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Mahalakshmi Scheme: Digital Travel Limit System

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Abstract: ***The Mahalakshmi Scheme is a welfare initiative introduced to provide free public transportation for women, aimed at improving accessibility, safety, and social inclusion. However, the existing manual and semi-digital methods suffer from challenges such as identity misuse, lack of real-time tracking, manual verification errors, and inefficient monitoring of travel limits. To overcome these limitations, this paper proposes a secure and intelligent Digital Bus Pass Management System that automates beneficiary registration, travel validation, and monitoring using modern web and mobile technologies.***

The proposed system enables female beneficiaries to register using Aadhaar-based identity verification and mobile OTP authentication, ensuring authenticity and eliminating duplicate entries. Upon successful registration, a unique Mahalakshmi ID along with a QR code is generated for each beneficiary. Conductors use a dedicated application to scan the QR code, validate user credentials, and record journey details such as source, destination, and travel distance. The system automatically calculates the traveled distance and enforces a monthly free travel limit, beyond which fare calculation is performed dynamically.

A centralized backend manages real-time data processing, maintains travel history, and supports administrative monitoring. The admin dashboard provides insights into beneficiary usage, conductor activity, total distance traveled, and revenue generated from excess travel. Security mechanisms such as role-based access control, encrypted data storage, and authenticated QR validation ensure data integrity and prevent fraudulent usage.

The proposed solution enhances transparency, efficiency, and accountability in public transport management while reducing manual workload and operational errors. By integrating mobile applications, cloud-based services, and automated analytics, the system provides a scalable and reliable digital infrastructure for effective implementation of the Mahalakshmi Scheme and serves as a model for smart governance in public transportation systems.

Index Terms: Digital Bus Pass, QR Code, Aadhaar Authentication, Smart Transportation, E-Governance, Public Welfare Systems.

I. INTRODUCTION

Public transportation plays a vital role in supporting economic growth and social inclusion, especially in urban and semi-urban regions. In India, government welfare schemes aimed at improving mobility for women have significantly contributed to enhancing safety, accessibility, and independence. One such initiative is the Mahalakshmi Scheme, which provides free bus travel facilities for women. While the objective of the scheme is impactful, the traditional manual and semi-digital implementation methods face several operational challenges such as identity misuse, lack of real-time monitoring, manual verification errors, and inefficient tracking of travel limits.

With the increasing scale of beneficiaries and daily commuters, manual ticketing and verification mechanisms become inefficient and vulnerable to misuse. Issues such as duplicate beneficiaries, unauthorized usage, incorrect fare calculations, and lack of centralized monitoring reduce the effectiveness of the scheme. Therefore, there is a growing need for a secure, automated, and transparent digital system that ensures accurate verification, efficient monitoring, and seamless travel experience for both beneficiaries and transport authorities.

This project proposes a Digital Bus Pass Management System for the Mahalakshmi Scheme, designed to automate beneficiary registration, verification, travel tracking, and fare calculation processes. The system leverages modern technologies such as mobile-based authentication, QR code generation, cloud-based databases, and real-time data processing. Female beneficiaries can register using Aadhaar-based identity verification and mobile OTP authentication, after which a unique digital ID and QR code are generated. Conductors use a dedicated application to scan QR codes, verify passengers, and record journey details including source, destination, and distance traveled.

The system automatically tracks monthly travel limits and calculates applicable fares once the free travel threshold is exceeded. An integrated admin dashboard enables authorities to monitor system usage, detect misuse, analyze travel patterns, and generate reports for decision-making. By digitizing the entire workflow, the proposed system ensures transparency, accuracy, and scalability while reducing manual workload and operational errors.

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Overall, the proposed solution provides a reliable and intelligent platform for implementing the Mahalakshmi Scheme effectively. It enhances user convenience, improves governance, and supports data-driven policy decisions, thereby contributing to the development of a smart and inclusive public transportation ecosystem.

