enable users with disabilities to independently book hotels, restaurants, flights, and tourism experiences without external assistance.

Despite progress, many current accessibility standards still overlook the nuanced and diverse needs of travelers with different disabilities. Accessibility is not one-size-fits-all; cultural and contextual differences—particularly between high-income and lower-income regions—shape how disability is experienced and how web access is achieved. Researchers have increasingly turned to big data as a tool to understand these variances and to design more context-sensitive and user-centered solutions for inclusive travel [33].

4.2 Enhancing Travel Accessibility Through Big Data Integration

Accessible transportation is fundamental to inclusive tourism. Barriers in mobility infrastructure can significantly restrict individuals—especially older adults, persons with disabilities, and those from low-income or rural backgrounds—from accessing essential services and participating in leisure or business travel. Concerns such as travel cost, limited walkability, inadequate transit services, and safety are disproportionately felt by vulnerable groups [4].

For the hospitality and tourism sector, fostering inclusive travel experiences requires addressing both physical and informational accessibility. An accessible destination hinges not only on the availability of inclusive infrastructure but also on seamless and inclusive transportation networks.

Airlines and Big Data in Tourism Mobility Airlines have long utilized big data to optimize operations, from ticket pricing and route planning to crew management [30]. Studies have leveraged datasets spanning decades (e.g., 1998–2014) to identify delay patterns, operational inefficiencies, and structural network changes [36]. Time-series analyses and real-time dashboards using R and integrated databases have proven valuable in visualizing seasonal delays and improving passenger flow [37].

Moreover, the rise of social media has provided a continuous stream of passenger feedback. Platforms such as Twitter and Facebook are increasingly used to capture real-time reviews on services, which, when processed through data

lakes, offer insights into passenger expectations, satisfaction, and service gaps [2]. Though not initially focused on accessibility, such datasets hold potential for identifying unmet needs of travelers with disabilities.

Big Data and Urban Transport Accessibility Urban transport accessibility studies traditionally address general mobility but can provide meaningful insights for tourism planning—especially for travelers with special needs. Accessibility, defined as the dynamic potential to reach destinations over time, is increasingly understood through real-time data [4]. Technologies such as GPS, smartphones, and public APIs (e.g., Google Maps, OpenStreetMap) have enhanced the granularity and accuracy of transport network assessments [1].

Recent research has utilized vehicle tracking, crowd-sourced data, and transit feeds to evaluate accessibility to tourism-relevant locations—restaurants, hotels, attractions—via various transport modes (car, public transit, walking, cycling) [4]. Social media and satellite data have been combined to map temporal fluctuations in city accessibility, offering tourism professionals tools to plan inclusive visitor journeys.

Assistive Technologies and Smart Travel Solutions One notable innovation is the Travel Assistance Device (TAD), which supports travelers with disabilities through real-time, GPS-based alerts on when to exit buses [1]. The device provides visual, audio, and tactile prompts, customizable trip itineraries, and remote monitoring for caregivers. While promising, challenges remain particularly around personalization and usability for individuals with cognitive disabilities.

Conclusion: The intersection of big data and accessible transportation presents powerful opportunities for the hospitality and tourism industries. Harnessing real time mobility data, traveler feedback, and assistive technologies can enable more inclusive travel ecosystems. Future research and practice should emphasize adaptive, data-driven approaches to ensure equitable tourism experiences for all.

4.3 Empirical Evidence and Illustrative Case Studies

Although this paper primarily develops a conceptual framework, several prior studies provide useful empirical grounding. Large-scale review mining, for example, has revealed accessibility as a recurring determinant of guest satisfaction, with one study analyzing more than 250,000 hotel reviews across thousands of properties. In the transport domain, pilot projects such as the Travel Assistance Device (TAD) have shown how GPS-based prompts enable individuals with cognitive impairments to navigate public buses more independently. Similarly, hybrid recommended systems tested in controlled settings demonstrate how integrating accessibility metadata into trip planning engines can personalize itineraries for diverse user groups.

Text mining and sentiment analysis further contribute empirical support, as demonstrated by case studies that process millions of online travel reviews to

detect accessibility-related themes. Collectively, these cases illustrate the feasibility of applying big data techniques to improve inclusivity in practice, thereby reinforcing the conceptual claims advanced in this work.

