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SMART DIGITAL TICKETING FOR TOWN BUS

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Abstract: This research focuses on the design and development of a fully automated digital ticketing system for public buses, eliminating the need for conductors. The system integrates modern technologies such as QR code scanning, motion detection sensors, voice recognition, cloud storage, and real-time alert mechanisms to create a seamless, contactless, and intelligent travel experience. By using touch and IR sensors for passenger detection, relay modules for automatic door operations, and voice alerts for boarding and deboarding assistance, this model ensures higher efficiency and safety in public transport. The proposed system also addresses the limitations of traditional bus ticketing methods, which rely heavily on manual intervention and are prone to errors, delays, and misuse. Real-time data processing through cloud integration supports route planning, monitoring passenger flow, and improving operational transparency. Additionally, this approach promotes digital transformation in public transportation by reducing labor costs, avoiding revenue leakage, and improving commuter convenience. This paper presents a scalable and affordable solution suitable for both government and private transit systems, offering scope for future enhancement using AI and data analytics. The work aims to contribute to smart city initiatives and support eco-friendly, paperless, and automated transport solutions aligned with India's digital vision.

Key word- Digital ticketing

INTRODUCTION

With the rapid advancement of smart city initiatives and automation technologies, public transportation systems are undergoing significant transformation. Traditional bus ticketing systems, which rely heavily on conductors and manual fare collection, often face challenges such as human error, time delays, revenue leakage, and lack of transparency. To overcome these limitations, we propose a fully automated digital ticketing system for town buses. This system integrates multiple modern components such as a touch screen interface for ticket selection a ticket vending machine for instant receipts, voice recognition for destination confirmation, AR sensors for real-time driver alerts, and a relay-based access control system that ensures entry only after payment. This conductor-less model not only reduces operational costs but also improves service efficiency and passenger convenience. By embedding automation directly into the bus infrastructure, the proposed system supports a more secure, transparent, and scalable transport solution aligned with India's digital and smart city goals.

NEED OF THE STUDY

With the growing complexity and demand in urban transportation, there is an urgent need to modernize and automate traditional public bus ticketing systems. Current methods that depend on human conductors often result in inefficiencies such as ticket fraud, manual errors, time delays, and revenue losses. These challenges not only affect the transport authority but also inconvenience passengers. The integration of digital technologies like voice recognition, touch sensors, QR scanners, and automated ticket vending machines provides an opportunity to streamline the ticketing process. Additionally, real-time alerts and cloud-based monitoring improve both security and operational efficiency. The study is essential to assess how such innovations can address these limitations and contribute to a smarter, safer, and more transparent public transport system.

3.1Limitations of Traditional Ticketing Systems

Traditional bus ticketing systems heavily rely on manual processes, such as conductors issuing paper tickets and verifying payments. These methods are often time-consuming, error-prone, and lack transparency. Human involvement leads to delays, potential fraud, and operational inefficiencies, especially during peak hours. Additionally, there is minimal data tracking for

passenger count, fare collection, and route analysis, making it difficult for transport authorities to plan or optimize services effectively. In rural or high-traffic urban areas, manual systems may cause miscommunication, revenue leakage, and lack of accountability. Moreover, traditional systems do not support contactless or online payment methods, which are essential in today's digital and hygienic standards. These limitations highlight the pressing need for fully automated, sensor-based ticketing solutions that ensure faster service, real-time data access, and reduced dependence on human operators.

3.2 Real -Time Alert

The real-time alert system in this idea is designed to enhance safety and operational efficiency in public transport. Using AR (Augmented Reality) sensors and voice recognition technology, the system continuously monitors the bus environment and passenger interactions. For example, it can detect when a passenger selects a destination or completes a payment, instantly notifying the driver through visual or audio alerts. Additionally, the system can recognize unusual activity, such as unauthorized door openings or failed payments, triggering immediate alerts to the driver or central control. This helps prevent fare evasion and ensures secure boarding processes. The real-time alerts also facilitate better communication between the automated ticketing machine and the driver, allowing quick responses to potential issues without human ticket inspectors. This proactive monitoring system improves overall passenger safety and streamlines bus operations.

3.3 Need of Visual Proof Instruction

In modern security and automated systems, having visible proof of intrusion is crucial for accountability, safety, and quick resolution of incidents. Visible proof, such as video footage, sensor logs, or alert notifications, serves as undeniable evidence when unauthorized access or suspicious activity occurs. This helps authorities or system administrators to verify incidents accurately, preventing false alarms and ensuring appropriate action is taken. In the context of automated ticketing and bus security, visible proof of intrusion can help detect tampering with the ticket machine, unauthorized entry attempts, or vandalism. It builds trust among passengers and operators by providing transparent monitoring and serves as a deterrent against potential intruders or fare evaders. Ultimately, visible proof strengthens the security framework by enabling timely intervention and supporting legal or disciplinary measures if needed.

RESEARCH METHODOLOGY

The proposed conductor-less digital ticketing system has its foundation in various fields of research, including automation, sensor integration, human-computer interaction, and smart transportation systems. Existing research in smart transit solutions emphasizes the need for reducing human intervention and enhancing real-time accuracy in fare collection. Touch screen ticketing systems with real-time fare calculation and digital payment methods like UPI (Google Pay) have been studied for urban transit applications.