II. LITERATURE SURVEY

Over the last decade, public transport systems have increasingly adopted digital identity and automated ticketing solutions to improve speed, transparency, and fraud control. Research and real-world deployments show that replacing manual verification with secure digital validation reduces impersonation, improves data accuracy, and enables better policy monitoring. The literature relevant to this project can be grouped into QR-based ticketing, digital identity verification, travel-limit management, automated fare systems, real-time monitoring, and user transparency portals.

A. QR Code Based Ticketing in Public Transport

Multiple studies and metro or bus implementations indicate that QR codes are a low-cost and fast alternative to paper tickets and physical smart cards. QR validation supports quick boarding, reduces printing costs, and enables real-time ticket generation and verification using a mobile device or scanner. QR systems are widely preferred in scenarios where infrastructure cost must be minimized and where mobile-first ticketing is required. This supports the proposed idea of issuing a Mahalakshmi QR ID and validating it inside buses through the conductor app.

B. Smart Pass and Travel Limit Enforcement Systems

Smart travel cards and account-based ticketing systems are commonly used to apply rules such as daily caps, monthly passes, or free-ride limits. Literature highlights that automated limit enforcement is more reliable than manual checking because the system can maintain user-wise counters, renew them per cycle, and prevent limit bypass. This directly aligns with the proposed requirement of tracking a 1600 km monthly free limit and auto-renewing usage each month.

C. Identity Verification Using Aadhaar and OTP

Digital identity verification mechanisms such as national ID validation, OTP-based login, and demographic checks are frequently recommended to reduce duplicate registrations and impersonation in welfare schemes. OTP login provides a simple and user-friendly authentication method, while Aadhaar-based verification improves uniqueness and reduces repeated accounts. Many systems adopt a hybrid approach where mobile OTP is the login mechanism and the ID number is stored and validated for identity assurance. This supports the proposed beneficiary registration flow: female-only validation, Aadhaar mandatory, OTP mandatory, and Telanganapincode restriction.

III. PROPOSED SYSTEM

The proposed system introduces a Digital Bus Pass Management Systemdesigned to automate and secure the implementation of the Mahalakshmi Scheme. The system replaces manual verification and paper-based processes with a centralized, technology-driven solution that ensures transparency, accuracy, and efficient service delivery. It integrates mobile applications, cloud-based data storage, and secure authentication mechanisms to manage beneficiary registration, travel tracking, and fare calculation.

The system consists of three major functional modules: Beneficiary Module, Conductor Module, and Admin Module. These modules work together through a centralized backend server that manages authentication, data processing, and reporting.

A. Beneficiary Module

The Beneficiary Module enables women users to register and access travel services securely. Registration requires mobile number verification through OTP, Aadhaar authentication, and submission of personal details such as name, address, and face photograph. Only female users with valid Telangana pin codes are allowed to register. Upon successful verification, the system generates a unique Mahalakshmi ID along with a QR code that serves as a digital travel pass. Beneficiaries can log in to view their travel history, remaining monthly travel balance (1600 km limit), and digital receipts for completed journeys.

B. Conductor Module

The Conductor Module is designed for authorized bus conductors whose credentials are pre-registered in the system. Conductors log in using their assigned ID and name.

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During travel, the conductor scans the beneficiary's QR code and enters the journey's starting and ending locations. The system automatically calculates the distance using a route database and checks whether the beneficiary has exceeded the free travel limit. If the limit is exceeded, the system computes the applicable fare based on predefined slabs and records the transaction. This module ensures accurate trip logging and minimizes manual errors.

C. Admin Module

The Admin Module provides centralized control and monitoring of the entire system. Administrators can view real-time data on beneficiary usage, travel distances, and conductor activities. The module supports fraud detection by identifying duplicate entries, abnormal travel patterns, and unauthorized access attempts. It also allows administrators to manage conductor accounts, generate analytical reports, and monitor system performance. This ensures accountability, transparency, and efficient governance of the scheme.

