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Automatic Bus Ticketing with Smart Card and SMS Facility

Nishkarsh Kumar, Rohan Madhukar Ghalme, Sumit Sunil Londhe, Prof. M. R. Deore
Electronics and Telecommunication Engineering
Sinhgad College of Engineering, Vadgaon, Pune, India
nishkarsh.entc@gmail.com, rohanghalme51@gmail.com
londhesumit09@gmail.com, mrdeore.scoe@sinhgad.edu

Abstract: *Traditional ticketing methods are often inefficient, leading to long queues, boarding delays, and increased operational costs. To address these challenges, this project introduces an Automatic Bus Ticketing System using smart card technology and SMS notifications. This system is designed to streamline the ticketing process by enabling cashless, contactless payments through smart cards. Passengers can tap their card on an RFID-enabled reader for quick boarding, significantly reducing wait times and improving overall user experience.*

By automating transactions and fare management, the system ensures accurate billing and minimizes human errors. The backend records all transactions digitally, allowing for data analysis on passenger flow and ticket usage. This gives transit authorities valuable insights for better decision-making and efficient resource management.

Keywords: Smart bus ticketing, Cashless and digital BHARAT, fastest means of transaction

I. INTRODUCTION

1.1 Overview

Public transportation in India and many other developing nations faces significant challenges in managing ticketing processes efficiently. The conventional system—based on paper tickets and manual fare collection—suffers from delays, human error, fare evasion, and lack of real-time monitoring. Additionally, the absence of digital transaction records creates inefficiencies in fleet management and data-driven decision-making.

To overcome these issues, this project proposes an Automatic Bus Ticketing System using RFID-based Smart Cards integrated with GSM-enabled SMS notification services. The system aims to automate the entire fare collection workflow, making it contactless, cashless, user-friendly, and transparent.

II. PROBLEM IN EXISTING SYSTEM

Current bus fare systems are predominantly manual, involving conductors issuing paper tickets and manually calculating fares. This traditional model is highly susceptible to errors, delays, and revenue leakage. Some common issues include:

- Manual Fare Calculation: Leading to inconsistencies and potential for overcharging or undercharging.
- Revenue Loss: Due to unregistered passengers or mismanagement of ticket sales.
- Time Consumption: Long queues during peak hours delay boarding and affect route schedules.
- Environmental Impact: Continuous usage of paper tickets contributes to deforestation and waste generation.
- Data Unavailability: Lack of digital records inhibits proper data analytics for policy making and optimization.

These problems clearly indicate the necessity for a digitized, efficient, and transparent fare management system.

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III. LITERATURE SURVEY

A review of past work reveals that RFID and GSM-based systems have been increasingly considered for public transportation. Projects in cities like Bangalore, Delhi, and Mumbai have attempted automated fare collection using smart cards and NFC devices.

- RFID Implementation: Research highlights RFID as a secure and efficient means to authenticate passengers, reduce fare evasion, and quicken boarding.
- GSM-Based Alerts: Systems integrating GSM modules have proven effective for sending real-time travel updates to passengers, increasing transparency.
- IoT Integration: Combining GPS, GSM, and RFID allows real-time tracking and analytics for transportation networks.
- Challenges Noted: Many systems lacked integration or were too expensive for deployment in smaller urban/rural settings.

This project improves on past limitations by creating a cost-effective, integrated, and scalable system suitable for a variety of public transport environments.

IV. SYSTEM DESIGN

4.1 Block Diagram:

Fig 4.1 shows the block diagram of the system. The block diagram mainly consists of the Seven main components required for the proper functioning of the project.

