Voice-Driven Bus Seat Booking System Using AI Models

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***Abstract*—This paper presents a voice-driven chatbot system for bus seat booking, using advanced AI models to streamline the booking process through the use of normal English language. Users can specify travel details, select buses, reserve multiple seats, or cancel bookings via voice commands. The system incorporates an audio-to-text conversion model (Whisper ASR model) and a large language model (FLAN-T5 model) to process and interpret user requests and convert them into sql Queries. This idea of ours enhances user convenience and accessibility in public transportation services.**

***Index Terms*—Voice chatbot, AI models, audio-to-text conversion, natural language processing, bus seat booking.**

I. Introduction

Efficient and user-friendly public transportation services are essential for most people traveling in modern times. Traditional method of bus seat booking often involves manual interaction with online platforms or in-person bookings, which can be time-consuming and inconvenient. Our project addresses these challenges by introducing a voice-driven chatbot system that allows users to book or cancel bus seats using everyday language like talking to a guy at the bus stand.

The system integrates advanced AI models that require less processing power to enable seamless voice interactions. The Whisper ASR model is used for converting voice inputs to text, while the FLAN-T5 model interprets the textual data to generate appropriate sql queries. This combination ensures accuracy and reliability in understanding user's intentions.

II. Related Work

A. Paper 1 : Online Bus Ticket Booking System

1) Strengths:

1) **Purpose and Relevance:**
   - The paper addresses a practical problem by developing a web-based system to simplify bus ticket reservations.
   - It highlights the relevance of the system in reducing the impact of traffic congestion and leveraging growing internet dependency.
2) **System Features:**
   - Includes key functionalities such as bus route navigation, seat selection, multiple payment methods, email notifications, and feedback mechanisms.
   - Provides admin-specific tools for managing bookings, payments, and user data.
3) **Methodology:**
   - Uses tools like MySQL, XAMP, and WordPress for implementation.
   - Illustrates system workflows through flowcharts, use-case, class, and sequence diagrams.
4) **Testing Procedures:**
   - Conducts application, admin panel, integration, and system testing, ensuring robustness.
5) **Future Recommendations:**
   - Proposes enhancements like multi-language support, voice commands, and comparison features for choosing the best offers.

2) Weaknesses:

1) **Literature Review:**
   - Limited coverage of contemporary and diverse studies on online ticketing systems and user-centric design.
2) **Technical Depth:**
   - Insufficient details about the system's architecture, database design, and algorithms.
3) **User Experience:**
   - No mention of usability testing or user feedback to evaluate the system's interface.
4) **Security Measures:**
   - Lack of emphasis on data security, especially regarding payment information.

3) Opportunities for Improvement:

1) Enhance the literature review by citing more studies on modern e-ticketing solutions and usability in web applications.
2) Add technical specifics about the implementation, such as database schemas, API details, and scalability measures.

3) Include a discussion on data security and encryption for sensitive information.
4) Conduct usability testing and incorporate user feedback to improve the interface.

4) Conclusion: . [1]

The project is a valuable contribution to simplifying bus ticket reservations, aligning with the trend of digital transformation in service industries. With improvements in technical and user-centric aspects, the system could become more robust and impactful.

B. Paper 2 : RFID-based automatic bus ticketing: features and trends

1) Strengths:

1) **Purpose and Relevance:**
   - The paper addresses a critical need for technological advancements in public transportation to improve convenience, reduce environmental impact, and assist visually impaired individuals.
   - It evaluates various ticketing technologies and highlights RFID as a promising solution.
2) **Comprehensive Overview:**
   - Provides a detailed review of existing ticketing systems, including GPS, GSM, smart cards, and ZigBee, alongside RFID-based systems.
   - Summarizes the findings of numerous studies to compare technologies in terms of cost, reliability, and user-friendliness.
3) **Innovative Solution:**
   - Proposes a dual-module system: an automated ticketing system and a handheld device for visually impaired users.
   - Integrates RFID, GPS, GSM, and ultrasonic sensors to enhance accessibility and navigation.
4) **Environmental Benefits:**
   - Highlights the environmental impact of traditional paper ticketing systems and the advantages of digital alternatives.

2) Weaknesses:

1) **Technical Depth:**
   - The proposed system's implementation lacks detailed technical specifications, such as database architecture or hardware integration methodologies.
2) **Usability Testing:**
   - The paper does not include experimental results or usability testing data to validate the effectiveness of the proposed solution.
3) **Scalability Challenges:**
   - The scalability of RFID systems for large-scale deployments in high-density urban areas is not thoroughly addressed.
4) **Comparison Limitations:**
   - While many technologies are discussed, the criteria for selecting RFID over others could be elaborated with quantitative analysis.

