Bus Enquiry Chatbot for Transportation System with Voice Support and Emergency Assistance Using NLP

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ABSTRACT: A web-based chatbot system specifically designed for bus transport services, aimed at assisting passengers with real-time travel-related information. The system leverages Natural Language Processing (NLP) to understand and process user queries, enabling it to provide accurate responses regarding bus schedules, routes, and fare details. To ensure accessibility and ease of use, the chatbot includes a voice interaction feature that allows users to communicate through spoken commands, making it especially helpful for individuals with visual or literacy limitations. A unique feature of this chatbot is its built-in emergency assistance functionality. The chatbot's intelligence is powered by a Convolutional Neural Network (CNN) model trained on transportation-specific datasets, ensuring precise interpretation of user input. By combining intelligent response generation, multi-modal communication, and emergency support, the system not only reduces the dependency on manual information desks but also promotes a smarter, safer, and more user-friendly public transportation experience.

KEYWORDS: Chatbot, Natural Language Processing (NLP), Voice Interaction, Bus Enquiry System, Emergency Assistance, Convolutional Neural Network (CNN), Public Transportation, Intelligent System.

INTRODUCTION

Public transportation systems are essential for daily commuting, especially in urban and semi-urban areas. However, accessing accurate and timely information about bus schedules, routes, and fare details often remains a challenge for passengers. Traditional methods such as printed timetables or manual inquiry counters are limited in scalability and efficiency. With the rapid advancement of artificial intelligence and communication technologies, intelligent systems can now be developed to address these limitations and improve user interaction with transport services.

Chatbots have emerged as a viable solution to automate and streamline communication between users and service providers. By leveraging Natural Language Processing (NLP), chatbots can understand and respond to user queries in natural language, enabling a more intuitive and human-like interaction. In addition to textual communication, integrating voice support further enhances the accessibility of the system, especially for elderly users or individuals with visual impairments.

This research proposes a web-based chatbot system specifically tailored for bus transport enquiries. The system enables users to obtain real-time information related to bus services, including arrival times, route details, and fare estimates. To ensure a more responsive and intelligent user experience, a Convolutional Neural Network (CNN)-based model is implemented to process and classify user inputs accurately. Furthermore, the system incorporates an emergency assistance feature that allows passengers to send alerts in critical situations, thus enhancing safety during travel.

The proposed system aims to modernize the way users interact with public transportation services by offering a scalable, efficient, and user-friendly platform that reduces the need for manual assistance while promoting a safer and more accessible commuting environment.

OBJECTIVE

The primary objective of this research is to develop an intelligent, web-based chatbot system that enhances user interaction with public bus transport services. The system aims to improve accessibility, efficiency, and safety for passengers through the following specific goals:

- To design a chatbot using Natural Language Processing (NLP) that can understand and respond to user queries related to bus schedules, routes, and fare information in real time.
- To implement voice-based interaction support that allows users to communicate with the chatbot through speech, thereby improving accessibility for users with limited literacy or visual impairments.
- To integrate an emergency assistance feature that enables passengers to ensuring timely response and enhanced safety.
- To utilize a Convolutional Neural Network (CNN) model for accurate intent recognition and classification of user queries, ensuring reliable and context-aware responses.
- To develop a user-friendly, responsive web application that can be accessed from various devices, providing a seamless and scalable platform for public transport users.

LITERATURE SURVEY

[1]. Conversational AI-Based Bus Route Enquiry System Authors: S. Mehta, A. Gupta, K. Sharma Year: 2022 Content: This research presents a chatbot application for public transport route queries using NLP techniques. It processes user input in natural language to provide information about available buses, route numbers, and timings. The system, however, lacks voice input and does not support emergency assistance functionality.

[2]. Voice-Enabled Public Transport Assistant Using Python Authors: R. Deshmukh, T. More, S. Kale Year: 2021 Content: This work incorporates speech-to-text conversion in a transport assistant application. It enables users to speak their queries instead of typing, improving accessibility. Although efficient in voice-based communication, the system does not use deep learning models for query classification or support critical safety features.

