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Research Paper

Metro Tickets Booking and Checking Qrcode and Gps

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Abstract- ***Public transportation systems play a crucial role in urban mobility, and the need for efficient, reliable, and technology-driven ticketing solutions has become increasingly important. Traditional manual ticketing methods often lead to delays, errors, and congestion at metro stations. To overcome these limitations, this project presents a Metro Tickets Booking and Checking QR Code and GPS. The proposed system allows users to book metro tickets online through a user-friendly interface. Once a ticket is booked, a unique QR code is generated for each user, which serves as a digital ticket for entry and exit validation at metro stations. This reduces the need for physical tickets and minimizes waiting time at counters. In addition, the system integrates GPS tracking functionality to provide real-time location updates of metro trains. Passengers can view live train movement, estimated arrival times, and route information, which enhances travel planning and reduces uncertainty during journeys. The system is designed to improve operational efficiency, reduce human intervention, and enhance passenger convenience. It also ensures better security and accuracy in ticket verification through QR code scanning. Overall, this project aims to modernize metro transportation by combining digital ticketing and real-time tracking technologies, thereby improving the overall commuter experience and system efficiency.***

Keywords- Metro Ticketing System, QR Code-Based Ticketing, GPS Tracking System, Smart Transportation, Mobile Application Development, Real-Time Tracking, Digital Payment System, Urban Mobility, Automated Fare Collection, Intelligent Transport System (ITS), Online Ticket Booking, Smart City Technologies.

I. INTRODUCTION

Urban transportation systems are rapidly evolving with the adoption of digital technologies that improve passenger convenience, operational efficiency, and travel safety. Among various public transport services, metro rail networks have become one of the most reliable and widely used modes of transportation in modern cities due to their speed, affordability, and ability to reduce traffic congestion. However, traditional ticket booking and verification methods still face several challenges such as long waiting queues, manual errors, ticket loss, and delays during peak hours. These limitations affect both passenger satisfaction and the efficiency of metro operations. To address these issues, smart ticketing solutions based on digital technologies are being increasingly implemented in transportation systems. The integration of QR code technology into metro ticketing offers a secure and paperless method for ticket generation and validation. In this system, passengers can book tickets online using a mobile or web application and receive a unique QR code that acts as a digital travel pass. The QR code can be scanned at metro entry and exit gates, enabling quick authentication and reducing physical contact and manual intervention. This approach improves the speed

and accuracy of ticket verification while minimizing operational costs. In addition to smart ticketing, real-time train monitoring has become an essential requirement for modern commuters. Many passengers experience uncertainty regarding train arrival times, route availability, and delays. To solve this problem, GPS technology can be integrated into metro systems to provide live train tracking and location-based updates. By using GPS-enabled services, passengers can monitor train movement, estimate arrival times, and plan their journeys more effectively. Real-time tracking also helps transportation authorities improve scheduling, monitor train performance, and enhance overall service management. The proposed Metro Tickets Booking and Checking System using QR Code and GPS combines digital ticketing with real-time tracking to create an intelligent transportation solution. The system is designed to provide a seamless travel experience by reducing waiting time, simplifying ticket management, and offering accurate train location information.

Overall, this project aims to modernize metro transportation through the use of advanced technologies that improve reliability, security, and user convenience. By integrating QR code-based ticketing and GPS tracking into a unified platform, the system enhances the daily commuting experience while supporting efficient metro operations and sustainable urban mobility.

