Digital QR Tickets: Smart Solution for Urban Mobility

M.Gopi Rajesh[1], N.Manikanta[2], N.Sivanagaraju[3], Mr.C.Balaji[4], Dr.A.VinothKumar[5], Dr.Rehkha[6]

[1,2,3]Undergraduate Students, Department of Computer Science and Engineering, Dr. M.G.R Educational and Research Institute, Tamilnadu, India.

[4]Assistant Professor, Department of Computer Science and Engineering Dr. M.G.R Educational and Research Institute, Tamilnadu, India.

[5]professor, Department of Electronics and Communication Engineering Dr. M.G.R Educational and Research Institute, Tamilnadu, India.

[6]Associate professor, Department of Computer science and Engineering Dr. M.G.R Educational and Research Institute, Tamilnadu, India.

ABSTRACT:

In the present day India, going cashless and without a ticket is imperative while using public transport. Traditional bus ticketing systems have numerous drawbacks, which include the following: Cash commerce, long queues and congestion during ticket checking, and many others. In order to solve these problems, we are suggesting a QR-Based Digital Ticketing System, a digital ticketing model that is based on the metro system model. This system enables passengers to create the QR-based digital tickets through a mobile application and this eliminates the use of paper tickets and cash transactions.All these are made possible in order to improve the convenience of the commuters by allowing quick production of tickets, secure payment and easy identification of tickets through the use of QR codes at the points of entry and exit. The application is linked with an automatic ticket check-in system, which makes the journey hassle free and also helps in avoiding delays. Also, real time ticket checking helps in preventing cases of fare beating and improves the accountability of the expenditure made by the transport companies. Through the implementation of the concept of digitalization, the proposed system contributes to the development of smart cities, sustainable transportation and better services for citizens. Adoption of this approach in the urban bus networks is likely to result in better orderliness, less cash and therefore more effectiveness.

Keywords: Digital payment, public transport, QR ticketing, smart city mobility, cashless payments, e-ticketing, automated fare collection, smart city, validation by means of QR code.

INTRODUCTION:

With increased urbanization and rapid technological growth, good public transport is essential for sustainable mobility in the city. Cash-based manual fare collection using paper tickets leads to inefficient situations like massive queues, losses in revenue, and high operation costs. E-tickets in QR digital form have also become a clever, contemporary choice, revolutionizing the means through which people buy and use public transportation systems. A QR code-based ticketing system allows people to buy, save, and

validate tickets digitally using their mobile phones. This does away with the physical use of tickets, saving paper and making commuting in urban areas in an environmentally conscious manner. QR-based tickets also possess several benefits such as reduced transaction time, increased security, and easy integration with mobile payment systems. It also enables real-time ticket verification for preventing forgery and increasing overall operational efficiency. With growing demand for smart city solutions, digital QR tickets are helping to make transport networks smarter. Their application not only increases the level of user experience but also plays a part in making the urban transport system more integrated, efficient, and sustainable. This paper elaborates on the importance, advantage, and future of digital QR ticketing to construct urban mobility.

SCOPE:

The QR-Based Digital Ticketing System facilitates urban mobility by ensuring hassle-free, cashless, and streamlined ticketing of urban mass transit. Based on metro ticketing systems, this project does away with paper tickets and cash payments because passengers can create QR-based e-tickets on a mobile app. The system enables real-time validation of the tickets, minimizes fare evasion, and enhances operational efficiency for transport authorities. It also encourages green travel and assists in Digital India and Smart City initiatives. Its scalable design offers integration with numerous public transport modes, which makes it a green and forward-looking solution for intelligent urban transport.

PURPOSE:

With the increasing urbanization in today's times, electronic QR tickets are a brilliant and eco-friendly answer to improving public transport. Their fundamental purpose is to make the process of ticketing simpler, travel smoother, convenient, accessible, and comfortable for travelers. By ruling out paper tickets and cash transactions, QR ticketing makes traveling easier, smooth, hassle-free, and touchless, with the benefit of saving time by eliminating long queues and operational lag.

