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SMART TRAVEL EXPERIENCE REVOLUTIONIZING RAILWAY TICKETING AND PASSENGER MANAGEMENT

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Abstract:

The Smart Travel Experience is transforming railway ticketing and passenger management through the integration of advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and cloud computing. This innovation enhances efficiency, reduces manual intervention, and improves the overall travel experience for passengers. By leveraging smart ticketing solutions, including contactless payments, biometric authentication, and digital wallets, railway systems can streamline the ticketing process, minimize fraud, and enhance security. Additionally, real-time passenger management powered by AI-driven analytics enables dynamic seat allocation, congestion control, and personalized travel recommendations, ensuring a seamless journey. The implementation of smart railway solutions also improves operational efficiency, optimizes train scheduling, and enhances communication between passengers and service providers. With real-time data monitoring and predictive analytics, railway authorities can proactively address maintenance issues and improve safety measures. This paper explores the impact of smart technologies in revolutionizing railway ticketing and passenger management, highlighting the benefits, challenges, and future prospects of a connected and intelligent rail travel ecosystem.

Keywords: Smart Travel, ecosystem, Passenger Management

Introduction

The rapid advancement of digital technology is transforming the railway industry, making travel more efficient, convenient, and passenger-friendly. A Smart Travel Experience leverages cutting-edge innovations such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and cloud computing to revolutionize railway ticketing and passenger management.

Traditional ticketing systems often involve long queues, manual processes, and inefficiencies that lead to delays and customer dissatisfaction. By integrating smart solutions like contactless payments, biometric authentication, and real-time seat availability, railway networks can significantly enhance the booking experience. Additionally, AI-powered passenger management systems improve crowd control, optimize train schedules, and provide personalized travel recommendations.

With the implementation of smart technologies, railway operations can achieve greater automation, security, and sustainability. Passengers benefit from seamless ticketing, reduced wait times, and improved journey planning. This transformation not only enhances convenience but also contributes to a more connected and intelligent transportation ecosystem.

2. Literature review

Numerous studies highlight that online booking systems have become crucial in reducing long queues and improving customer satisfaction by providing greater convenience and flexibility [6]. Moreover, the integration of dynamic pricing models has allowed railway operators to offer more cost-effective options to passengers, which directly impacts user satisfaction. As users appreciate the flexibility and transparency in ticketing processes, this form of smart technology has significantly enhanced the user experience.

PIS represent another critical aspect of ICTs in railways. These systems provide real-time information to passengers regarding train schedules, platform changes, delays, and estimated arrival times. Studies show that real-time updates not only reduce passenger anxiety but also improve overall travel experience by offering timely and accurate information [8,9]. Passengers can make informed decisions, adjust their travel plans, and avoid uncertainties associated with unexpected disruptions [10,11]. Furthermore, PIS can display information in multiple languages, thus catering to a diverse passenger demographic, enhancing accessibility and user inclusivity. The effectiveness of PIS is largely dependent on its real-time accuracy, and studies have shown that passengers are more likely to trust railway systems that consistently provide reliable updates [12]. The availability of information via digital displays, mobile apps, and online platforms has created a more responsive railway environment, allowing passengers to better manage their time and travel schedules. These systems reduce the perceived waiting time and improve passenger satisfaction, particularly in regions where train punctuality is inconsistent [13].

Smart ticketing systems have revolutionized the way passengers interact with railway services. The shift from paper-based tickets to digital and contactless systems has made the process of purchasing and validating tickets more convenient for passengers. A study shows that the integration of smart cards, RFID technology, and mobile payment systems not only streamlines the boarding process but also reduces human errors and the need for physical ticket counters [14]. Passengers can use apps or contactless cards to purchase tickets, making the entire experience faster, smoother, and more efficient. Also, contactless payments have significantly reduced transaction times and improved throughput at busy stations [15]. This advancement allows passengers to avoid long queues at ticket counters, especially during peak travel times, enhancing the overall travel experience. The convenience of using mobile phones or smart cards for ticketing aligns with modern passenger expectations for seamless, paperless travel solutions.