D. System Workflow

The system workflow begins with beneficiary registration and verification, followed by QR code generation. During travel, the conductor scans the QR code, and the system processes the journey details. Based on the distance traveled, the system either approves free travel or calculates the applicable fare. All records are stored securely in the database and made available for administrative review.

E. System Benefits

The proposed system minimizes misuse, reduces manual effort, ensures real-time monitoring, and improves service efficiency. By combining digital identity verification, automated fare calculation, and centralized management, the system provides a scalable and secure solution for implementing the Mahalakshmi Scheme effectively.

IV. FIGURES

Figure 1- System Architecture

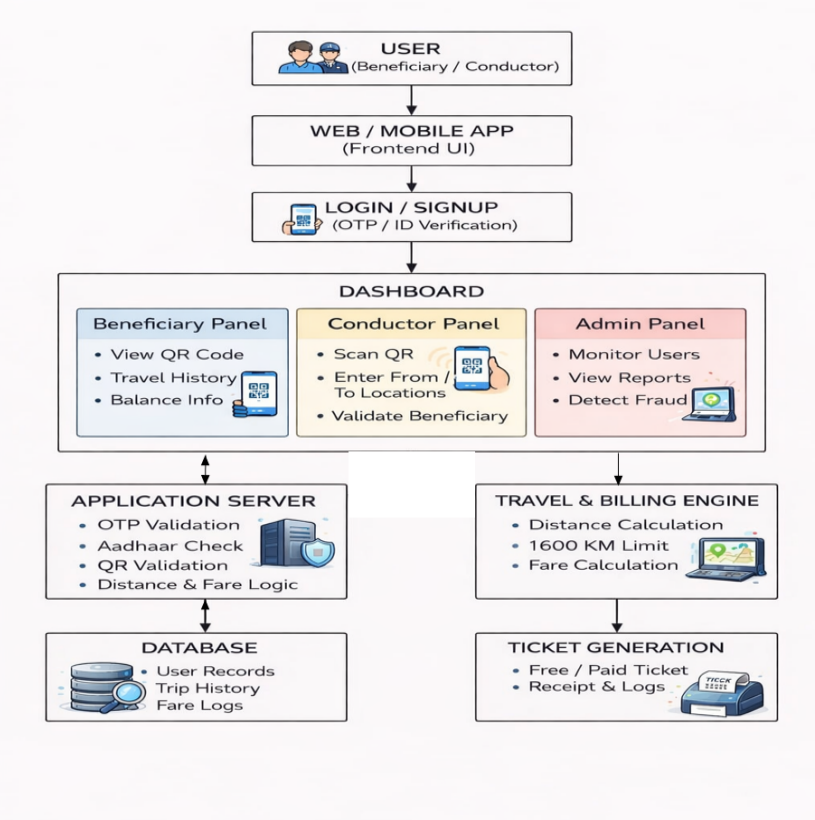
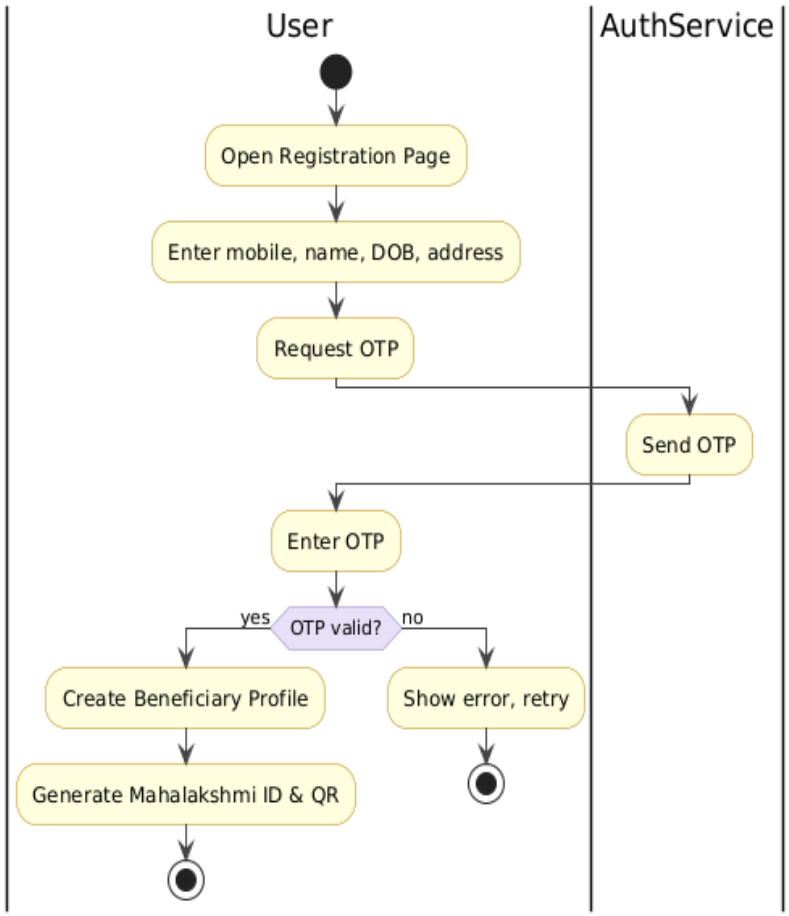