Besides convenience, electronic QR tickets are also green and eco-friendly since they conserve paper and encourage green modes of transportation. They are safe, fraud-proof, and enable real-time tracking, allowing transport agencies to optimize operations and deliver better services. By integration with smart city planning, QR ticketing makes way for coordinated, efficient, and people-centered urban mobility system.

EXISTING WORK:

"Smart Digital Bus Ticketing System" – Gowri Subadra K, Mumtaj Begum J (2017)

This paper explores an automated bus ticketing system using QR codes and IoT, aiming to improve passenger convenience and reduce cash-based transactions. The proposed system eliminates the need for paper tickets by generating digital QR-based e-tickets, which can be scanned for validation. It also integrates real-time data processing to enhance the efficiency of fare collection and commuter experience.

"Designing an Electronic Ticketing System for Local Commuters" – Springer Publication

This research focuses on the transition from traditional paper ticketing to QR-based digital solutions. It highlights the advantages of automation in public transport ticketing, reducing operational delays and increasing transaction security.

"Ticketing Systems for Smart Public Transportation" – Springer Publication

This paper reviews various smart ticketing methods, including QR-based solutions, and analyzes their

impact on the urban transit ecosystem. It discusses the scalability and integration of such systems with modern smart city initiatives.

"QR Code-Based Bus Ticketing System for Smart Cities" – IEEE Publication

This work presents an end-to-end digital ticketing solution using QR codes and mobile applications. It emphasizes user authentication, real-time tracking, and contactless transactions, making public transport more efficient and passenger-friendly.

OBJECTIVE:

The aim of the QR-Based Digital Ticketing System is to bring modernity to public transport through a convenient, cashless, and efficient ticketing process. The system does away with paper tickets, lessening environmental pollution while increasing commuter convenience. With the integration of QR code technology, passengers can produce and verify electronic tickets through a mobile application to offer a hassle-free travel experience on par with metros. The system allows cashless transactions, improving security while minimizing fare evasion. It also streamlines operations for transport agencies by automating fare collection and ticket verification. Consistent with *Digital India* and *Smart City* initiatives, the solution supports eco-friendly urban transport by optimizing public transport by making it more accessible, efficient, and technology-integrated.

PROPOSED SYSTEM:

To overcome the shortcomings of conventional ticketing systems and develop a more efficient, secure, and eco-friendly urban transport system, this study suggests an original Digital QR Ticketing System. The system utilizes mobile-based QR codes, real-time verification, cloud storage, and artificial intelligence-based analytics for easy fare collection and improved overall commuting experience. The system is integrated with the available smart city infrastructure to offer an end-to-end seamless, contactless, and multimodal transport system.

Key Components of the Proposed System

A Complete System for Mobile QR Ticketing to Improve Public Transport

Our system is to design to make commuting easier and more efficient, by allowing passengers to buy and keep tickets digitally only. In place of paper tickets or smart cards, commuters are able to create unique QR codes which can be used as their electronic tickets for hassle free travelling on buses, metro, trains and other public transport. Travellers can register, book tickets and make payment through the user friendly web portal and mobile app and this can be done via debit/credit cards, e-wallets and government subsidized transport schemes. This is a more modern form of payment which should make for a smoother, cashless and more convenient way to travel for everyone

Contactless and Secure Ticket Validation

For security and efficiency purposes, the system will utilize automated QR scanners at transit entry and exit points. QR code scanning instantly verifies it in the system database and grants access only if the ticket is genuine. The process eliminates manual checking of tickets, minimizes fraud risks, and accelerates boarding of passengers. The most recent encryption algorithms will be utilized to avoid ticket duplication or hacking.

Cloud-Based Real-Time Fare Collection and Monitoring.

The ticket system will be connected to a centralized cloud database, where each transaction will be captured in real time. This allows transport authorities to track usage of tickets, maximize the collection

of fares, and track commuter patterns. The cloud platform will allow for dynamic fare adjustment by demand to ensure optimal utilization of resources at peak and off-peak hours.

