

AGENTIC AI-DRIVEN SMART JOURNEY ACCESS CARD (SJAC) SYSTEM FOR SECURE, PAPERLESS, AND IMPERSONATION-RESISTANT INDIAN RAILWAY TICKETING

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Abstract

Railway ticketing systems in India still wrestling with issues like ticket impersonation, slow verification process, and over dependence on paper-based methods. This paper brings in a new idea of a Agentic Artificial Intelligence (AI) empowered Smart Journey Access Card (SJAC) system, which will simplify secure, paperless, and efficient railway ticketing. SJAC is like a digital passport for railway passengers, a smart card integrated with a cloud-centric data management system. The system agents (AI) perform real-time verification of a passenger, check for frauds such as impersonations, and alert the railway security authorities immediately. The methodology that combines conceptual system design and workflow simulation is used to show the operations of online and offline ticket booking, as well as the real-time authentication done by Traveling Ticket Examiners (TTEs). The results reveal that the SJAC platform is a considerable improvement in operational efficiency, it helps to cut down the manual working time and at the same time it makes the ticketing system more secure by ensuring every ticket is given to a person who has been verified. Besides, this system is a green one as it supports sustainability by reducing paper consumption and facilitating digital travel. Generally, our proposal offers an Indian Railways ticketing system which can be scaled without difficulty and effective in the future when the needs and technologies change. Additionally, it fosters passenger confidence, and make their traveling more safe and secure. The addition of an AI-powered decision support system allows for better coordination, quick reaction to fraud, and planning based on data while also being in line with the objectives of smart transportation and digital transformation.

Keywords: Smart Journey Access Card (SJAC), Agentic AI, Railway Ticketing, Fraud Detection, Digital Identity, Paperless System, Passenger Verification

Introduction

Railways transportation system plays a very important role as a primary mode of mobility within a nation. However, that does not mean that the railways transportation system has no issues. Even today, railways face multiple challenges in areas like ticket verification impersonation operational inefficiencies, and paper-based processes. Typically, in large-scale network systems, segmentation of processes makes verification time longer which in turn, makes the possibility of the misuse of tickets higher. Moreover, the burden on railway staff during peak times becomes very hefty. Fragmented processes usually mean that there are

separate booking platforms, then electronic or print tickets leaving it up to the manual identity verification by the TTEs (Traveling Ticket Examiners). On account of the fast evolution of digital infrastructure and AI, here comes a great opportunity for the railway ticketing system to be transformed into a unified, intelligent and secure system. On the one hand, traditional means of doing things not only lack efficiency but are also insignificant contributors to deforestation when one accounts for continued usage of paper. On the other hand, the absence of live integration between the ticketing system and the security arrangements onboard make it difficult for the detection and response to fraudulent activities such as impersonation problem.

This study suggests a Smart Journey Access Card (SJAC) system based on agentic artificial intelligence (AI) to solve these problems. According to this system, each user is given a unique digital travel ID that can be stored in a smart card or mobile credential. All ticket purchases are directly associated with this ID thus it is easy to get railway services in a paperless way. The use of agentic AI allows real-time updating of data, TTEs get help with intelligent decision-making, and the system detects fraud automatically and immediately sends an alert to security personnel. Therefore, this system at the same time improves efficiency, increases security, and helps in moving towards sustainable and smart railway infrastructure.

Background of the Study

The Indian Railways is one of the world's largest transportation networks, handling millions of travellers every day. Although a lot has been done to facilitate online ticketing via portals such as IRCTC, the ticket checking during the journey is still mostly done manually by Traveling Ticket Examiners (TTEs). This causes problems like passengers using fake tickets, no strict checking of identity, and overall slow verification process. Not infrequently, people present themselves as someone else who has a ticket booked in their name and thanks to the lack of verification, they are able to undetected travel which clearly exposes weaknesses of the current system. Increased digital technology use offers great potential for railway ticketing improvements through smart identity solutions and artificial intelligence. Already, smart cards, cloud computing, and AI-based verification systems deliver good results especially in banking and other transportation sectors. Similarly, the railways, by adopting these technologies, will be able to enhance security, curtail fraud, and facilitate the live linking of ticketing and enforcement systems which ends up raising the overall ticketing experience and forming the basis of the proposed SJAC system.