Figure 2- Activity Flow Diagram



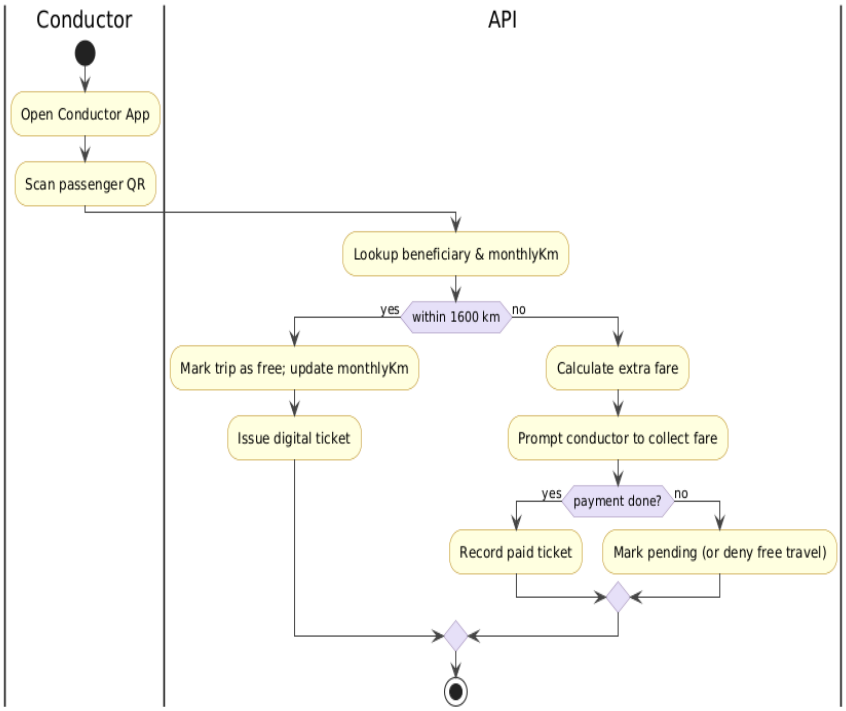
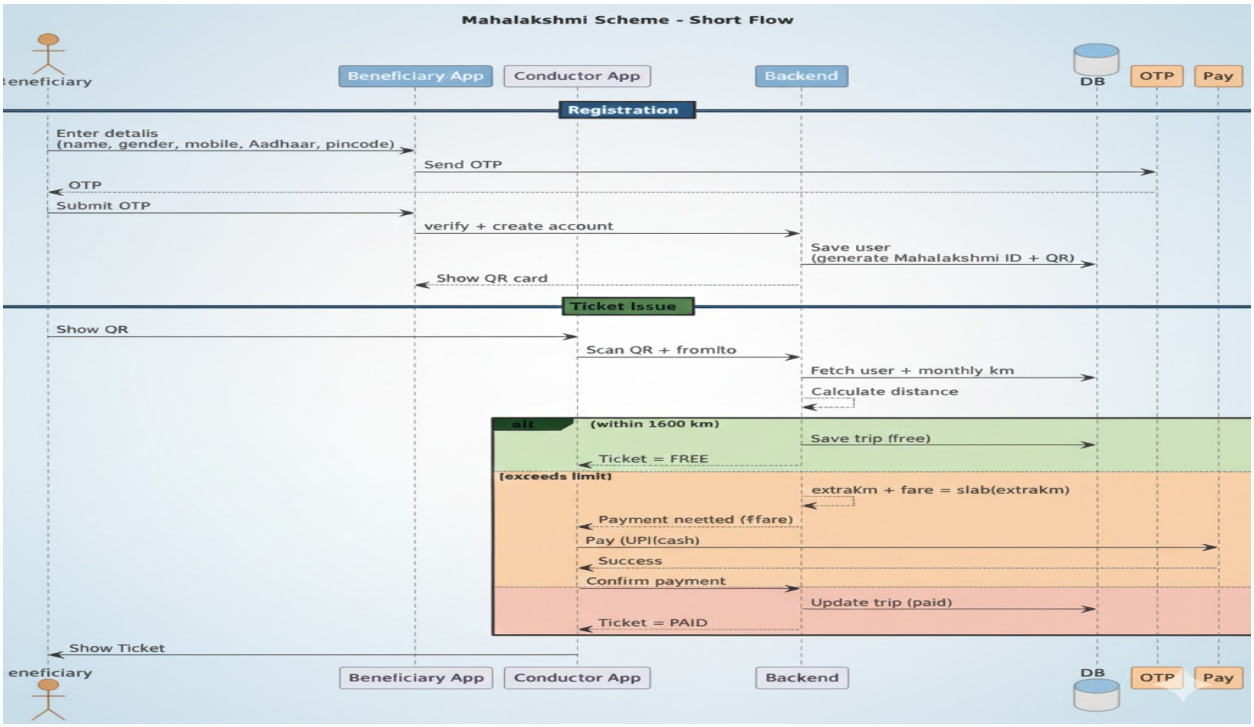