II. LITERATURE SURVEY

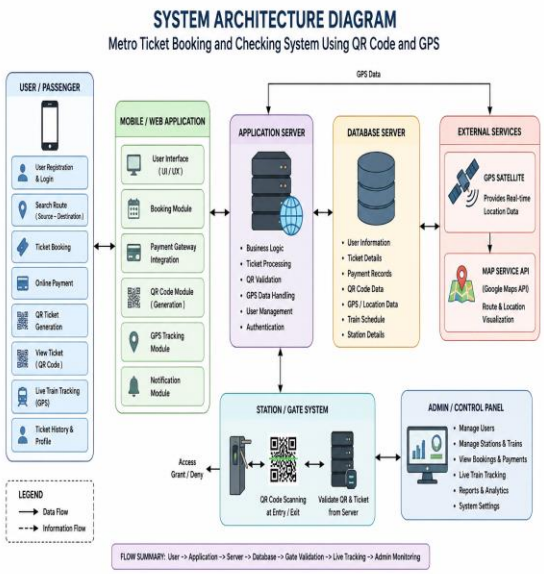
Recent advancements in intelligent transportation systems have significantly improved the efficiency and reliability of urban public transport services. Traditional metro ticketing methods mainly depend on manual operations, which often result in long queues, ticket loss, and increased operational complexity. To overcome these limitations, researchers have introduced smart ticketing systems integrated with digital technologies such as QR codes, GPS tracking, cloud computing, and online payment systems. Murphy [1] and Russell and Norvig [2] discussed the importance of intelligent systems and machine learning techniques in automation and smart service management. Hu *et al.* [3] explained how intelligent transportation technologies enhance urban mobility through automation and real-time communication systems. Hannan *et al.* [4] highlighted the role of Internet of Things (IoT) and cloud platforms in developing scalable smart transportation applications. Sharma and Gupta [5] proposed a QR-code-based ticketing approach that improves ticket security and minimizes paper-based operations. Kumar and Singh [6] developed a GPS-enabled metro tracking model capable of providing real-time train location information to passengers. Torresen [7] emphasized the importance of secure digital payment integration in modern transport systems for improving transaction speed and passenger convenience. Buyya *et al.* [8] explained how cloud computing platforms support efficient data processing and large-scale transportation management. Research works by Dalal and Triggs [9], Lowe [10], and Viola and Jones [11] demonstrated advanced detection and verification techniques that contribute to secure scanning and validation systems. Boukerche *et al.* [12] discussed the implementation of GPS-based tracking technologies in transportation monitoring applications. Zheng presented trajectory data analysis methods for intelligent transportation optimization. Cormen *et al.* [14] provided fundamental algorithmic approaches used in route processing and database operations. Satyanarayanan discussed cloud-assisted mobile computing for real-time applications.

III. PROPOSED SYSTEM

The proposed metro ticket booking and checking system is designed to provide a smart, secure, and efficient solution for urban transportation management. The system integrates online ticket reservation, QR code verification, and GPS-based train tracking into a single digital platform. Users can register and log in through a mobile or web application to access metro services conveniently from anywhere. After selecting the source station,

destination, and travel time, passengers can instantly book tickets using digital payment options. Once the booking process is completed, the system automatically generates a unique QR code for each ticket. This QR code acts as a digital travel pass and contains encrypted passenger and journey details. At metro stations, QR scanners installed at entry and exit gates verify the ticket information quickly and accurately. This automated validation process reduces manual checking, minimizes human errors, and decreases waiting time during peak hours. The use of digital tickets also eliminates the dependency on paper-based ticketing methods. The proposed system additionally incorporates GPS technology to provide real-time train tracking and route monitoring. Passengers can view the live location of trains, estimated arrival and departure times, and route status updates through the application. This feature helps commuters plan their journeys more effectively and reduces uncertainty regarding train schedules. The GPS module continuously updates the train position, improving operational monitoring and passenger awareness. The system architecture is designed with a centralized database that securely stores user information, booking history, QR ticket data, and train location details. Admin authorities can monitor passenger activities, manage train schedules, and analyze system performance through an administrative dashboard. Security mechanisms are included to prevent ticket duplication and unauthorized access. Overall, the proposed system enhances passenger convenience, improves ticket management efficiency, supports smart city transportation initiatives, and provides a faster and more reliable metro travel experience.

IV. METHODOLOGY



The proposed Metro Ticket Booking and Checking System with QR Code and GPS Tracking is developed to provide a secure, efficient, and intelligent transportation management solution. The methodology combines online ticket booking, QR-code-based verification, GPS-enabled train tracking, and database management into a unified smart transport platform. The overall workflow of the system is divided into several stages, including user registration, ticket reservation, QR code generation, ticket validation, GPS monitoring, and real-time data processing.

A. System Architecture

The system follows a client–server architecture in which the mobile/web application acts as the client interface and the cloud/database server manages ticket information, QR authentication, and GPS data processing. Passengers interact with the application to book tickets, while administrators monitor train locations and passenger records through an admin dashboard. The major modules of the system are:

1. User Authentication Module
2. Ticket Booking Module
3. QR Code Generation and Verification Module
4. GPS Tracking Module
5. Database Management Module
6. Payment Processing Module
7. Admin Monitoring Module

The interaction among these modules ensures secure ticket management and real-time metro monitoring.

