

SMART SOLUTIONS FOR RAILWAYS

Introduction

The smart railway is a new stage of the development of intelligent transportation informatization, and it is the total integration and comprehensive embodiment of the railway informatization public service system. In 2010, the leadership of the Ministry of Railways, in conjunction with the need to change the way of railway development, proposed the development direction for the smart railway. It is expected to improve the overall capacity of the railway through the intelligent development of the railway, accelerated the transformation of the railway development mode, and realized the sustainable development of the railway. In recent years, China has been working hard in the direction of railway informatization. However, as of now, there is still no standardized norm in the field of smart railways. People's understanding of smart railways is rather vague. In the research of top-level design of smart railways, it is necessary to establish a conceptual model of smart railways, clearly define the connotation and characteristics of smart railways, and build a model of a smart railway architecture system, which will not only help deepen the understanding of the smart railway, but also play a guiding role in the development planning and construction of the smart railway.

Literature Review

Japan RTRI introduced the railroad system for the 21st century in 2000 - Cyber Rail (Digital Network Interconnected Railway). In 2005-2010, the EU invested in supporting the Integral project to meet the development needs of the European railway system integration. In 2014, the EU proposed the Shift2Rail program, which is the first large-scale railway research and innovation project in the history of the European Union. In 2007, British rail operator Network Rail proposed the Intelligent Infrastructure strategy, which changed the strategy of detecting faults in the infrastructure maintenance process to predictive avoidance, and finally avoided by design. In 2009, IBM proposed the Smarter Rail development concept based on the wisdom of the Earth strategy. It outlines the needs of the development of smart railways and the three key intelligent features that smart railways should have: more thorough perception, more comprehensive interconnection, and deeper intelligence. In 2017, China Railway Corporation set up a smart station forum at China Railway International Equipment Exhibition to discuss the application and development of smart stations at home and abroad. In summary, the smart railway is the development direction of railway informatization, the basis for realizing the sustainable development of green railways, and the overall embodiment of the railway modernization level. Therefore, the development of a clear intelligent railway architecture model is an effective way to solve the problems faced by China's railway informatization process and will have a great significance for scientifically guiding the development and planning of smart railways.

Smart Railway Concept and Model

The concept of smart railway Under the background of accelerating the construction of smart cities in China, railways are an important transportation channel between cities, and their information construction should also rely on emerging technologies. It should move from the traditional concept of “railway” to the “smart railway”. According to the current research status of railway intellectualization, the definition of smart railway is proposed in this paper: Smart Railway refers to a railway transportation subsystem of intelligent traffic system in smart cities. It mainly uses new generation information technology such as Internet of Things, cloud computing, big data, satellite positioning and navigation, geospatial information, and artificial intelligence. It is a new system and new ecology that fully integrates with railway transportation planning to support, promote and guide the intelligent development of railway transportation. At the same time, it is also a comprehensive service platform and mobile information physics space on the railroad for mobile leisure, office, learning and consumption.

The overall architecture model of the top design of the smart railway Smart Railway integrates new generations of information technology such as cloud computing and big data with railway management to build an intelligent information railway and realize various services such as accessing various intelligent terminals online at anytime and anywhere in the railway operation. The main features are network ubiquitous interconnection, intelligent sensing, data sharing, business collaboration, and intelligent services. The overall structure model of the smart railway is shown in Figure 1. It mainly includes the intelligent sensing layer, intelligent transmission layer, information resource layer, application support layer, application platform layer, standard specification management system and information security system.

The idea of building a smart railway

general idea The construction of smart railways must adhere to the development concept of "innovation, coordination, green, openness, and sharing", adhere to the people-centered development thinking[10], implement the development requirements of the "Thirteenth Five-Year Development Plan for Railways", and focus on the three core functions of smart railway transportation, operation services, and promoting industrial development, closely linked to the construction of smart railways, vehicles, stations, people "one main line". At the same time, it is necessary to work hard to promote the construction of a new generation of information infrastructure, enhance the smart development capability of the railway, and improve the railway service system to enhance the passenger service experience and strengthen security measures. In addition, it also needs to complete the “five major tasks” of improving the information management and security support capabilities of smart railways, promoting the sustainable development of railway, promoting the construction of high-end cultural brands, and enhancing international influence.