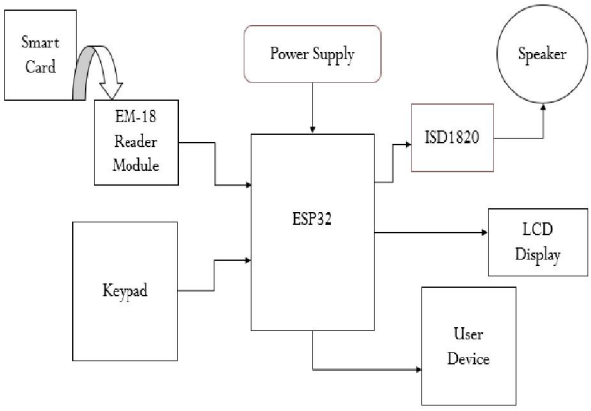

Fig 4.1 Block Diagram of Bus Ticketing System

The block diagram illustrates the architecture of a real-time ticketing and monitoring system.

1. ESP32: It is a powerful, low-cost microcontroller with built-in Wi-Fi and Bluetooth capabilities, making it a popular choice for IoT
2. Keypad: A 4x3 keypad refers to a type of matrix keypad commonly used in electronic devices
3. ISD 1820: It is an audio record and playback module
4. LCD display: It is a popular screen used in electronics to display text, numbers, and simple graphics.
5. Speaker: A speaker is a device that converts electrical signals into sound.
6. RFID: It is a technology used to identify objects or people using radio waves.
7. EM-18 Reader: It is module designed for reading low-frequency RFID tags.

V. METHODOLOGY

The methodology for developing the Automatic Bus Ticketing with Smart Card and SMS Facility involves integrating various technologies to establish a user-friendly, efficient, and secure ticketing system. This project leverages advancements in RFID-based smart card technology and real-time embedded systems to automate the ticketing process and provide instant notifications to passengers. To realize this goal, a structured approach is adopted, starting with the

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selection and configuration of suitable hardware, capable of interfacing with smart card readers (RFID modules) and for SMS communication.

Step 1: Scan you RFID

Fig 5.1

At the beginning of the interaction, the system prompts the user to initiate the process by scanning their RFID card. This step is essential for authenticating the user's identity and ensuring secure access to the system's features and functionalities..

Step 2: Tap to reader of the system

Fig 5.2

The user is required to simply place their RFID card in front of the scanner, within a range of 0 to 10 centimeters. Once the scanning process is successfully completed, the system verifies whether the card is valid or invalid. If the card is deemed valid, the system further determines the type or category of the card. Based on this classification, the system proceeds to take appropriate actions and provide services in accordance with the privileges or facilities associated with that specific card type..

Step 3: Enter destination code:

Fig 5.3

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Once the user successfully completes the RFID card scanning and the system has verified the authenticity and type of the card, the next step involves the user entering their desired destination code. This code corresponds to the location where the user intends to travel, allowing the system to accurately process the travel request and proceed with further steps such as fare calculation, ticket generation, and service eligibility based on the user's card type.

Step 4: Collect ticket via SMS:
Fig 5.4 displays that how commutators will get ticket on their devices as SMS.

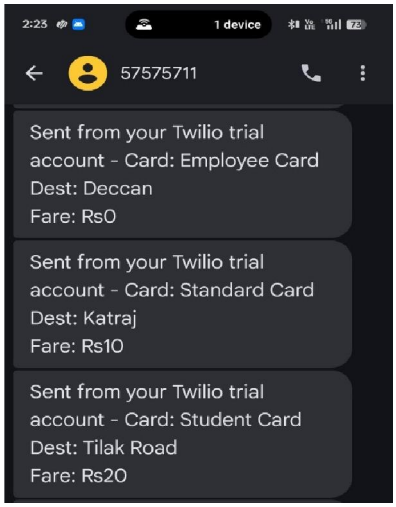

Fig 5.4

The SMS serves as a digital ticket that can be verified by the conductor or an automated validation system. This approach improves passenger convenience while minimizing the reliance on printed tickets and physical contact.