5 Leveraging Big Data for Enhancing Travel Accessibility

Big data presents transformative potential in advancing accessible travel within the hospitality and tourism sector. It enables researchers and policymakers to identify patterns, predict needs, and implement inclusive infrastructure. This section discusses the role of data-driven technologies—particularly the Internet of Things (IoT) and assistive systems—in empowering travelers with disabilities to experience greater independence and inclusion.

5.1 IoT-Enabled Assistive Technologies in Tourism

Potential of IoT for Accessible Travel Assistive technologies (AT) have long supported individuals with disabilities by enhancing functional capabilities. These range from mobility aids to advanced digital tools that facilitate communication and navigation. In the context of tourism, such technologies play a critical role in ensuring that individuals with visual, cognitive, or physical impairments can navigate unfamiliar environments confidently and independently.

The rapid evolution of IoT—embedded sensors, smart devices, and real-time data exchange—has opened new frontiers for accessibility. Smart environments, such as IoT-enabled hotels, transportation hubs, and urban attractions, allow for personalized support and responsive services tailored to individual needs [25].

For example, smart devices such as smartphones now integrate over 20 sensors, including GPS, accelerometers, and gyroscopes, which can assist with real-time outdoor navigation. However, their effectiveness for visually impaired users often falls short due to issues in precision and reliability [11]. To bridge this gap, Bluetooth beacons and audio-based guidance systems have been introduced. Projects like the Wayfinder app—implemented in the London Underground—utilize a network of beacons to deliver precise indoor navigation for visually impaired travelers [1]. These initiatives exemplify how inclusive technology can enhance autonomy and participation in tourism experiences.

Challenges of Big Data in IoT-Based Assistive Systems Despite their promise, IoT-based assistive technologies face significant challenges, particularly in terms of data management and user adaptability. These systems generate vast volumes of real-time data, which must be processed quickly and efficiently to deliver meaningful guidance. Constraints such as limited device memory, energy resources, and communication bandwidth add further complexity [11].

A primary concern lies in ensuring that computational resources can support real-time synchronization of sensor inputs—especially for location-based services. Moreover, user interfaces must be intuitive and adaptable to a diverse

range of accessibility needs [11]. Failure to meet these requirements can lead to exclusion rather than inclusion.

Another critical issue is user-centric design. Assistive technologies often fall short when they are developed without deeply engaging the end-users. While technically robust, many devices do not align with the lived experiences or preferences of people with disabilities [43]. It is essential for developers to prioritize flexibility, personalization, and co-design methodologies when creating accessible solutions.

Additionally, some users—particularly older adults—may feel overwhelmed by frequent updates and steep learning curves associated with new technologies [42]. Rapid technological turnover can lead to frustration or disengagement, undermining long-term adoption. Cost, lack of awareness, and insufficient training further exacerbate these barriers.

Future Directions in Inclusive Travel Technology IoT-based assistive technologies hold significant potential for reshaping the accessibility landscape in tourism and hospitality. However, more inclusive research is needed to understand the diverse and evolving needs of travelers with disabilities. Holistic studies that emphasize user experience, socio-cultural factors, and practical implementation will be essential to advancing equitable access in travel.

By integrating big data analytics with participatory design and smart infrastructure, the tourism industry can move towards a more inclusive future—one where mobility, independence, and dignity are standard for all travelers.

5.2 Sentiment Analysis of Online Travel Reviews

The growth of social media platforms and review websites such as TripAdvisor has led to a massive increase in user-generated content (UGC) related to travel experiences [17]. These reviews offer valuable insights for both travelers and tourism service providers, helping inform decisions, improve services, and guide strategic planning [24]. Among the diverse contributors to these platforms are travelers with disabilities, whose shared experiences can provide critical data for enhancing accessibility in tourism. Sentiment analysis is one of the key techniques used to extract meaningful patterns from such large-scale textual data [17].

Sentiment Analysis in Tourism Research Sentiment analysis, also referred to as opinion mining, is a natural language processing (NLP) technique that identifies and categorizes sentiments expressed in text [18]. The goal is to transform unstructured reviews into structured, actionable insights by classifying sentiments—typically as positive, negative, or neutral [21]. These insights are valuable in designing customer-centered services and monitoring reputation in the tourism industry [23].

Within tourism studies, sentiment analysis has evolved as a key analytical tool, allowing researchers to process large volumes of online reviews efficiently.