Research in relay-based access systems has shown increased security in automated entry control, especially when paired with payment confirmation logic. Studies on voice recognition and AR-based driver alert systems highlight improved communication between the system and the driver, increasing passenger safety. The integration of these technologies in a single embedded system reflects ongoing advancements in embedded electronics, IoT, and machine learning for public transport management.
This model aligns with recent publications in IEEE Xplore and Elsevier that discuss smart bus systems, automated fare collection (AFC), and sensor-based automation in transport. The convergence of these technologies into one unified ticketing solution demonstrates a novel contribution to existing research and sets the foundation for scalable, smart public transit systems in developing cities.

3.3 Cloud Storage automation:

The integration of cloud storage and automation in the proposed conductor-less ticketing system plays a critical role in ensuring efficiency, scalability, and data security.

By storing transaction data, passenger logs, and ticketing history on a centralized cloud platform, the system allows real-time access and monitoring by transport authorities.

This eliminates the need for manual record-keeping and supports data analytics to improve route planning, passenger flow management, and revenue tracking.

Automation reduces human error and operational delays, streamlining ticket generation, fare calculation, and passenger access.

Each interaction, from ticket purchase via touchscreen to receipt generation and voice confirmation, is executed by embedded systems connected to the cloud, ensuring seamless communication between hardware components and backend systems. Moreover, cloud integration supports future expansion, such as integrating facial recognition or predictive maintenance alerts for onboard devices.

By combining automation with cloud infrastructure, the system enhances transparency, accountability, and adaptability, marking a significant step forward in smart public transportation.

3.4Tools and Statistics Measures

1. Touch Screen Sensor
Interface for user input to select town, ticket count, and make payments.

2. QR Code Scanner
Scans passenger payment or identity for validation.

3. Ticket Vending Machine
Prints the ticket receipt automatically after successful payment.

4. G Pay Sound Acknowledgement
Provides audible confirmation of successful digital transactions.

5. Relay-Controlled Door System
Allows access only after payment confirmation using a relay mechanism.

6. Voice Recognition Module
Detects and announces the selected destination or town name.

7. AR Sensor (Augmented Reality Sensor)
Sends alerts to the driver for passenger updates or safety notifications.

8. Fully Automated Ticketing Controller
Handles ticket issuing, verification, and monitoring without human staff.

9. Fixed In-Bus Machine Integration
All systems are embedded inside the bus for seamless operation.

3.4.3 Statistical Measures of Automation

To evaluate the effectiveness of the proposed fully automated ticketing system, various statistical measures can be applied to assess performance, efficiency, and user adoption. Key performance indicators (KPIs) such as average transaction time, error rate, daily ticket count, and system uptime percentage can be recorded and analyzed. For example, before automation, the average ticketing time per passenger might be around 30 seconds; with automation, this can reduce to under 10 seconds. Error rates in manual systems (such as incorrect fares or ticket loss) can be compared with the automated system, showcasing a significant drop, potentially from 5% to less than 0.5%.

Measures	Description of example	Example Result
Ticket Purchas Time	Time taken to purchase a tick using the touch screen interface	30 seconds
System Uptime	Percentage of time the system is operation and available for use	99.9%
User Satisfaction	Percentage of users satisfied with the system's ease of use and functionality	95%
Transaction Success Rate	Percentage of successfully transactions processed through the system	98%
Voice Recognition Accuracy	Percentage of accurate voice recognition for conformation ticket, town name, and other information	97%
Relay Control Door Response Time	Time taken for the relay control door to open after payment	2 seconds
AR Sensor Alert Response Time	Time taken for the AR sensor to alert drivers to important information	1 seconds

Financial Status and Budget Justification

Implementing a fully automated digital ticketing system in town buses, which includes advanced technologies such as touch screen sensors, voice recognition, QR scanners, GPay sound alerts, AR driver alert systems, and relay-controlled access doors, represents a significant step toward smart public transportation. From a financial perspective, the investment in such a system involves the cost of hardware components (touch panels, vending machines, sensors, relays, and voice modules), software development,

installation, and maintenance. However, this upfront budget can be justified by the long-term operational savings. By eliminating the need for conductors and manual ticket checkers, recurring salary expenses are reduced. Additionally, digital payment and real-time monitoring prevent ticket fraud and revenue leakage, ensuring better financial accountability

On average, each bus may require a setup cost ranging between ₹1,00000 depending on the quality and integration level of the system. Over time, this investment is offset by increased efficiency, better passenger experience, and transparency in revenue collection. Furthermore, this system opens the door for government grants, smart city funding, and private-public partnerships. Thus, the proposed idea is not only technically viable but also financially sustainable for scalable deployment across urban transport networks.

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Conclusion

In conclusion, the proposed fully automated bus ticketing system presents a revolutionary shift in public transportation by eliminating the need for conductors and manual ticket checks. By integrating advanced technologies such as touch screen sensors for destination and fare selection, QR scanners for verification, ticket vending machines, and G Pay sound alerts for transaction confirmation, the system enhances operational efficiency and user convenience. Features like voice recognition for town names, AR sensors to alert drivers, and relay-controlled doors ensure both safety and accessibility. The entire process is embedded within the bus, making it a self-contained unit that reduces human error, minimizes fraud, and improves real-time responsiveness. This innovative model supports digital transformation goals and aligns with smart city initiatives, offering a scalable and cost-effective alternative to traditional ticketing methods. Through automation and sensor-driven intelligence, this system not only elevates passenger experience but also lays the foundation for a sustainable, transparent, and technologically empowered public transport infrastructure.

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Interfaces like touchscreens and voice recognition that allow users to interact directly with automated systems.