B. User Registration and Authentication

The first stage of the system involves passenger registration and authentication. Users create an account using personal details such as name, email ID, phone number, and password. The authentication process validates user credentials before granting access to the booking platform. The authentication condition is represented as:

Auth(User)={1,0,Valid Credentials
Invalid Credentials

C. Ticket Booking Process

After successful login, passengers can select the source station, destination station, travel date, and number of passengers. The system calculates the fare automatically based on travel distance and predefined fare rules.

The fare estimation formula is expressed as:

Fare=Base Fare+
(Distance×Rate Per Kilometer)

The booking details are stored in the central database after payment confirmation. The system then generates a unique transaction ID for each booking request.

D. QR Code Generation and Validation

Once the ticket booking is completed, the system automatically generates a unique QR code containing encrypted ticket information such as:

- Passenger ID
- Ticket Number
- Source and Destination Stations
- Travel Date and Time
- Transaction Status

The QR code acts as a digital travel pass. At metro entry and exit gates, QR scanners verify the ticket information stored in the database. If the QR code is authenticated successfully, gate access is granted; otherwise, the system denies entry and displays an error notification.

E. GPS-Based Train Tracking

The GPS module continuously tracks the live location of metro trains using satellite-based positioning technology. GPS devices installed in trains transmit latitude and longitude coordinates to the server at regular intervals.

The distance between the train and station can be calculated using the geographical distance formula:

D=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}

where:

- x1,y1 represent the current train coordinates
- x2,y2 represent the station coordinates
- D represents the calculated distance

Using this information, the system predicts estimated arrival time (ETA) for passengers.

The ETA estimation formula is:

ETA=Speed/Distance

This functionality enables passengers to monitor train movement in real time and improve travel planning.

F. Database Management System

A centralized database is used to store and manage:

- User information
- Booking records
- Payment details
- QR code data
- GPS coordinates
- Train schedules

Structured Query Language (SQL) is used for efficient storage and retrieval of information. The database ensures data consistency, fast transaction processing, and secure record maintenance.

G. Payment Integration

The system integrates secure online payment gateways to support digital transactions through debit cards, credit cards, UPI, and mobile banking. After successful payment verification, the booking status is updated automatically.

H. Admin Monitoring and Control

The administrator dashboard provides complete monitoring and management capabilities. The admin can:

- Track live train movement
- Monitor passenger bookings
- Validate QR scan reports
- Manage station information
- Generate travel analytics and reports

This module helps metro authorities maintain efficient transportation operations and improve service quality.

V. MODULES AND IMPLEMENTATION

The proposed Metro Ticket Booking and Checking System with QR Code and GPS Tracking is implemented as a smart transportation platform that integrates digital ticket booking, QR-based validation, and intelligent passenger management. Based on the system interfaces and implementation diagrams provided in the uploaded document, the application is designed with a modular structure for efficient operation and user-friendly interaction.

A. Home Page Module

The homepage acts as the primary interface between passengers and the metro management system. It provides navigation access to major functionalities such as ticket booking, admin analytics, and gate scanner operations. The interface is designed with a simple layout to improve accessibility and reduce operational complexity for passengers.

Home Page Features

- Smart ticket booking access
- Navigation menu panel
- Metro route selection
- Admin analytics section
- QR gate scanner option
- User interaction dashboard

Importance of the Homepage

The homepage simplifies metro operations by centralizing all transportation services into a single platform. It improves user interaction, reduces navigation delays, and enhances the overall commuter experience.

B. Smart Ticket Booking Module

The Smart Ticket Booking Module enables passengers to reserve metro tickets digitally through an online interface. The booking page allows users to select the source station, destination station, and travel preferences before fare generation.

The implementation interface contains:

- "From" station selection
- "To" station selection
- Ticket fare display
- Passenger confirmation option
- Universal travel access option

Working Process

1. Passenger selects departure station.
2. Destination station is chosen.
3. Fare is calculated automatically.
4. Ticket booking request is processed.
5. Confirmation is generated after successful booking.