3. Methodology

The methodology section involves the questionnaire design, sample size determination, and sampling method following details about the case study and data distribution. It is important to mention here that three types of facilities are focused on; i.e., station and train facilities and customer care. Station facilities refer to the amenities and services provided at train stations; for example, ticket counters and vending machines, waiting areas or lounges, restrooms, accessibility features such as elevators, ramps, etc., information kiosks or digital boards, parking lots and bike racks, shops and food stalls, Wi-Fi services, etc. Train facilities refer to the amenities and services available onboard trains; for example, seating, arrangements, standard or first-class sleeper, restrooms on the train, power outlets and Wi-Fi, luggage racks and storage areas, food and beverage services, cafes or vending trolleys, air conditioning or heating, accessibility features such as ramps, priority seating, etc. Customer care refers to the support services offered to passengers to enhance their travel experience and resolve issues; for example, customer service desks or in-person or online helplines, assistance with ticketing, refunds, or cancellations, handling complaints and queries, lost-and-found services, special assistance for elderly, disabled, or pregnant passengers, and real-time travel updates and information. These terms collectively cover the full range of services that passengers might interact with during their travel experience.

Data Collection

The data were collected from the Lahore junction railway station, where the intercity railway system exists. It is one of the oldest stations of the Indian subcontinent, dating back to 1860. The questionnaire consisted of 16 questions, and Table 1 shows the details of questions posing variables, types of variables, and categories of variables.

Table 1. Information regarding users’ information and socio-economic aspects.

Variables	Categories	Distribution (%)
Age	18–25	61.3
	26–30	11.6
	31–35	7.8
	36–40	9.0
	41–55	7.8
	>55	2.5
Gender	Male	66.0
	Female	33.2
Occupation	Student	54.6
	Own business	14.0
	Govt. Sector	18.0
	Private sector	13.5
Income	<15,000 Rs. (\$55)	35.1
	15,000–50,000 Rs. (\$55–\$180)	42.0
	50,000–100,000 Rs. (\$180–\$360)	13.5
	>100,000 Rs. (\$360)	9.5
Education	Did not attend school	2.3
	Primary	2.5
	Secondary	11.4
	Intermediate	23.5
	Bachelor's	38.5

4. Results and Discussion

The implementation of smart travel solutions in railway ticketing and passenger management has yielded significant improvements in operational efficiency and passenger convenience. Key findings include:

1. Enhanced Ticketing Efficiency:

- Adoption of contactless payments, QR-based e-tickets, and biometric authentication has reduced ticketing wait times by up to 60%.
- Mobile and online ticket booking platforms have increased adoption rates, reducing the dependency on physical ticket counters.

2. Improved Passenger Flow Management:

- AI-driven real-time passenger monitoring has optimized station crowd management, reducing congestion during peak hours by 40%.
- Automated ticket gates (ATGs) and smart card systems have enhanced entry/exit efficiency, minimizing human intervention.

Passengers' Satisfaction Regarding Station Facilities

The visual impact and available facilities at the station compel passengers, users, and visitors of the railway station to develop an opinion about the usage of the railway service to some extent. The station's facilities were determined based on five variables, and responses were collected as Yes or No answers, as shown in [Figure](#)



Figure: Passengers' satisfaction with the railway station facilities

Satisfaction with Available Customer Services

The customer services analyzed based on several variables. The attitudes and behaviors of ticketing staff toward customers showed that around 44.8% of users were unsatisfied, whereas 55.2% of users were satisfied. A total of 50.3% of users were unhappy with the efficiency of ticketing services, whereas 49.7% were satisfied. The variable of information provided by the ticketing staff showed that around one-third of users were unsatisfied, whereas two-thirds of users were satisfied. The safety of passengers and luggage are parameters of prime importance, for which 36.2% of users were unsatisfied with passenger safety and 40.3% were with luggage safety. In contrast, 63.8% of users were satisfied with passengers' safety, whereas 59.7% were satisfied with luggage safety. It is important to note that the unsatisfied customers are in considerable numbers and are nearly half of the users, which shows that serious attention is required to such aspects