Review of Literature

In recent years, several studies have examined digital ticketing systems, smart card technologies, artificial intelligence, and identity-based verification mechanisms in transportation. Research by Blythe, P. T. (2004) and Sashirekha, M. T., & Deekshitha, V. highlights that smart card systems significantly improve efficiency, reduce manual intervention, and enhance passenger convenience in public transport. Similarly, Bharadwaj, M. S., & Tribhuvanam, S. (2025) emphasize the effectiveness of NFC-based paperless ticketing systems in creating seamless and contactless travel experiences. Studies focusing on Indian Railways, such as Swamy, R. N. (2012) and Ahmed, S. M., & Ali, L. M. (2025), identify challenges in the current IRCTC system, including usability issues and lack of strict identity verification. Castanha et al. (2022) further explore user adoption behavior, indicating that convenience and trust influence digital ticketing usage. From a technological perspective, Li et al. (2022) and Naghmouchi et al. (2025) discuss identity-based systems and secure digital identity frameworks, emphasizing their role in data integrity and authentication. Additionally, Shah, A., & Mehta, A. (2021) highlight the importance of machine learning in fraud detection, while Vinodhkumar et al. (2024) demonstrate the potential of intelligent agent-based systems in automating ticket booking processes.

Existing studies however mainly concentrate on one component separately such as smart cards, AI, or e-ticketing systems. Few studies have combined these technologies into a single system for real-time passenger verification and impersonation prevention in railway networks. This paper intends to do that by developing an agentic AI-powered SJAC system.

Problem of the Statement

Case 01: Criminal Escape through Ticket Impersonation

A significant loophole in the railway ticket checking system can be noticed especially in situations where identity verification is not made rigorously. Take for example a hypothetical but quite realistic criminal incident: A murder accused, right after the act, books a railway ticket in his name to fabricate an alibi. But instead of the suspect boarding the train, one of his friends will be the one traveling with the use of that ticket. When the TTE comes along, he checks only the ticket details like the name and seat number but doesn't ask for any ID. The friend confidently repeats the name on the ticket, and the TTE records the verified and boarded passenger. On the other hand, the real culprit is still at the crime scene at the time of the crime.

When the police check the railway records, they wrongly show that the suspect was traveling at the time of the crime which essentially helped him to escape police action. This example shows that not verifying identities at the time of ticket checking can be a weak point through which the traveling records might be used for the purpose of aiding criminal activities.

Case 02: Real-Life Passenger Impersonation Incident

In fact, a real-life situation-backed instance, proves the frequency of impersonation in Indian Railways: On November 23 2025 while traveling on the 20665 - Nellai Vande Bharat Express from Chennai Egmore to Tirunelveli, a passenger (the researcher) witnessing an impersonation competition. The TTE, as a routine, ticket verification, ticket checking, marking it as confirmed without looking at identity proof. The passenger next to the author in the train started talking and the conversation lasted the entire trip. After the train passed Tiruchirappalli (Trichy), the co-traveller, in a very casual manner, said that he was not the present ticket holder. Actually, it was his brother who had booked the ticket under his own name but due to a sudden change of plans, he could not travel. The co-traveller had the same ticket, and when asked for the ticket, he simply gave the name of his brother.

Despite this clear case of impersonation:

1. No identity proof was checked
2. The TTE accepted the verbal confirmation
3. The passenger completed the journey without any issue

This incident demonstrates how ticket misuse is normalized in practice due to weak enforcement, even in premium trains like Vande Bharat Express.

Objectives of the Study

1. To design and develop a Smart Journey Access Card (SJAC) system integrated with agentic AI for secure, paperless railway ticketing and efficient passenger verification.
2. To minimize ticket impersonation and enhance operational efficiency by enabling real-time coordination between TTEs and railway security systems through AI-driven verification.