Figure 3- Sequence Diagram



V. CONCLUSION AND FUTURE WORK

The Digital Bus Pass Management System proposed for the Mahalakshmi Scheme provides a secure, efficient, and transparent solution for managing free public transportation services for women. By replacing traditional manual processes with a fully digital platform, the system successfully addresses key challenges such as identity misuse, lack of real-time monitoring, manual fare calculation, and inefficient record management. The integration of mobile-based OTP authentication, Aadhaar verification, QR code–based identification, and automated distance calculation ensures accurate beneficiary validation and fair usage of the scheme.

The system enables seamless interaction between beneficiaries, conductors, and administrators through well-defined modules. Beneficiaries can easily access their travel details and remaining free travel balance, while conductors can validate passengers and record journeys efficiently. The centralized admin dashboard supports real-time monitoring, fraud detection, and data-driven decision-making. Overall, the proposed solution improves transparency, operational efficiency, and accountability, making it a reliable digital infrastructure for public welfare transportation systems.

FUTURE WORK

Although the proposed system effectively addresses current challenges, several enhancements can be introduced in future versions to further improve performance and usability. Advanced features such as GPS-based live bus tracking can be integrated to automatically detect routes and distances without manual input. AI-based fraud detection models can be implemented to identify unusual travel patterns and prevent misuse more intelligently.

The system can also be extended with multi-language support to improve accessibility for users from different linguistic backgrounds. Integration with real-time government transport databases and smart city platforms can further enhance accuracy and scalability. Additionally, incorporating mobile payment gateways, facial recognition for faster verification, and data analytics dashboards for policy-level insights will strengthen decision-making capabilities.