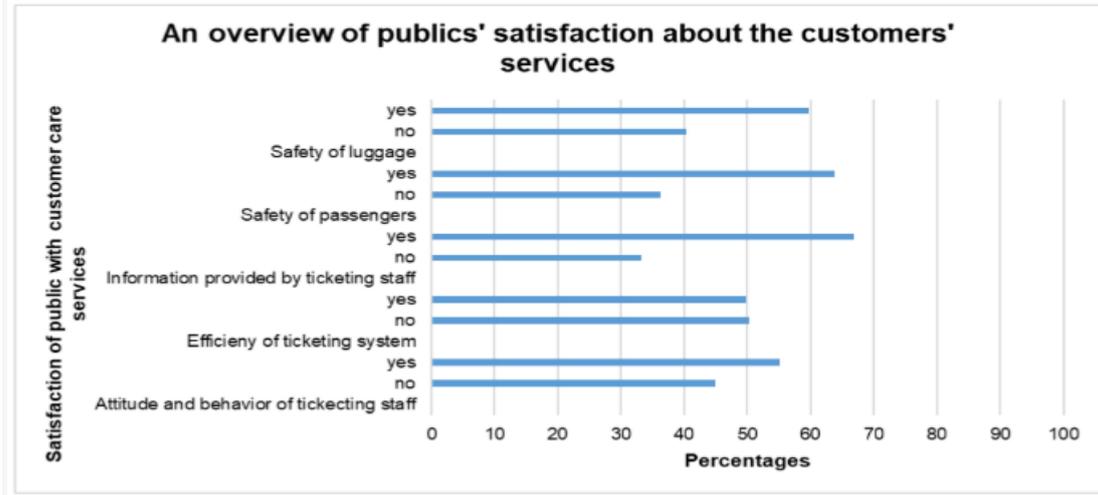
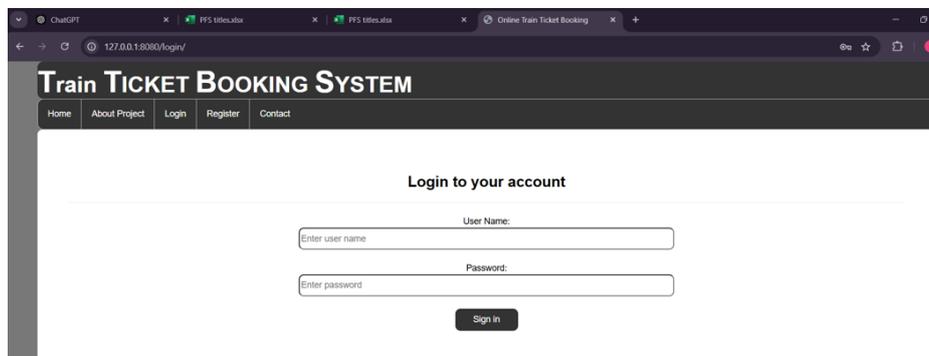
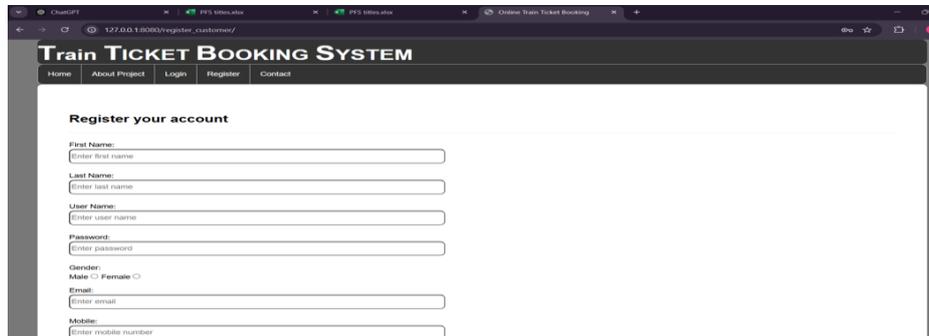
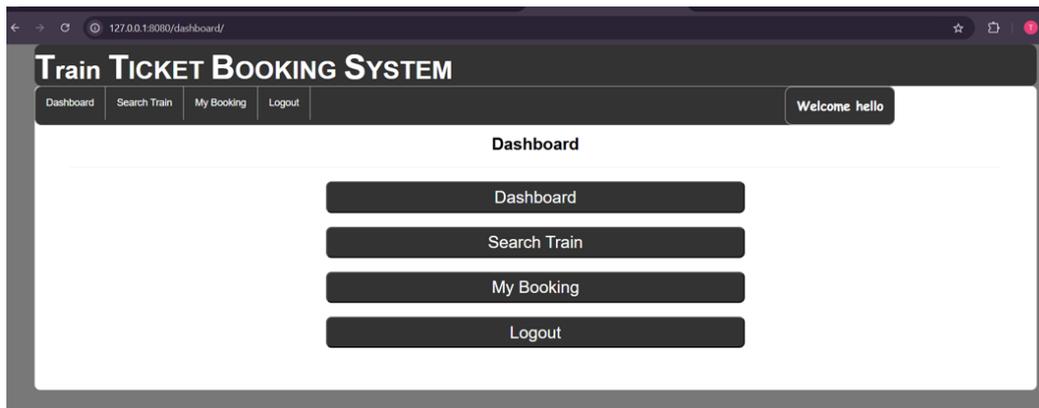