VI. SYSTEM WORKFLOW

6.1 Flowchart:

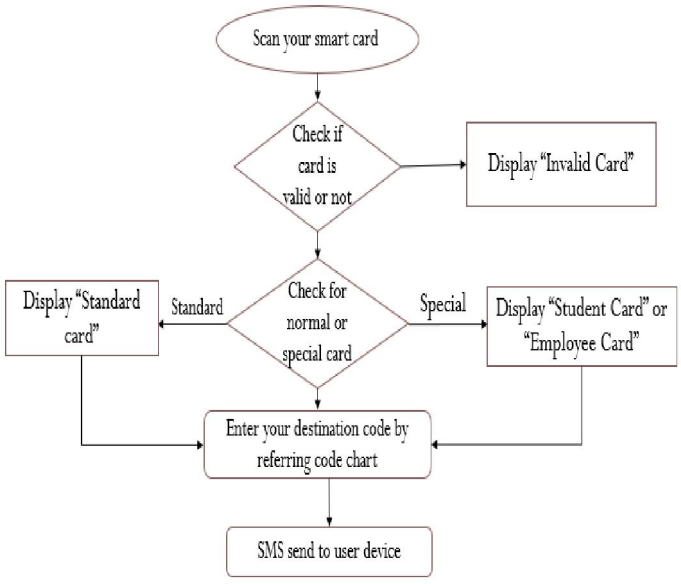

Fig 6.1 Flow Chart

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6.2 Overview of Used Technologies:

This project combines a set of hardware and communication technologies, each serving a critical role:

- ESP32 Microcontroller: Acts as the central processing unit. It handles RFID input, SMS transmission via GSM, fare computation, and LCD display updates. Its low power consumption and integrated wireless capabilities make it ideal for IoT applications.
- RFID and EM-18 Reader: RFID smart cards store user data such as name, balance, and ID. The EM-18 reader decodes this data upon scanning and forwards it to the ESP32 for processing.
- GSM Module: Facilitates SMS communication with passengers. Upon successful fare deduction, journey details and balance are sent to the user's mobile.
- ISD1820 Audio Module: Provides audio alerts and instructions for visually impaired users, enhancing system accessibility.
- LCD Display: Shows user instructions and status messages such as balance, journey start/end, and errors.
- Keypad Interface: Enables user input of destination or travel zone, which is used to calculate fare dynamically.

These technologies work in tandem to create a robust and user-friendly fare automation system.

6.3 Implementation:

The hardware prototype consists of all integrated modules mounted on a bus dashboard prototype. The system workflow is as follows:

1. Card Authentication: Upon boarding, the passenger taps the RFID card on the EM-18 reader. The card ID is validated.
2. Input Collection: The passenger is prompted via the LCD to enter destination using the keypad.
3. Fare Computation: Based on preloaded distance or zone-based fare data, the ESP32 calculates the fare and deducts it from the card's balance.
4. SMS Notification: The GSM module sends a detailed SMS to the passenger's registered mobile number.
5. Voice Assistance: ISD1820 module plays pre-recorded audio instructions.
6. Data Logging: All transaction data is stored locally and optionally on a server/cloud for analytics.

System testing involved simulation of real passenger flow scenarios. The prototype functioned efficiently with <1 second processing time for each passenger.

VII. RESULT & DISCUSSION

7.1 Circuit Design Result:

To validate the functionality of Automatic bus ticketing system, a simulation was created as shown in Fig 6.1 using Simulator to emulate real-time ticketing and data analysis.

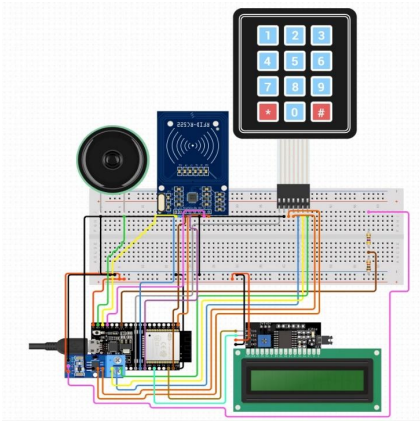

Fig 7.1 Circuit Design

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This design showcases the ESP32 microcontroller integrated with various components for Automatic bus ticketing. The ESP32 is connected to sensors like EM-18 Reader Module which will take input from RFID card, which provide data for detecting user type and location. Keypad are connected to specific GPIO pins on the ESP32 for destination input, while LCD display, provides real-time instruction for user guidance or assistance. The ISD1820 used for voice assistance. The design uses the ESP32's I/O pins for communication and control, making it suitable for real-time data processing and transmission. The system is powered through the VIN pin.