3) Opportunities for Improvement:

1) Include detailed technical blueprints and flowcharts for the proposed system.
2) Conduct usability testing and provide quantitative results to strengthen the solution's validation.
3) Address potential challenges in scaling RFID-based systems for urban environments.
4) Perform a cost-benefit analysis comparing RFID with alternative technologies to justify its selection.

4) Conclusion: The paper provides a valuable contribution to the development of automatic ticketing systems, particularly for the visually impaired. By integrating RFID with other technologies like GPS and GSM, the proposed solution offers a user-friendly and environmentally sustainable approach. However, detailed technical implementation and validation are necessary to fully realize its potential. . [2]

C. Paper 3 : Factors of Effectiveness on Implementation for Online Bus Ticketing System

1) Strengths:

1) **Timeliness and Relevance:**
   - The paper addresses the integration of Internet of Things (IoT) technologies into online bus ticketing systems, a critical innovation for improving public transportation efficiency.
   - Highlights global trends such as digital transformation and increased IoT adoption in transportation.
2) **Identification of Key Factors:**
   - Identifies three core factors influencing the effectiveness of IoT in ticketing systems: secure online booking, smart tracking, and accessible websites and mobile applications.
   - Provides a conceptual framework based on a comprehensive literature review.
3) **Real-World Case Study:**
   - Explores the RedBus system as a practical example of successful IoT integration in bus ticketing.
   - Highlights key features such as real-time bus tracking and secure payment systems.
4) **Environmental and Operational Benefits:**
   - Emphasizes the reduction of paper waste and improvement of operational efficiency through digital ticketing solutions.
   - Discusses the role of IoT in enhancing data security, user convenience, and real-time information access.

2) Weaknesses:

1) **Lack of Empirical Validation:**
   - The paper does not include field data or user feedback to validate the effectiveness of the identified factors.
2) **Technical Implementation Details:**
   - Limited discussion on the technical aspects of implementing IoT technologies, such as system architecture, device interoperability, and cybersecurity measures.

3) **Scalability and Cost Analysis:**
   - Does not address potential scalability challenges or provide a cost-benefit analysis for deploying IoT systems in large-scale transportation networks.
4) **User Experience Analysis:**
   - Minimal focus on usability testing or user-centric design principles for mobile and web applications.

3) Opportunities for Improvement:

1) Include empirical studies or pilot projects to evaluate the real-world impact of IoT integration on bus ticketing systems.
2) Provide detailed technical blueprints and guidelines for implementing IoT systems, focusing on security and interoperability.
3) Address scalability concerns and conduct a cost-benefit analysis for different deployment scenarios.
4) Incorporate user feedback and usability testing to enhance the design of web and mobile applications.

4) Conclusion: This paper provides a valuable overview of the potential of IoT technologies to revolutionize online bus ticketing systems. By identifying key factors such as secure online booking, smart tracking, and accessible platforms, it lays a foundation for future research and practical implementation. However, detailed empirical validation, technical guidelines, and user-centered approaches are essential to fully realize the benefits of IoT in this domain. . [3]

III. Proposed Methodology

The system has the following key components:

A. Audio-to-Text Conversion

The Whisper ASR model is a sequence-to-sequence Transformer-based architecture designed for robust automatic speech recognition across diverse languages and acoustic conditions. It processes audio inputs by extracting Mel-spectrogram features, which are encoded into latent representations through a Transformer encoder. The auto regressive decoder then generates textual tokens, including words, punctuation, and special markers, to produce transcriptions. Pretrained on large multilingual datasets with varying noise and accents. So we use this to our advantage and catch users voice and generate a text form of the query user wants to generate. Although the query is in simple english and not a proper sql query