Benefits of IoT Applications in Railways

By leveraging IoT technologies, railway operators can aim to provide a more intelligent, connected, efficient, safe, and convenient railway experience for everyone while also realizing these benefits:

- **Increased efficiency:** Congestion and overcrowding create operational inefficiencies. Using deep learning and AI through computer vision, operators can monitor passenger flow and gather data for advanced analytics to help enable more-informed decision-making around staffing and security.
- **Reduced downtime:** Sensors, cameras, and in-vehicle computers empower rail operators to monitor their fleet's diagnostic data to minimize breakdowns, predict maintenance repairs, and optimize servicing schedules to keep trains in working order and moving.
- **Enhanced safety:** Computer vision and AI-enabled smart cameras help automate safety alerts when there are potential water spills, fire and smoke, or accidents. They can also be used to help locate missing children in crowds or detect if someone climbs onto conveyor belts, falls on escalators or onto trackways, or enters restricted areas.
- **Increased passenger satisfaction:** IoT technologies provide operators myriad possibilities for creating new solutions and services to meet passenger expectations. Operators can personalize travel for individual passengers with near-real-time data collection and analysis or provide strong and reliable onboard Wi-Fi so passengers can stay connected throughout their journey.

Literature Survey

PAPER NAME	AUTHOR	METHODOLOGY	MERITS	DEMERITS
Passenger Monitoring Model for easily Accessible Public City Trams/Trains.	Roman Khoebal, Teeravisit Laohapensaeng, Rounsang Chaisricharoen [2015]	Passenger monitoring, passenger control RFID distance reading, ticket control, RFID ticket inspection.	It is possible to travel cross country with a single public transportation card, using transport systems of several transport operators.	Applicable only for passenger monitoring
Application of smart computing in Indian Railway Systems.	Parag Chatterjee, Asoke Nath [2014]	By Interlinking unique identification system with train ticket reservation system by using video surveillance, rail sensors, biometric input devices	Reduces manual effort in passenger data entry. Provides security verification.	<ul style="list-style-type: none"> • Significant investment is needed. • Risk of database.

		and multimedia displays.		
Android Suburban Railway Ticketing with GPS as Ticket Checker	Sana Khoja, Maithili Kadam [2012]	Android, SQ lite, Cloud Database, ASR, QR Code.	E-Ticket facility, enabling reuse and replacement of components.	QR Codes before the user enters or leaves the station, where the user can have access which is risk in ticket booking.
Novel Approach for Smart Indian Railways	Sujith Kumar, K.M.Yatheendra Parvan, V.Sumathy, Thejeswari C.K [2017]	Digitalization, Smart Railways, Aadhar Card, Smartphone, Identity Verification.	Employ a mobile application through which passengers can access various ticketing options in user friendly and efficient manner.	Biometric database is risk of hacking.
A Review on IOT based automated seat allocation and verification using QR code.	Sarvath Saba, Sharon Philip, Shriharsha, Mukund Naik, Sudeep Sherry [2022]	The system lets the passenger to have a comfortable journey by checking the temperature first for normal and then the count for avoid crowd using the QR Code.	This model proposes a radical change in train operation and passenger experience. One of the many steps towards a more digitized society as a part of the "Digital India" movement proposed in 2015 by the Prime Minister.	The system is not fool-proof and requires a dramatic change in the existing system in terms of the people allowed on platforms, etc. but baby steps matter.

Conclusion

This paper takes the application of Jing-Zhang high-speed railway as the research object, analyses and studies the top-level design of the smart railway, clarifies the connotation and definition of the smart railway, deepens people's understanding and understanding of the smart railway, and proposes the overall design architecture model. It has a certain guiding role for the development of railway Informationization in China. However, this paper stands in the perspective of the overall development of the smart railway. There are still many shortcomings in the preliminary exploration and research of the Smart Railway. The top-level design is a macro-plan that affects the subsequent development of the smart railway. In the future, it should be updated and improved in real time according to the development of the smart railway, providing powerful guidance for the information development of the railway.

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