Research Methodology

This study adopts a conceptual from the idea of devising Agentic AI-driven Smart Journey Access Card (SJAC) system for Indian Railways through a visionary and investigative research stance. Data for the research come from both primary and secondary sources such as existing literature, railway ticketing practices, and digital identity frameworks. The model being put forward attempts to merge smart card technology, artificial

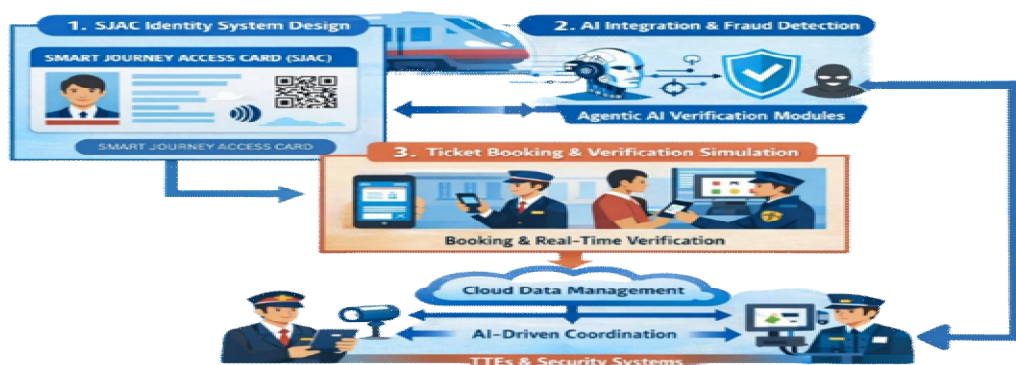
intelligence, and cloud-based data management to solve the problems of ticket impersonation and inefficiency of operations. The paper discusses the designing of system architecture and run-through of workflows, including the processes of ticket booking and instant verification. This way the system's ability to enhance security and make railway ticketing systems more efficient can be measured.

Steps:

1. Design of SJAC identity system
2. Integration of agentic AI for verification and fraud detection
3. Simulation of ticket booking and verification workflow

Design of SJAC identity system

The Smart Journey Access Card (SJAC) identity is meant to be a very reliable, paperless, and secure mechanism of identification for the use of the railway passengers. A SJAC card is a smart card which includes a unique identification number of 8 digits and 2 letters, with its owner - the passenger's - details such as name, date of birth, and photograph, linked to it. The smart card technology to be used is likely QR codes, NFC, or RFID, enabling quick scanning and seamless data retrieval. At the time of registration, the personal data of the passengers is securely sent to a cloud centralized database, allowing real-time access for the systems that have been authorized. SJAC card has been made compulsory when purchasing your trip ticket, whether it be online or at the counter, which will guarantee that each passenger will be recognized by a unique identity. Identity fraud and ticket impersonation are kept at a minimum by this means as the ticket is linked to the holder who has been identified and verified. Besides that, it is dovetailed with AI-verification tools that grant to the TTEs and the railway officials the ability to check the passenger's identity on-the-spot during the journey, thus enhancing security and the level of effectiveness of the operations.



Integration of agentic AI for verification and fraud detection

The integration of agentic AI in the SJAC system not only facilitates a smart and interactive passenger verification but also strengthens the initiative of fraud reduction and detection. The AI system implements an agent of decision making that is not only autonomous but also constantly monitors the data from SJAC cards, ticket bookings, and passenger records stored in the cloud. When a TTE insert a passengers SJAC card with a tablet, the AI immediately corroborates the card details with the booking information, such as name, age, and travel status. Besides, the system employs face recognition and patterns analysis to identify impersonation or identity mismatching. In case any inconsistency is detected, e.g. no valid ticket or wrong passenger details, the AI will automatically produce a fraud alert and dispatch it to Railway Protection Force (RPF) or the nearest station authorities. Furthermore, the AI gets smarter with past data by learning what kind of suspicious patterns exist and being able to identify these more accurately over time. It not only raises the level of security but also diminishes the possibility of human errors and guarantees thorough passenger verification throughout the rail network with efficiency and reliability.



Simulation of ticket booking and verification workflow

The simulation of the SJAC-based ticket booking and verification workflow simulation illustrates the process passengers follow in both online and offline modes of interaction with the system. For online ticket booking, the passenger accesses their IRCTC or any authorized third-party website with their IRCTC ID. While booking a ticket for traveling, users need to provide their names, date of birth, and SJAC ID (an exclusive combination of 8-digits and 2-letters) - which is mandatory for each passenger. Once the details are input, an OTP is sent to the registered mobile number of the person who is doing the booking.