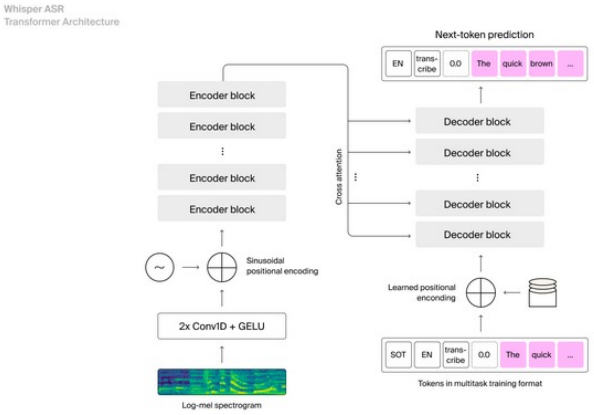

Fig. 1. Caption

B. Text to SQL Query Interpretation

The converted text is analyzed using the FLAN-T5 model, which is a fine-tuned version of the T5 (Text-to-Text Transfer Transformer) architecture, optimized for instruction-following tasks. It uses an encoder-decoder framework, where the encoder converts input text into contextual embeddings, and the decoder generates output sequences. By leveraging instruction-tuning with a curated dataset of prompts, FLAN-T5 achieves state of the art performance across tasks like summarization, translation, and reasoning, demonstrating its versatility and alignment with human intent. This is why we are using it to convert the text query to an sql query that can be understood by the sql database to generate the required output.

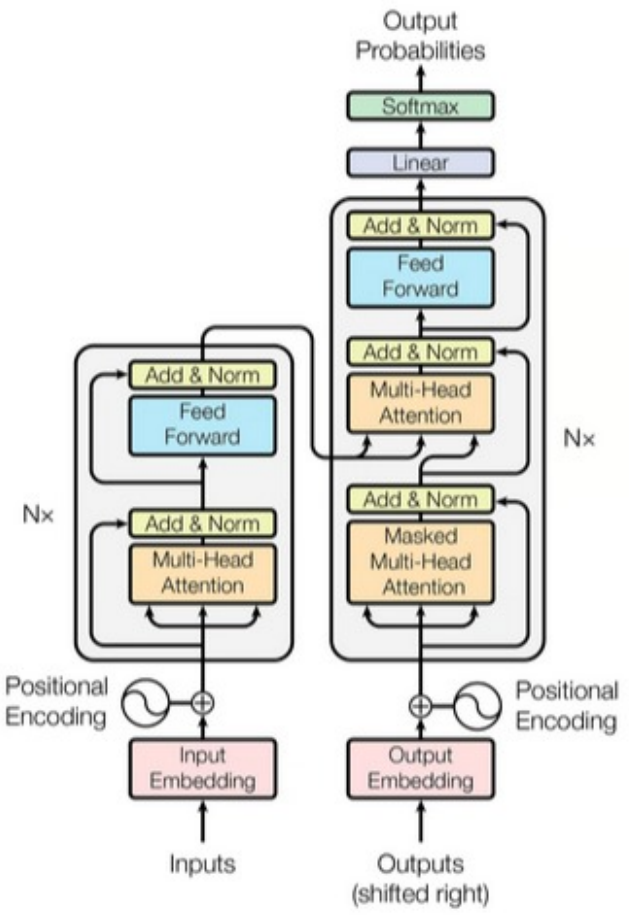

Fig. 2. Caption

C. Features

Users can specify their travel details (e.g., source, destination) through voice commands. The system:

- Displays available buses for the specified route.
- Allows users to select a bus and specify the number of seats to book.
- Supports multiple seat bookings in a single transaction.

This functionality is achieved through dynamic interaction between the AI models and the database.

IV. Experimental Setup and Results

For the Experimental Setup we used other models like whisper tiny and simple T5-Base as well in order to check if the models we used were out performing them or not. For this we simply used a jupyter notebook and wrote all out experimental code in it to test the model performance manually.

```
Elapsed time: 0.8124217987060547 seconds
Whisper tiny result  I want to take a bus from Islamabad to Muthan on one December.
Elapsed time: 4.171750068664551 seconds
Whisper medium result  I want to take a bus from Islamabad to Multan on 1 December.
```

Fig. 3. Comparisons of small Whisper Models

The Tests performed were not based on any other metric than simple test outs of seeing if the model is able to properly convert our voice recordings into the desired text.

V. Limitation and Future Work

Despite the models being light weight cannot be deployed in a standard device as is. That is the biggest limitation of our project as it heavily depends on the users available internet speed to proper make the app available to them.

VI. Conclusion

The voice-driven chatbot system demonstrates a significant advancement in public transportation services by making seat booking and cancellation more accessible and efficient. The integration of [Audio Model] and FLAN-T5 model ensures accurate processing of user inputs, setting a new standard for AI-based solutions in the transportation sector. Future work may involve enhancing the system's scalability and integrating multilingual support to cater to a broader audience.

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