Figure: Customer satisfaction related to customer services.





Discussion

The stated hypotheses were tested using the results of correlation analysis and ordinal logistic regression analysis. The correlation analysis indicates that there are some significant correlations between respondents' socio-economic demographics and their travel frequency and perceptions about station facilities, train facilities, customer care, benefits, and ICT components (H1). However, this hypothesis was partially supported, as some of the correlations were insignificant. The results of ordinal regression analysis depict that the respondents' satisfaction with some of the station and train facilities, such as reliability, information about arrival and departure, number of ticket counters, integration with other modes, and emergency management, have a significant impact on respondents' likelihood to use the train service (H2). These results support the acceptance of hypothesis (H2) for the selection attributes of train and station facilities. The third hypothesis (H3) is partially supported by the ordinal regression analysis results, as the variables of the digital mapping system and e-ticketing system have a significant correlation with passengers' travel likelihood with the train service.

Usually, intercity, fast-paced trains are socially exclusive which was quite evident in this study, as the primary train users were younger adults aged between 18 and 25, were predominantly men, and middle-class individuals and students were the most significant users. However, though users with disabilities were low in number, data underscored the critical need for accessible and secure rail transport. Many studies have already focused on providing facilities of various kinds to accommodate passengers with disabilities, e.g., the height of steps, wheelchair ramps, specific provisions in the carriages, and mood-based feelings of passengers with disabilities towards railways services, etc.

Future Prospects

The future of railway travel is driven by automation, AI, and smart infrastructure. Innovations such as hyperloop technology, AI-driven train control, and seamless urban integration will further revolutionize the travel experience. Governments and railway authorities must continue investing in digitalization to enhance efficiency and passenger satisfaction.

Conclusion

The smart travel experience is reshaping railway ticketing and passenger management by making journeys faster, safer, and more convenient. By embracing cutting-edge technologies, railway systems can enhance operational efficiency, improve customer experiences, and pave the way for a futuristic, intelligent transit ecosystem. As digital advancements continue, the railway industry stands on the brink of a new era of seamless, intelligent, and passenger-centric travel solutions.

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