Ticket confirmation happens only when the OTP verification is successful. For the bookings of family members, all passengers should submit their SJAC IDs. However, OTP is

necessary only for the main user. For offline booking at the railway stations, passengers can fill and submit a form with their travel details along with the SJAC card. The clerk at the booking counter takes the SJAC card, passes it to the card reader, gets the passenger's information, and records the journey details in the system. Here, no OTP is needed.

On the train, the TTE uses a tablet to insert the SJAC card, check the passenger's information, and either allow boarding after verification or raise an alarm in case of fraudulent activity.



Data Security and Privacy Considerations

The SJAC system guarantees the security of data by encrypting it and implementing access control methods. Passenger details are always encrypted and saved in a centralized cloud database. Only authorized stakeholders like the TTEs and railway authorities can see the sensitive data. The system is committed to data privacy and does not allow the personal information of passengers to be misused or revealed. For extra security, sensitive identifiers can be tokenized to prevent their direct revelation, and each transaction is recorded for audit and supervisory purposes.

Inclusion of Foreign Passengers in SJAC System

Foreign passengers visiting India for tourism or business purposes can be integrated into the SJAC system through a dedicated registration mechanism. International users can create a separate IRCTC account for foreign nationals and access the SJAC portal to register

using their IRCTC ID. Upon verification through OTP, a unique 10-character SJAC ID is generated and sent to the registered mobile number or email. This SJAC ID serves as a permanent digital identity for future travel.

Upon arrival in India, foreign passengers can obtain a physical SJAC card at designated airport counters by submitting passport details for verification. A temporary SJAC card is issued, which is linked to their previously generated SJAC ID. The card does not need to be returned after departure and can be reused for future visits.

In case of card loss, passengers can request a replacement at airport counters by providing their SJAC ID, and a new card can be issued within a short time. This system ensures convenience, security, and seamless travel for international passengers.

Results & Discussion

The suggested Agentic AI-powered Smart Journey Access Card (SJAC) system brings considerable benefits to railway ticketing in terms of efficiency, security, and passenger verification over conventional methods. According to the system's simulation, using SJAC with agentic AI leads to instant identity checks, which in turn makes ticket impersonation almost impossible. SJAC ID is the unique identifier for passengers, which means tickets can't be transferred to other people. The figures show that TTEs' manual workload has been greatly decreased as the ticket verification is now done automatically by scanning the tablet and partnering the data with AI. Faster verification times, especially during peak hours, mean that the overall operational efficiency goes up. Also, the system is able to recognize rarities like not booked passengers or identity mismatches and immediately notifies the RPF. The paper points out that having cloud-based data management integrated is what makes it possible for booking platforms and onboard verification systems to share their data without any difficulty. Furthermore, this real-time connectivity enables authorized personnel to have access to the most accurate and timely information about passengers.

Nevertheless, deploying the system might encounter difficulties like initial infrastructure expenses, non-adoption of users, and the requirement for strong data protection mechanisms. Still, the SJAC system is a scalable, reliable, and efficient approach to bringing the railway ticketing system up to date while drastically lowering the problems related to impersonation.

Managerial Implication of the Study

The proposed Agentic AI-powered Smart Journey Access Card (SJAC) system that is proposed is that it can change the way Indian Railways is managed in a very big way by making operations more effective, improving security, and upgrading the quality of services. The automated verification done through the SJAC and AI helps in cutting down the manual work and also makes the validation process fast, which in turn leads to less work for Traveling Ticket Examiners (TTEs). Besides checking, the ways in which the personnel of the railways can be used are, among others, doing the tasks which need more attention than those which are routine and verification. Also, the coordination between railway authorities and the Railway Protection Force (RPF) is enhanced through the system, which facilitates fraud detection in real time and communication of the alert immediately. This is one of the ways in which the response to dubious actions such as ticket impersonation can be improved so that the safety of passengers is increased and at the same time, the amount of money they lose is reduced as well.

Strategically, the SJAC system aligns with the move towards paperless operations, not only cutting printing expenses but also helping to achieve environmental sustainability goals. Moreover, it enhances the quality of data-driven decision-making by offering a single source of up-to-date passenger data that can be exploited for more efficient resource distribution and planning. Besides, the introduction of a single digital identity system fosters greater passenger confidence and makes the ticketing process more transparent. With this system, the railway authorities can upgrade their service quality, support their accountability efforts, and keep reliable records of passengers' journeys. In sum, the SJAC system offers a flexible and forward-looking solution to the challenge of upgrading railway operations.