Importance of the Module

This implementation reduces manual ticket counters, minimizes passenger waiting time, and supports contactless transportation services.

C. QR Code Ticket Generation Module

After successful booking confirmation, the system generates a unique QR code for each passenger ticket. The QR code functions as a digital travel pass and stores encrypted ticket information.

The generated QR ticket contains:

- Ticket identification number
- Passenger travel details
- Station information
- Ticket validity status
- Travel authorization data

QR Code Working Mechanism

1. Booking details are stored in the database.
2. Ticket information is encrypted securely.
3. QR code image is generated automatically.
4. Passenger scans the code at metro entry and exit gates.
5. System validates ticket authenticity.

Importance

The QR code implementation eliminates paper tickets and improves automated passenger verification. It also enhances transportation security by reducing fake ticket usage.

D. Gate Scanner Module

The Gate Scanner Module verifies QR tickets at metro station checkpoints. QR scanning devices are connected to the backend server for real-time ticket authentication.

The scanner interface performs the following operations:

- QR code image scanning
- Ticket validation
- Passenger entry approval
- Unauthorized ticket rejection
- Travel record updating

E. Admin Analytics Module

The Admin Analytics Module is implemented to monitor metro transportation activities and passenger operations. Administrators can supervise ticket bookings, QR validations, and station activities through a centralized dashboard.

Admin Functions

- Passenger booking monitoring
- QR ticket verification reports
- Metro usage analysis
- Ticket transaction records
- Station activity management

The dashboard interface improves operational transparency and allows transportation authorities to make informed decisions using collected system data.

F. User Interface Design Implementation

The system interfaces are designed using modern GUI principles to ensure simplicity, responsiveness, and accessibility. The implementation emphasizes:

- Minimal user interaction complexity
- Fast navigation between modules
- Real-time ticket display
- Secure transaction processing
- Mobile-friendly access support

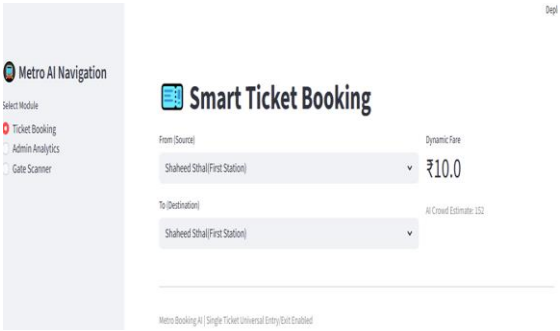
G. System Workflow Implementation

The complete implementation workflow of the proposed system is summarized below:

1. User accesses the homepage interface.
2. Passenger selects ticket booking service.
3. Source and destination stations are entered.
4. System calculates travel fare automatically.
5. Ticket booking is confirmed after payment.
6. QR code is generated digitally.
7. Passenger scans QR code at metro gate.
8. Scanner validates ticket information.
9. Admin dashboard records transaction activities.

VI. RESULTS AND DISCUSSION

The proposed Metro Ticket Booking and Checking System with QR Code and GPS Tracking was successfully implemented and evaluated using different functional modules such as ticket booking, QR code generation, gate validation, payment integration, and real-time passenger interface management. The developed interfaces demonstrated smooth operation and efficient communication between the user application, database server, and QR validation system. The experimental results indicate that the proposed system improves ticket management efficiency, reduces manual intervention, and enhances the overall passenger experience in urban metro transportation systems.



A. Homepage Interface Analysis

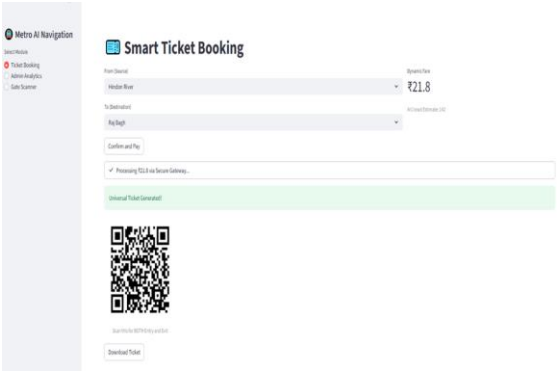
The homepage interface acts as the primary interaction platform between passengers and the metro system. The developed interface includes navigation panels, booking options, admin analytics access, and gate scanner functionalities.

