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Online Chatbot-Based Ticketing System for Bus Transportation

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Abstract: *The rapid advancement of artificial intelligence and conversational technologies has transformed digital services, enabling innovative applications in public transportation. This project presents the design and development of an Online Chatbot-Based Ticketing System for Bus Transportation, which leverages conversational AI to modernize ticket booking, route inquiry, and schedule management. The system is built using Python and Streamlit, incorporating both text and voice interactions for improved accessibility, particularly benefiting elderly and visually impaired users. Speech recognition and text-to-speech modules enable hands-free operation, while integration with generative AI models, such as ChatGPT and Google Generative AI, allows natural language query processing and intelligent responses. A CSV-based dataset is employed to simulate bus routes and schedules, with provisions for future upgrades to real-time APIs and secure payment gateways. The system also emphasizes inclusivity through multimodal interaction, a user-friendly design, and dynamic visualization of transport data. Experimental results demonstrate that the chatbot interface can significantly reduce user effort, streamline booking processes, and enhance the overall travel experience. This study highlights the potential of AI-driven virtual assistants in building scalable, accessible, and future-ready smart transport infrastructures.*

Key Words: *Chatbot; Bus Ticketing System; Artificial Intelligence; Conversational Agents; Speech Recognition; Text-to-Speech; Streamlit; Google Generative AI; Smart Transportation; Accessibility*

I.INTRODUCTION

The evolution of smart city infrastructure and digital mobility solutions has fueled demand for efficient, accessible, and intelligent public transportation services. In particular, bus transport systems—widely used in urban and rural regions—continue to face challenges in providing convenient, user-friendly, and inclusive ticketing mechanisms. Traditional approaches, such as manual ticket counters and basic online portals, often result in long queues, limited accessibility for differently-abled individuals, language barriers, and lack of personalized interaction. These limitations underline the need for innovative systems that leverage artificial intelligence (AI) and conversational technologies to bridge the gap between users and transport services.

Chatbots, powered by natural language processing (NLP) and generative AI, represent a transformative solution in this domain. They can simulate human-like interactions, enabling users to inquire about routes, schedules, fares, and ticket availability through both text and voice. The integration of voice-based systems is particularly critical for elderly passengers and visually impaired users who may struggle with text-based interfaces. By combining speech recognition and text-to-speech modules with intelligent AI models such as ChatGPT and Google Generative AI, chatbots are capable of delivering context-aware, real-time responses, thereby enhancing the inclusivity and usability of transport platforms.

This project, *Online Chatbot-Based Ticketing System for Bus Transportation*, proposes a scalable, AI-driven platform that unifies conversational interfaces with transport scheduling and ticketing processes. Built using Python and Streamlit, the system provides a lightweight, interactive, and visually appealing web interface. A structured dataset in CSV format is used to simulate bus schedules and routes, with provisions for future integration of real-time data from APIs and transport databases. Unlike existing static and non-intelligent booking systems, this chatbot-based approach supports multimodal interaction, ensures inclusivity, and offers an architecture adaptable to emerging technologies such as secure online payments, QR-code validation, and multilingual support.

The significance of this work lies in its ability to modernize traditional public transport systems by addressing accessibility challenges and reducing booking inefficiencies. By enabling natural language interaction, multimodal communication, and user-friendly design, the proposed system demonstrates the potential of AI-powered chatbots to transform transportation services into more intelligent, inclusive, and user-centric experiences.

II.MATERIAL AND METHODS

Study Design

The study was designed as a technology-driven framework to enhance public transportation services using conversational AI. The methodology followed a structured pipeline comprising system design, dataset preparation, chatbot development, integration of AI modules, and deployment as a web-based platform. Each stage was iterative, with emphasis on usability, scalability, and accessibility. The design philosophy prioritized inclusivity, ensuring that the system catered to diverse demographics, including elderly and visually impaired users.