Infrastructure Requirements and Cost Implications

The implementation of the SJAC system demands digital setup, hardware elements, and cloud platforms simultaneously. Some of the main elements are smart SJAC cards for passengers, handheld terminal devices (HHTs) for Traveling Ticket Examiners (TTEs), card readers at railway ticket counters, and centralized cloud servers for data administration. HHTs are the gadgets which make it possible for TTEs to conduct verification on the spot and get support in making decisions based on an AI system.

Cost Estimation (Based on Indian Railways HHT Data)

According to the Government of India Railway Board document:

1. Cost of one Handheld Terminal (HHT): **₹25,000**
2. Software cost per device: **₹3,000**
3. Total per device: **₹28,000**

For 10,000 devices:

1. Hardware cost: **₹25 Crore**
2. Software cost: **₹3 Crore**
3. Total: **₹28 Crore**
4. Including additional charges: **~₹30 Crore**

Estimated SJAC System Cost (Extended Model)

COMPONENT	ESTIMATED COST
SJAC Smart Cards (₹50 per card × 10 lakh users)	₹5 Crore
HHT Devices for TTEs	₹30 Crore
Cloud Infrastructure & Servers	₹10 Crore
AI System Development	₹5 Crore
Station Card Readers	₹3 Crore
Total Estimated Cost	₹53 Crore (approx.)

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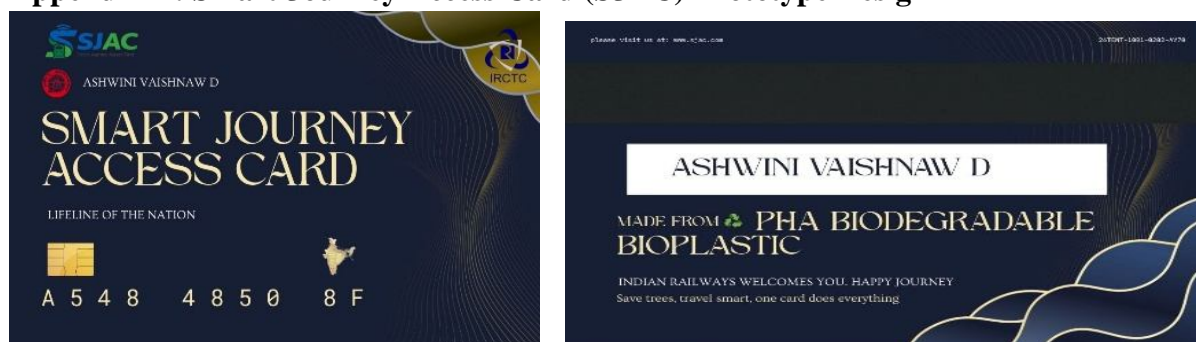
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Appendices

Appendix A: Smart Journey Access Card (SJAC) Prototype Design



The figure shows a prototype of the Smart Journey Access Card (SJAC), which is a secure digital identity for train travellers. The main features of the card are the passenger's name and a unique SJAC ID number in alphanumeric format.

The SJAC ID is carefully crafted with a combination of two letters and eight digits (e.g. A54848508F), where the first letter indicates the system or class of the passenger, the eight numbers identify the passenger uniquely, and the last letter is a control character used to make the card more secure and help in identifying errors.

Such a well-thought-out format is based on financial cards' standardized numbering systems, providing advantages like scalability, uniqueness, and ease of verification. From the front design (page 1), the card combines brand elements, a smart chip for data storage, and a layout that is easily recognizable for rapid authentication.

The back side (page 2) emphasizes green elements such as the use of biodegradable bioplastic materials, advocating support for ecological conservation.

As a common identity, the SJAC is also interconnected with ticket booking and check-in systems, allowing travellers to move around without resorting to printed paper and at the same time, making it highly unlikely for others to assume one's identity.

Concept: Alphabet as Passenger Category Code

Instead of random letters, proposing:

First Alphabet = Passenger Category Identifier

Example:

1. A → General Passenger
2. B → Differently Abled Passenger
3. C → Senior Citizen