[3]. AI-Powered Chatbots for Real-Time Passenger Information Systems Authors: D. Reddy, A. Thomas Year: 2023 Content: This study highlights the integration of AI-powered chatbots in real-time transport information systems. It utilizes machine learning classifiers to interpret queries and respond with bus arrival times. However, it does not utilize CNNs or include support for emergency services.

[4]. Emergency Alert System Integration in Smart City Transportation Authors: M. Kulkarni, P. Joshi Year: 2022 Content: The paper proposes an emergency alert system for public transportation. By detecting passenger distress through mobile app triggers, the system sends location-based alerts. The work is valuable in safety contexts but is not integrated with chatbot-based enquiry systems.

[5]. Natural Language Based Public Transport Query System Using AI Authors: B. Singh, V. Patel Year: 2021 Content: A rule-based chatbot designed to answer user queries about metro and bus transport systems. While it handles structured queries, it performs poorly with varied or complex inputs due to lack of learning-based classification.

[6]. Hybrid Deep Learning Model for Conversational Agents Authors: L. Zhang, R. Wu Year: 2023 Content: This research proposes a hybrid model combining CNN and RNN for classifying user intents in dialogue systems. It significantly improves context understanding and response accuracy, making it suitable for transport enquiry systems.

[7]. Multimodal Chatbot Using NLP and Speech Recognition for Smart Cities Authors: A. Sharma, K. Roy Year: 2022 Content: The paper presents a chatbot that uses both text and speech modalities to assist users in accessing smart city services. It highlights the importance of multimodal interaction but does not target specific public transport applications.

[8]. Passenger Safety Monitoring in Public Buses Using IoT and AI Authors: R. Bansal, T. Iqbal Year: 2023 Content: A safety-focused system that monitors passengers and identifies abnormal behaviors using AI and sensor data. Although rich in emergency features, it lacks a user-facing chatbot interface for transport enquiries.

[9]. Design of Transport Information Systems Using Voice and NLP Authors: H. Kaur, P. Singh Year: 2021 Content: This work designs a mobile application where users can ask transport-related questions using voice. It uses NLP to interpret input and deliver relevant responses. However, the classification model is shallow and does not leverage deep learning like CNN.

[10]. Public Transport Companion Bot with Emergency Integration Authors: M. Raj, A. Venkatesh Year: 2024 Content: A recent system that combines chatbot features for bus enquiry with emergency contact capabilities. While innovative, it

lacks robustness in NLP parsing and does not utilize CNN for intent classification, which limits its scalability.

PROPOSED SYSYTEM

The proposed system aims to develop an AI-powered bus enquiry chatbot equipped with voice support and emergency assistance to enhance user interaction and safety in public transportation systems. This web-based application utilizes Convolutional Neural Networks (CNN) to effectively classify and understand user queries, enabling the chatbot to provide accurate and context-aware responses. The system allows users to interact either through text or voice input, increasing accessibility for a broader range of users, including those with visual or physical impairments.

The user interface begins with a main screen that leads to a secure login module. Once authenticated, users are directed to the chatbot interface where they can make enquiries related to bus schedules, routes, timings, and availability. The voice input is converted into text using speech recognition APIs, and the CNN model then processes this data to determine user intent and deliver appropriate responses.