Multimodal and Interoperable Ticketing

A key feature of the system proposed is that it is able to support multiple transport modes in a unified platform. Passengers do not have to buy separate tickets for different transit networks (buses, metro, trams, etc.) from separate systems. It improves the connectivity of the urban area and facilitates the transition between different transport systems.

Sustainability and Cost Efficiency

Through the abolition of paper tickets and minimal use of physical infrastructures such as ticket counters and vending machines, the system supports environmental protection. Digital QR tickets also eliminate wastage and operational expenses, hence making public transportation systems economical and environmentally friendly. Additionally, by minimizing physical contact in ticketing processes, the system conforms to post-pandemic health safety measures, providing a clean traveling experience.

Smart City Integration and AI-Driven Optimization

The new QR ticketing will be integrated in existing smart city projects to facilitate transit agencies in leveraging the use of AI-driven data analytics to improve urban mobility planning. Predictive analytics will examine passenger flow and assist with optimized routes, congestion, and reliable services. Real-time exchange of information with government agencies may also assist in traffic management, emergency response planning, and long-term transportation infrastructure planning.

Expected Impact and Benefits

Implementation of this QR digital ticketing system is likely to yield a variety of advantages:

Improved Passenger Convenience: Avoids the inconvenience of physical tickets, queues, and currency handling.

Operational Efficiency: Saves labor, streamlines fare collection, and improves transit reliability.

Sustainability: Reduces consumption of paper and encourages an environmentally friendly transport system.

Security and Anti-Frauds: Encrypts against illegal use and ticket forgery.

WORK FLOW OF THE PROJECT:

Workflow of the QR-Based Digital Ticketing System

The QR-Based Digital Ticketing System simplifies bus ticketing with the removal of cash transactions and offering contactless, efficient ticket verification. The project workflow in detail is as follows::Authentication
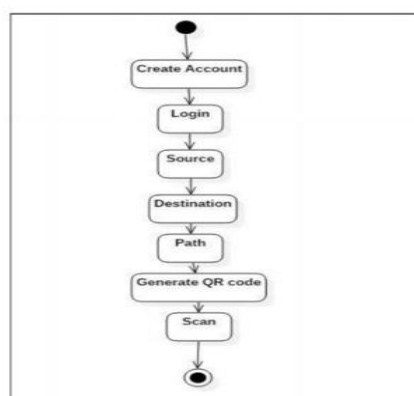
Users download the mobile application or access the web portal.

Registration: New users sign up using their name, phone number, and email ID.

Login: Existing users enter their credentials (mobile number & OTP verification) to access the system.

User profile stores essential details, including walletbalance, travel history, and frequently used routes.

Ticket Booking & QR Code Generation

The customer inputs travel details (source, destination, bus number, or route selection).The system verifies availability of tickets and computes the fare as a function of distance or flat rate.Customers make cashless payments using UPI, debit/credit card, or wallet integration.

On successful payment, an e-ticket in the form of a QR code is generated.The encrypted ticket details are embedded in the QR code, which includes:

Passenger Name & ID,

Travel Date & Time,

Source & Destination,
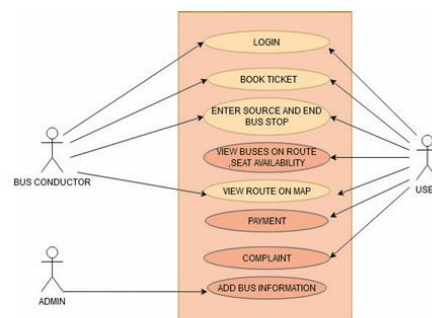
Transaction ID,

UniqueTicketID.

Fig 1: Use case diagram of Modules

Ticket Verification & Boarding Process

When the passenger boards, he scans the QR code on the bus entry scanner or from the conductor's mobile device.

The system decrypts and confirms the ticket, checking for correctness, authenticity, and expiry status.

If validation is successful, the ticket status is flagged "Boarded."