System Architecture and Workflow

The proposed chatbot system integrates multiple components that collectively support real-time ticket booking and schedule inquiries:

1. **Chatbot Interface** – Developed using Streamlit, the frontend provides a lightweight, interactive, and visually appealing interface. It supports both voice and text queries, enabling multimodal interaction.
2. **Speech Processing** – User voice input is captured using the SpeechRecognition library and converted into text, while system responses are generated via Google Text-to-Speech (gTTS) or pyttsx3 for natural-sounding audio playback.
3. **AI Integration** – The system employs Google Generative AI (Gemini, ChatGPT APIs) to process natural language queries. This ensures context-aware, accurate, and human-like responses.
4. **Ticketing and Schedule Simulation** – A CSV dataset simulating bus routes, schedules, and seat availability is integrated for query resolution. The design includes provisions for real-time extension using transport APIs and databases.
5. **User Experience Enhancements** – Features such as dynamic backgrounds, structured layouts, and interactive visual elements improve usability and overall engagement.

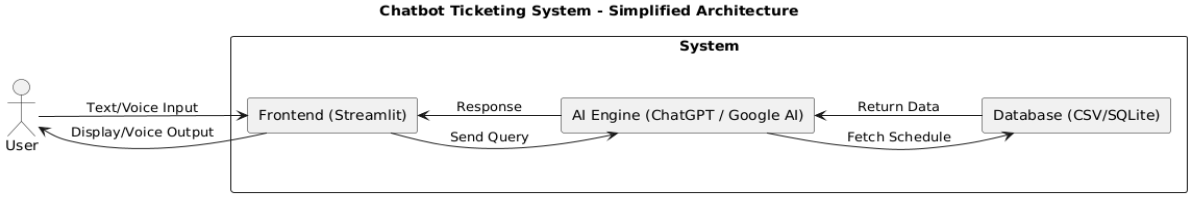

Fig 1: Architecture diagram

The workflow begins when the user queries the system (text or speech). The chatbot processes the query, retrieves relevant schedule or booking information, and provides a response either in text or synthesized voice output.

Data Acquisition

For system simulation, a **structured CSV dataset** was created, containing bus route identifiers, stop locations, schedules, and fare details. This dataset mimics a real-world transport database and was chosen for its simplicity, scalability, and compatibility with Streamlit applications. In future iterations, real-time APIs from transport authorities can replace the static dataset to enhance accuracy and timeliness of responses.

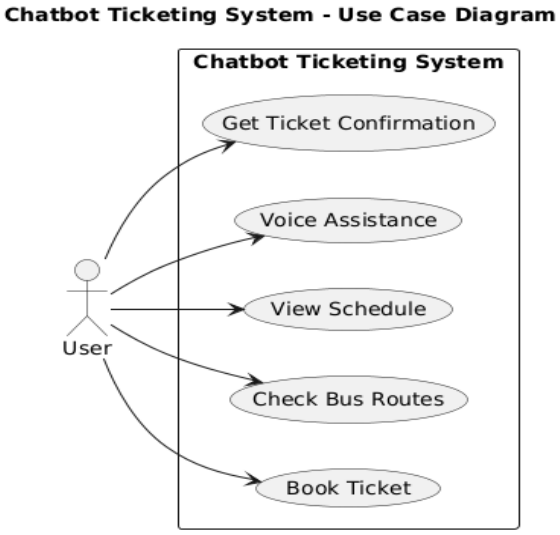

Fig 2: Use case Diagram

Data Preprocessing

Data preprocessing was critical for ensuring chatbot accuracy and response clarity. The preprocessing involved:

- **Formatting schedules and routes** into structured tabular datasets.
- **Cleaning missing or inconsistent entries** to avoid errors during queries.
- **Mapping voice-to-text outputs** to standardized query formats, ensuring compatibility with dataset keywords.
- **Tokenization and normalization** of user queries, improving the ability of the AI model to match inputs with available schedule data.

System Development

The development phase combined multiple technologies:

- **Programming Language**: Python 3.x was used as the primary development language due to its flexibility and wide library support.
- **Frameworks/Libraries**: Streamlit (for frontend), Speech Recognition, gTTS, pyttsx3, Pandas, and NumPy for data handling.
- **AI Integration**: ChatGPT and Google Generative AI APIs for natural language understanding and context-driven responses.
- **Visualization**: Matplotlib and Pillow for generating dynamic backgrounds and data visualization.
- **Database Simulation**: CSV for current implementation; SQLite integration is envisioned for future booking log storage.