Two primary approaches dominate: lexicon-based methods that rely on predefined dictionaries and parsing rules, and machine learning techniques such as Support Vector Machines (SVM), Naïve Bayes, and N-gram models [24]. These methods have been used to evaluate reviews of various travel destinations, enabling the identification of trends and preferences across diverse traveler groups.

Applications and Comparative Methods Tools like the etBlogAnalysis project have integrated web crawlers and sentiment extractors to analyze tourism-related blogs and reviews using linguistic parsing and terminology extraction [17]. These tools can serve as early warning systems for hospitality providers by detecting spikes in negative sentiment [21].

Moreover, sentiment analysis has been benchmarked against traditional qualitative methods in tourism research. Studies comparing manual content analysis, corpus-based semantic analysis, and stance-shift analysis highlight the strengths of automated approaches in retaining contextual meaning and detecting emerging themes [25][20][15]. In particular, stance-shift analysis excels in preserving the narrative voice of reviewers without imposing external interpretation, making it highly suitable for analyzing nuanced feedback from marginalized groups.

Identifying Sentiments by Demographics Despite its widespread use, sentiment analysis in tourism has seldom incorporated demographic segmentation—especially for understanding the travel experiences of people with disabilities. Recent technological developments show promise in bridging this gap. For instance, sentiment analysis can now be integrated with algorithms that infer reviewer demographics, enabling targeted analysis of specific population groups [26]. This opens new opportunities for inclusive tourism planning, allowing stakeholders to address accessibility concerns more effectively.

However, challenges remain. Privacy concerns, particularly regarding the identification of sensitive user information, limit the extent to which such data can be ethically leveraged [27]. Additionally, the underrepresentation of people with disabilities in online reviews may skew findings and hinder efforts to improve accessibility across the industry.

Future Potential As the tourism sector increasingly embraces data-driven decision-making, sentiment analysis stands out as a valuable tool for enhancing accessible travel. By integrating demographic-aware sentiment analysis with user-centered design and inclusive policy frameworks, stakeholders can better understand and cater to the needs of travelers with disabilities—fostering a more inclusive and equitable tourism experience.

5.3 Recommender Systems in Tourism

In the age of information overload, travelers face the daunting task of navigating vast amounts of content when planning their trips [13]. Recommender systems

have emerged as essential tools in the tourism domain—helping tourists make informed decisions and enabling tourism operators to reach targeted customer segments. These systems support decisions related to destinations, attractions, accommodations, and dining. At the same time, they serve as powerful marketing tools for businesses within the industry. Research in this field has increasingly addressed complex problems such as automated trip planning, semantic knowledge integration, group-based recommendation, and context-aware systems [8].

Types and Functionalities of Tourism Recommender Systems Several recommender systems have already been deployed for public use. For example, TIP and Heracles use hybrid algorithms to suggest tourist activities based on user profiles and location data via mobile platforms [8]. The Crumpet system leverages multi-agent technology to deliver personalized, location-aware content—including accessible multimedia communication features for diverse user needs [6]. CATIS, a web-based tourist information system, integrates context-awareness elements such as geographic location, time, and user preferences to provide timely and relevant information [6]. Additionally, systems like TravelWithFriends support group recommendations by combining individual preferences into a ranked shortlist using techniques like the Borda count [8].

Traditional recommender systems often rely on individual user data—such as demographics, past ratings, or purchase history—to make suggestions [14]. While this works well for domains like music or movies, it does not fully account for the social and group-based nature of tourism. Group recommender systems address this challenge by either merging individual recommendation lists into one or building a unified group profile based on all members' preferences [15]. A more advanced approach iteratively adjusts individual preferences through a consensus-reaching process, leading to a recommendation list that reflects group agreement [15].

Integrating Semantic Knowledge and Accessibility Features The incorporation of semantic domain knowledge has significantly enhanced the performance of recommender systems. Semantic similarity—defined as the proportion of shared versus distinct ancestors between two concepts—enables the clustering of recommendation items [8]. Items within semantically similar clusters are then selected to ensure both relevance and diversity in recommendations [6]. This approach has been applied to museum visits and destination planning, using semantic distance algorithms to optimize personalized itineraries [8].

Importantly, some studies have explored recommender systems tailored for people with physical or intellectual disabilities. These systems not only aim to improve user experience but also strive to build confidence by offering accessible travel options. As illustrated in Figure 2, such systems model user stereotypes based on functional capabilities and accessibility requirements. These layered knowledge representations inform recommendation engines that produce personalized, inclusive travel plans [6]. This hybrid system presents an opportunity

to bridge information gaps for travelers with disabilities, empowering them to engage more fully with tourism experiences.