7.2 Hardware Results:

Fig 6.2 displays the Automatic bus ticketing system For bus commutators.

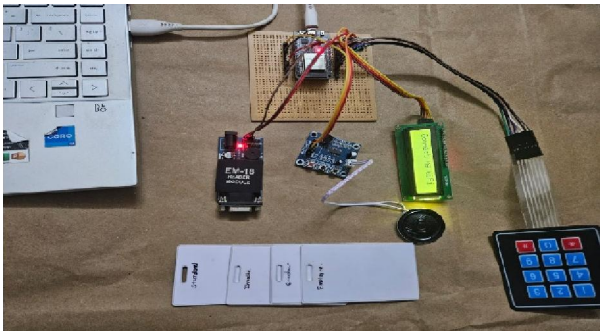

Fig. 7.2 Hardware

This device will detect the RFID credentials and validate the user. RFID gives us the digital mode of transaction and EM-18 will read it within a second and data sent to ESP32 for processing and user gets their ticket as SMS in their device within a second.

These sensors send data to the ESP32, which processes and transmits it wirelessly to a cloud platform for real-time storage and analysis. The stored data can be accessed via a web-based dashboard, allowing us to track and getting ready for future change trends over time. This system is particularly useful for data monitoring and preventive cashflow, reduces queues and man power dependencies.

7.3 Avg. Ticketing Time Result:

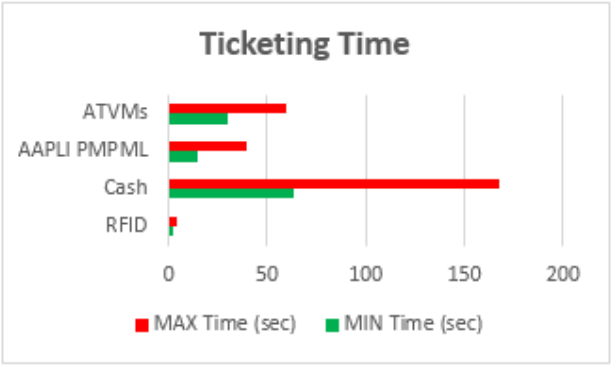

Fig. 7.3 Avg. Time Graph

RFID-based ticketing is the most time-efficient method among all available systems. It completes transactions in just 2 to 4 seconds, significantly faster than cash (63–168 seconds), AAPLI PMPML (15–40 seconds), and ATVMs (30–60 seconds). This quick, contactless process reduces queues and speeds up passenger flow, making RFID the most efficient and convenient ticketing solution.

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VIII. FUTURE SCOPE

Future developments can done in many dimensions include:

- GPS Integration: Enables location-based dynamic fare calculation and real time integrated device route tracking.
- UPI/Wallet Recharge: Integration with payment gateways like Google Pay, PhonePe for seamless top-up of smart cards.
- Mobile Application: For balance check, travel history, and digital handy card management.
- Biometric Authentication: Adding fingerprint or facial recognition for enhanced security.
- Cloud-Based Analytics: Using AI and ML to analyze commuter trends and optimize bus routes and frequency.

The ongoing development and feedback from users will drive continuous enhancement and broader deployment.

IX. CONCLUSION

The Automated Bus Ticketing System represents a significant advancement in modernizing urban public transport in India. By leveraging RFID and GPS technologies, the system streamlines fare collection, reduces wait times, and ensures accurate fare calculations, all while promoting environmental sustainability through the use of reusable RFID cards. This project effectively addresses the needs of diverse passengers, particularly students and daily commuters, by enhancing both efficiency and user experience. As the system continues to evolve, its potential for integration with other modes of transport and smart city initiatives can further improve accessibility and overall effectiveness. In summary, the successful implementation of this project will lead to a more efficient, user-friendly, and environmentally responsible public transport system, capable of meeting the growing demands of urban populations.

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