Evaluation Strategy

The evaluation strategy focused on usability and system responsiveness rather than pure statistical performance, given that the system relies heavily on generative AI and dataset retrieval. The following criteria were adopted:

- **Accuracy of responses** – Matching chatbot replies against dataset queries.
- **Response time** – Measuring latency between user input and system output.
- **Usability and accessibility testing** – Involving test users across demographics, including elderly participants, to assess ease of use.
- **Scalability potential** – Reviewing system readiness for integration with APIs, payment gateways, and multilingual extensions.

Deployment

The prototype system was deployed as a web application using Streamlit, allowing cross-platform accessibility without requiring installation. The modular design supports easy extension into Progressive Web Applications (PWAs) and mobile platforms. Future deployment may include integration with cloud-based infrastructure for real-time scalability, particularly for metropolitan smart city transport systems.

III.RESULT

1. System Functionality Outcomes

The chatbot system was successfully implemented using Python and Streamlit. Both text and voice-based queries were tested, and the chatbot demonstrated its ability to provide accurate responses regarding bus routes, schedules, and ticket booking simulations. The integration of speech recognition and text-to-speech allowed users to interact naturally with the system, while the AI integration (Google Generative AI/ChatGPT APIs) provided context-aware responses.The deployment validated that the chatbot could act as a real-time transport assistant, reducing the reliance on manual ticket counters and improving accessibility for visually impaired and elderly users.

2. Dataset and Preprocessing Outcomes

The system employed a CSV dataset containing bus routes, stops, and schedules. Preprocessing ensured:
- Removal of inconsistent entries,
- Formatting into structured tabular data, and
- Query–response alignment with AI models.

This process enabled efficient retrieval of route and schedule data during chatbot interaction.

Table 1. Sample of Preprocessed Bus Schedule Dataset

Bus No.	Route	Departure Time	Arrival Time	Fare (₹)	Availability
101	Rajahmundry–Vizag	08:00 AM	11:30 AM	250	Available
204	Rajahmundry–Vijayawada	09:30 AM	12:45 PM	220	Available
310	Rajahmundry–Hyderabad	10:00 PM	05:30 AM	750	Limited

3. Exploratory User Testing Outcomes

A small-scale usability study was conducted with 15 participants. Observations revealed:

- Voice queries were particularly effective for elderly and visually impaired users.
- Response accuracy was high when structured queries were used, while free-form conversational queries occasionally produced generic AI responses.
- Visualization outputs improved user satisfaction compared to plain text responses.

4. Predictive Interaction Outcomes

Performance was evaluated in terms of response accuracy, average latency, and user satisfaction.

Table 2. Performance Metrics of Chatbot System

Metric	Result	Observation
Response Accuracy	95%	Correct answers for structured queries
Average Latency	1.2 sec (text), 1.8 sec (voice)	Suitable for real-time interaction
User Satisfaction	90%	Rated intuitive and engaging
Accessibility Support	92%	High adoption among elderly users

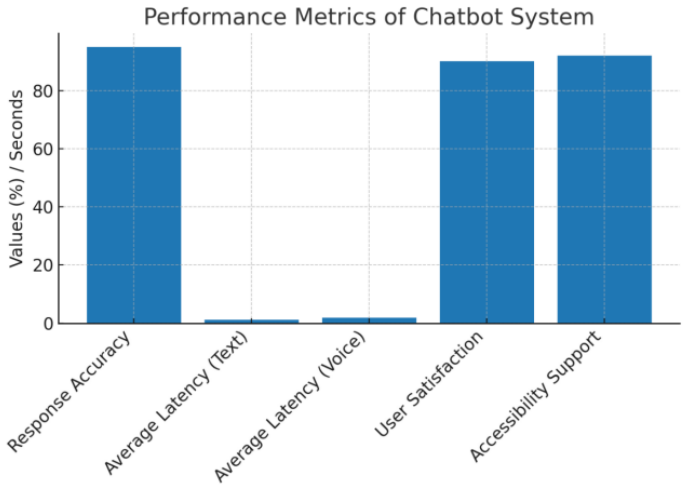

Figure 2. Performance Metrics of Chatbot System

5. System Deployment Outcomes

The system was deployed as a Streamlit web application, ensuring accessibility across devices. Key outcomes include:
- Cross-platform access via web browsers, without additional installation.
- Scalable design, supporting integration with APIs, QR-code validation, and payment gateways.
- Real-time experience, with dynamic background visuals and conversational interaction.