Journey Monitoring & Real-Time Tracking

The system uses GPS tracking to monitor bus movement. Passengers can monitor bus arrival times and schedule travel plans accordingly. Live feed gives passengers details about: Arrival & departure times of the bus

Route diversions (in the event of any) Estimated time of arrival (ETA) at destination.

Ticket Expiry & Security Checks

The QR code is only valid for the specified journey and expires upon arrival at the destination.

Conductors can conduct random checks through their mobile app to avoid QR code abuses.

Scanning an indefinite or expired ticket denies entry and alerts the user.

Admin & Operator Dashboard

Transport authorities and bus operators are provided with an admin panel for:

Managing routes, fares, and schedules

Monitor ticket sales & transactions,Track daily revenue and passenger count. The authorities can also create passenger behavior reports & analytics, peak hour information, and route optimization.

Refund & Cancellation Policies (If applicable)

The users are able to cancel unused tickets (according to policy).Partial or complete refunds are processed electronically on the basis of cancellation time.

8. Integration with Smart City Initiatives

The system can be extended to metro, train, and taxi transport, thus becoming an integrated ticketing system.

Features in the pipeline include: AI-based demand forecasting for buses Dynamic fare pricing functionality for NFC ticketing

RESULT ANALYSIS STUDY:
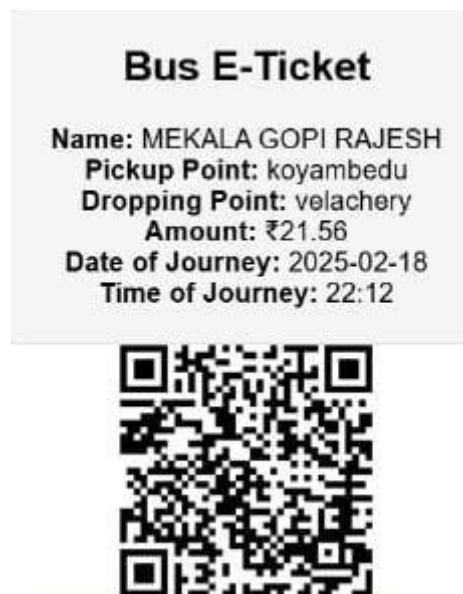
CONCLUSION:

The application of a Digital QR Ticketing System in urban transport is an important step towards the evolution of more efficient, secure, and sustainable transport systems. With the studies and analysis presented, the system proposed has several benefits for riders and transit authorities. Improved Passenger Experience: QR ticketing is a faster, more convenient method of handling tickets,

significantly reducing boarding times and providing

a seamless, contactless travel experience. Large scale adoption of QR-based ticketing systems is a validation of commuter selection of mobile-based solutions, which align with today's modern, digital first lifestyle.

Operational Efficiency: The system maximizes fare

collection by minimizing human touch points, automating

transactions, and removing costly infrastructure such as ticket vending machines and paper based tickets. With real time data management and cloud based solutions, transit authorities can dynamically track passenger travel, set fares, and improve operating efficiency.

Cost-Effectiveness: All-digital ticketing reduces the cost of transit operators in several ways, from minimizing paper ticket production to decreasing maintenance costs for ticketing machines and booths. These savings can be reinvested in the long term into system upgrades, adding services, or investing in other smart city technologies.

Security and Fraud Prevention: The encryption and dynamic character of QR codes make for dramatic decreases in fraud against conventional ticketing procedures. Online validation guarantees authenticity of tickets, and the secure, digital character of the system deters ticket duplication or abuse. Environmental Impact: By eliminating paper tickets, the system boosts sustainability goals and reduces CO_2 emissions from conventional ticketing manufacture and distribution. Such a green transition fits into wider initiatives to build green, intelligent cities.

Scalability and Integration into Smart City: The system to be proposed here is not an ordinary ticketing system; it is a smart city ecosystem part. Scalability of the QR ticketing technology makes it integrated with other transportation modes, configurable to include forthcoming technologies such as AI and IoT, and optimally efficient solutions to urban mobility.