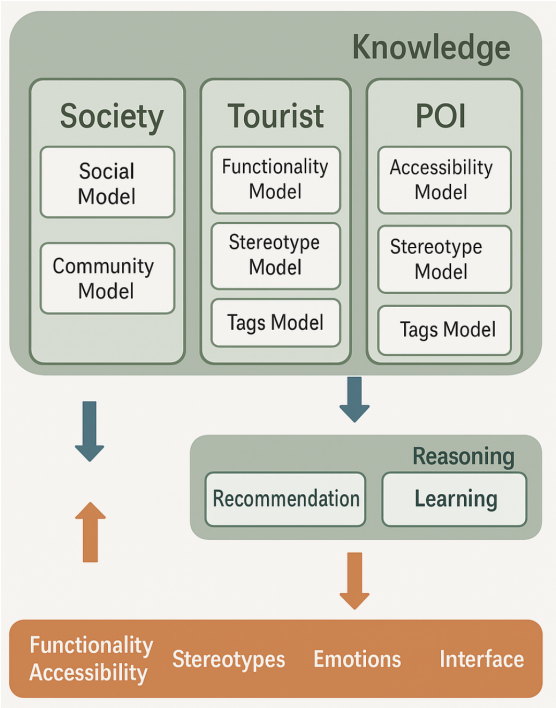

Fig. 2. Architecture of a Hybrid Recommender System Supporting Accessible Tourism [6].

6 Conclusion

This study has examined the intersection of big data analytics and accessibility in the context of the hospitality and tourism industry, with a specific focus on addressing the needs of travelers with disabilities. The research underscores the critical need for inclusive practices within tourism systems and highlights the underrepresentation of people with disabilities as a valuable and often overlooked market segment.

A key gap identified is the limited integration of big data methodologies in accessibility-related tourism research. Despite the growing adoption of data-driven decision-making in broader tourism domains, applications specific to accessible travel remain scarce. This study argues that, by acknowledging the multifaceted nature of travel accessibility, big data technologies can serve as a power-

ful tool for generating actionable insights into the experiences and expectations of travelers with disabilities.

In particular, this study has explored the potential of big data applications in two primary areas of accessible tourism:

- **Online Reservation Systems:** Although few studies directly address accessibility in digital booking platforms, research on web accessibility highlights the opportunity for applying big data analytics to enhance user experience for people with disabilities, ensuring compliance with accessibility standards and improving usability.
- **Accessible Transportation:** While not extensively studied through the lens of big data, previous work in airline operations and urban mobility illustrates the feasibility of utilizing data-driven solutions to optimize transport services and infrastructure for individuals with mobility impairments.

In addition to these domains, three emerging areas offer significant promise for improving travel accessibility through big data analytics:

- **IoT-based Assistive Technologies (AT):** IoT-enabled solutions can help overcome physical barriers in tourism environments by continuously monitoring user interactions with the built environment, enabling real-time adaptations and predictive support for travelers with disabilities.
- **Recommender Systems:** Personalized recommender systems—augmented with accessibility metadata and user-generated data—can enhance the online travel planning experience by tailoring content to the functional needs of diverse traveler profiles.
- **Sentiment Analysis of Online Reviews:** By analyzing large volumes of unstructured user-generated content, sentiment analysis can provide critical insights into the satisfaction levels and pain points of travelers with disabilities, informing service design and policy interventions.

Despite these advancements, several challenges persist. One of the most complex barriers is the heterogeneity in functional needs among individuals with different types and levels of disabilities. This diversity requires adaptive and highly granular data models capable of capturing nuanced user requirements.

Future research should prioritize the development of multimodal big data frameworks that integrate demographic, behavioral, and sensor-based data to capture the lived travel experiences of people with disabilities. For instance, sentiment analysis of accessibility-specific travel reviews could be used to segment user preferences and identify inter-group disparities. Furthermore, real-time data from IoT-enabled assistive devices could offer deeper insights into spatial mobility patterns, thereby enabling the design of responsive and inclusive tourism infrastructures.

In conclusion, the integration of big data analytics into hospitality and tourism offers substantial potential to enhance accessibility and inclusivity. By advancing data-driven frameworks tailored to the needs of travelers with disabilities, the industry can move toward a more equitable and informed tourism ecosystem.

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