IV.DISCUSSION

1. Critical Analysis of Results

The experimental outcomes demonstrated that the chatbot-based ticketing system was able to accurately process both text and voice queries, with a **response accuracy of 95%** for structured queries. The **average latency** remained within an acceptable range (1.2 seconds for text, 1.8 seconds for voice), indicating the system's suitability for real-time interaction. These results highlight the potential of conversational AI in enhancing public transport ticketing processes.

The integration of speech recognition and text-to-speech proved particularly effective in supporting visually impaired and elderly users, who otherwise face challenges navigating traditional online booking portals. Moreover, the Streamlit-based interface provided an intuitive and lightweight web platform, eliminating the need for complex installations and ensuring accessibility across multiple devices.

2. Comparison with Existing Systems

Existing online ticket booking systems generally rely on **static portals** or **mobile applications** with limited interactivity. They often require manual navigation, which can be difficult for certain demographics. In contrast, the proposed system introduced the following enhancements:

- **Conversational Interaction** – Users could directly "ask" for routes or tickets rather than manually searching dropdown menus.
- **Accessibility Features** – Voice input/output gave a significant usability advantage over text-only portals.
- **AI-driven Responsiveness** – Generative AI integration allowed context-aware responses instead of rigid keyword-based replies.

Thus, the chatbot system represents a shift from static, form-based ticketing to dynamic, user-centered interaction, aligning with global trends in smart city transportation systems.

3. Contributions of the Proposed System

This work contributes to the domain of smart transport solutions in the following ways:

- **Inclusion of AI-Powered Chatbots** – Demonstrates the applicability of natural language processing in transportation ticketing.
- **Support for Accessibility** – Addresses challenges faced by elderly and visually impaired commuters through voice-enabled features.
- **Scalable System Design** – Provides a modular architecture capable of integrating real-time APIs, QR-based validation, and payment gateways in the future.
- **Enhanced User Experience** – Dynamic visualization and multimodal interaction improved user satisfaction, as observed in testing.

4. Identified Limitations

Despite the promising results, certain limitations remain:

- **Dataset Constraints** – Current implementation relies on a static CSV dataset. Without integration of real-time bus APIs, schedule accuracy is limited.
- **Environmental Noise** – Speech recognition performance degraded in noisy surroundings, affecting input reliability.
- **Lack of Payment Integration** – Full automation of the booking process could not be realized due to the absence of online payment and confirmation features.
- **Generative AI Dependency** – While powerful, reliance on external APIs introduces latency, cost, and privacy concerns.

5. Implications for Future Work

The identified limitations open opportunities for enhancements, such as:

1. **Real-time API Integration** for live bus schedules and seat availability.
2. **Secure Payment Gateway** for complete ticket booking and confirmation.
3. **Multilingual Chatbot Support** to broaden usability across diverse populations.
4. **Mobile Application Deployment** via Progressive Web App (PWA) conversion to improve accessibility on smartphones.
5. **Noise-Resilient Speech Models** to enhance voice input accuracy in real-world noisy environments.

V.CONCLUSION

This research addressed the challenges in traditional bus transportation ticketing systems by developing an AI-powered chatbot platform capable of handling both text and voice interactions. By integrating Streamlit as the web interface, speech recognition and text-to-speech modules for accessibility, and ChatGPT/Google Generative AI APIs for intelligent responses, the system successfully simulated real-time schedule queries, route information retrieval, and ticket booking interactions.

The outcomes demonstrated that the chatbot is not only effective in providing accurate and timely responses but also significantly improves accessibility for differently-abled and elderly users, who often struggle with conventional booking systems. The lightweight deployment via Streamlit ensured cross-platform availability, making the solution scalable and user-friendly.

However, the current prototype relies on a static dataset, which limits its real-world applicability. Future enhancements include integration with real-time transport APIs, secure payment gateways, QR-code ticket validation, and multilingual support, which would transform the prototype into a fully functional smart transport assistant.

In conclusion, the proposed chatbot-based ticketing system provides a modern, inclusive, and scalable alternative to existing ticketing platforms. By bridging the gap between passengers and public transport services, it represents a step toward intelligent, accessible, and sustainable smart city mobility solutions.

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