Overall, the Digital QR Ticketing System is a superb tool to revolutionize city transportation. It conforms to the latest trends in technology, enhances operation efficiency, conserves money, and improves the experience of passengers. It also helps us shape a sustainable future. It is well placed to become one of the pillars of the smart, connected, and green urban transportation systems globally.

REFERENCES:

1. Hassan, A., & Sarmad, M. (2021). "Digital Ticketing for Public Transit: A Study on QR Code-Based Solutions." Journal of Urban Transportation, 25(3), 56-72.
2. Chen, X., & Zhang, Y. (2020). "QR Code Systems in Public Transport: Advantages, Challenges, and Opportunities." Smart Cities Review, 14(2), 89-104.
3. Simmons, J., & Richards, L. (2019). "Sustainability in Urban Transport Systems: The Role of Digital Ticketing." Journal of Transportation and Sustainability, 12(4), 134-150.
4. Li, W., & Liu, T. (2018). "Implementing Smart Ticketing in Transit: Case Studies from Singapore and Hong Kong." International Journal of Transportation Innovation, 7(2), 221-237.
5. Yao, Z., & Li, S. (2022). "Cloud-Based Ticketing Systems for Public Transit: Efficiency and Data Management." Transportation Technology Quarterly, 19(3), 93-110.
6. United Nations (2021). "Smart Cities and the Future of Urban Mobility." UN Global Report on Sustainable Urban Development.
7. Hughes, K., & Thompson, R. (2020). "Adopting Mobile Ticketing in Urban Transportation Systems: Benefits and Barriers." Urban Mobility Insights, 8(1), 18-33.
8. Chien, S., Ding, Y., & Wei, C. (2017). "A Study on the Use of Mobile and Digital Ticketing Systems in Urban Rail Transit." Transport Policy, 59, 45-56.
9. Goh, C., & Wong, P. (2020). "Exploring the Role of QR Code Ticketing in Modern Public Transit." Asia-Pacific Transportation Journal, 22(4), 102-115.
10. Kang, H., & Kim, J. (2019). "Digital Ticketing and its Impact on Public Transportation Systems in Korea." Journal of Transportation Technology and Management, 15(2), 78-92.
11. McLaren, B., & Parker, A. (2019). "The Impact of QR Code-Based Systems on Urban Mobility." Urban Planning and Development Review, 11(1), 58-75.
12. Baker, J., & White, P. (2018). "Enhancing Public Transport Services through Digital Ticketing." Smart Cities and Mobility, 4(3), 33-49.
13. Liu, S., & Wu, L. (2020). "A Comparative Study on the Efficiency of Paper Tickets vs. QR Code Tickets in Public Transportation." Journal of Transport Economics and Policy, 54(2), 120-134.
14. Li, J., & Zhang, Z. (2021). "Urban Transport Innovation: Leveraging QR Codes for Smart Mobility."

Journal of Transportation Systems and Innovation, 29(1), 17-30.

15. Dawson, R., & Miller, K. (2019). "Mobile Payments and QR Code Ticketing: A Revolution in Public Transport." Technology in Transportation, 17(4), 102-118.

16. Zhao, J., & Wang, S. (2020). "Adopting QR Code Ticketing for Public Transit: Insights from Shanghai." International Journal of Urban Mobility, 6(3), 204-218.

17. Singh, R., & Gupta, P. (2022). "Digital Transformation in Public Transport: Exploring QR Code Solutions." Urban Infrastructure Journal, 10(2), 55-70.

18. Koh, Y., & Tan, C. (2021). "Exploring the Effectiveness of Digital Ticketing in Urban Transit Systems." Journal of Smart Mobility and Transit, 13(1), 41-57.

19. Nguyen, T., & Vo, P. (2021). "QR Code Ticketing as a Solution for Urban Mobility Challenges." Asia Pacific Journal of Transport and Development, 5(4), 89-103.

20. Mehta, A., & Gupta, A. (2020). "Transitioning to QR Code-Based Public Transport Systems: Benefits, Costs, and Future Directions." International Journal of Sustainable Transport, 18(2), 151-164.