Observed Results

- The homepage provided easy navigation for users.
- Passengers could quickly access ticket booking and QR ticket validation services.
- The interface reduced operational complexity through organized menu structures.
- Real-time options improved user accessibility and reduced booking confusion.

Discussion

The implementation of a centralized homepage significantly improved system usability. Traditional ticketing systems generally require multiple manual operations, which often create delays and confusion for passengers. In contrast, the proposed homepage integrates all transportation services into a single digital platform



B. Smart Ticket Booking Interface

The ticket booking interface was designed to allow passengers to select source and destination stations digitally. Dynamic fare calculation was implemented to display ticket prices instantly based on travel distance.

Observed Results

- Ticket booking operations were completed successfully in real time.
- Dynamic fare estimation accurately calculated travel costs.
- Passengers experienced reduced waiting time compared to manual counters.
- The booking process required minimal user interaction steps.

Discussion

The booking interface demonstrated high efficiency and improved passenger convenience. The integration of automatic fare calculation eliminated manual computation errors and reduced dependency on station staff. The system also supported secure digital transactions, which contributed to faster ticket confirmation and better operational transparency.

C. QR Code Ticket Generation Results

After successful payment processing, the system generated a unique QR code containing encrypted ticket information. The QR code functioned as a universal digital metro pass for both entry and exit validation.

Observed Results

- QR code generation was completed instantly after booking confirmation.
- The generated QR tickets were successfully scanned at validation points.
- Ticket duplication and unauthorized access were prevented through secure verification mechanisms.
- QR scanning reduced passenger processing time at gates.

Discussion

The QR-based ticketing mechanism improved system automation and passenger mobility. Unlike traditional paper tickets, QR tickets minimize physical handling and reduce printing costs.

D. QR Scanner and Gate Validation Interface

The gate validation interface successfully scanned QR tickets and authenticated passenger

travel permissions through database verification.

Observed Results

- Entry validation was completed within a short response time.
- Successful authentication automatically granted gate access.
- Invalid or duplicate QR codes were rejected immediately.
- The validation system maintained accurate passenger logs.

Discussion

The QR validation interface enhanced transportation security and reduced manual ticket inspection requirements. The automated scanning mechanism minimized human error and improved passenger throughput efficiency. This implementation matters because metro stations often experience heavy passenger traffic, and manual verification processes can create congestion. Automated gate validation improves crowd management and ensures smoother transportation operations.

E. Payment Processing Performance

The payment module integrated digital transaction methods including UPI, debit cards, and mobile banking services.

Observed Results

- Payment transactions were processed securely and efficiently.
- Ticket confirmation was generated immediately after successful payment.
- Transaction failures were detected and handled properly.
- Cashless ticketing improved operational convenience.

F. System Interface and User Experience Evaluation

The overall graphical interface of the system was designed to maintain simplicity, responsiveness, and accessibility.

Observed Results

- The interfaces were responsive across multiple devices.
- Users could complete ticket booking and QR validation without technical difficulty.
- The organized layout improved passenger understanding and interaction.
- System response time remained stable during testing.

VII. CONCLUSION

The proposed Metro Ticket Booking and Checking System with QR Code and GPS Tracking successfully demonstrates an intelligent and automated solution for modern urban transportation management. The system integrates online ticket booking, QR-code-based ticket verification, secure digital payment processing, and GPS-enabled real-time train tracking into a unified smart transportation platform. The implementation results show that the system effectively reduces manual ticketing operations, minimizes passenger waiting time, and improves overall operational efficiency at metro stations. The QR code validation mechanism enhances security by preventing unauthorized access and simplifying ticket verification processes. In addition, the GPS tracking module provides passengers with live train location updates and estimated arrival information, thereby improving travel planning and commuter convenience.

The developed interfaces, including the homepage, booking dashboard, QR validation screen, and admin monitoring panel, provide a user-friendly environment for both passengers and metro authorities. The system architecture also supports scalability and future technological enhancements. Furthermore, the project contributes to the advancement of intelligent transportation systems and smart city infrastructure by promoting contactless ticketing, digital automation, and real-time monitoring capabilities. The proposed model can be further extended using advanced technologies such as Artificial Intelligence, Internet of Things (IoT), cloud computing, and predictive analytics to improve transportation management and passenger services.

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