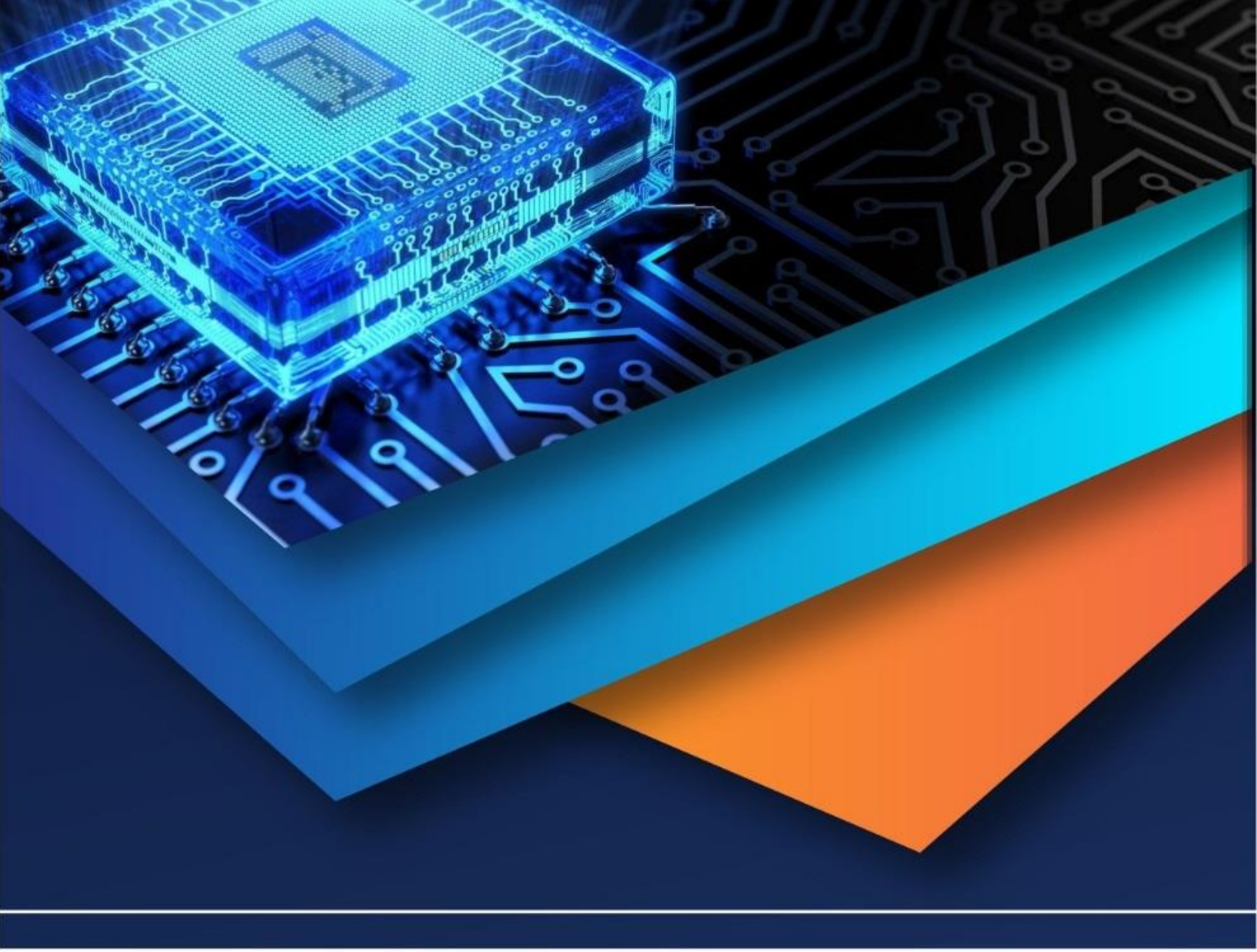
In the future, this platform can be expanded beyond a single state and adapted for other welfare and public transportation schemes, contributing to a more inclusive, efficient, and digitally empowered governance system.

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