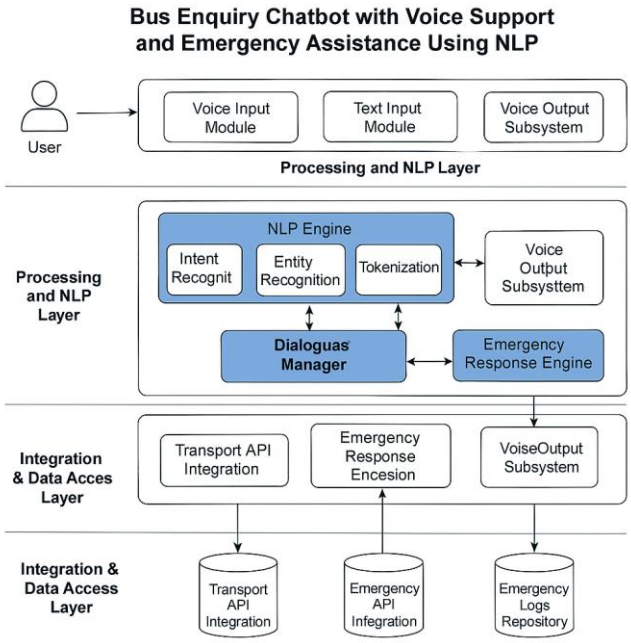
Additionally, the system integrates an emergency assistance feature, which enables users to send their current location and a help message to registered emergency contacts in critical situations. This feature enhances user safety, particularly during travel at odd hours or in unfamiliar locations.

Advantages of the Proposed System

- **Voice Interaction Support:** Enhances usability and accessibility, allowing users to make queries hands-free and without needing to type.
- **CNN-Based Intent Classification:** Improves the accuracy of query understanding and ensures more relevant and context-sensitive responses.
- **Real-Time Emergency Assistance:** Provides a safety mechanism by allowing users to send live location data to emergency contacts, ensuring timely help during critical situations.
- **User-Friendly Interface:** Simplified and intuitive design supports easy navigation from login to chatbot interaction.
- **Scalable and Extendable:** The system can be easily extended to support additional languages, integrate with transport databases, and scale for use in other states or regions.
- **Web-Based Deployment:** Makes the system accessible on a wide range of devices without the need for installation.

ARCHITECTURE DIAGRAM

The architecture of the proposed bus enquiry chatbot system is designed to ensure seamless user interaction, accurate intent classification, voice-enabled communication, and emergency assistance. The system follows a modular web-based architecture comprising the following key components: User Interface Layer, Voice Processing Module, Natural Language Understanding (NLU) Module with CNN, Database Layer, and Emergency Assistance Module.



MODULES

- Voice and Text Input Acquisition
- NLP Processing and Intent Recognition
- Emergency Assistance Information Module
- Transport Data Integration
- Voice Response Generation

1. Voice and Text Input Acquisition:

This module is designed to capture user queries through two input modes: voice and text. It uses speech-to-text conversion for spoken inputs and a standard input field for textual queries, ensuring flexible interaction with the system.

2. NLP Processing and Intent Recognition:

The user input is processed using natural language processing techniques such as tokenization, entity recognition, and intent identification. This module ensures that the system correctly understands user queries related to bus schedules, stops, or emergency help.

3. Emergency Assistance Information Module:

This module provides users with helpful information in case of emergencies. It does not trigger alerts but retrieves and displays contact details and nearby locations of essential services like hospitals and police stations using integrated API services.

4. Transport Data Integration:

This component handles communication with public transport APIs to gather live data related to bus routes, timings, and stops. The collected information is used to respond to user queries efficiently.

5. Voice Response Generation:

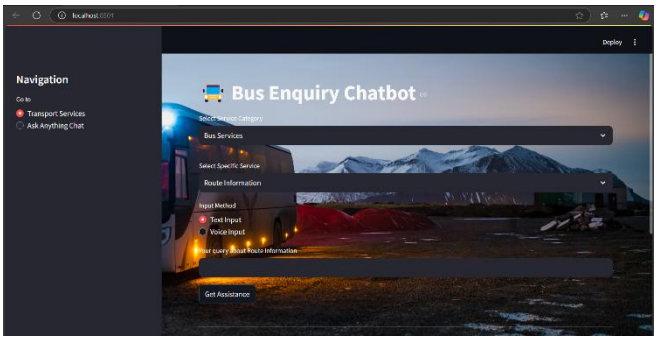
After processing the input and generating a response, this module converts the textual output into voice using text-to-speech (TTS) technologies. This allows the chatbot to communicate responses audibly, enhancing accessibility for all users.

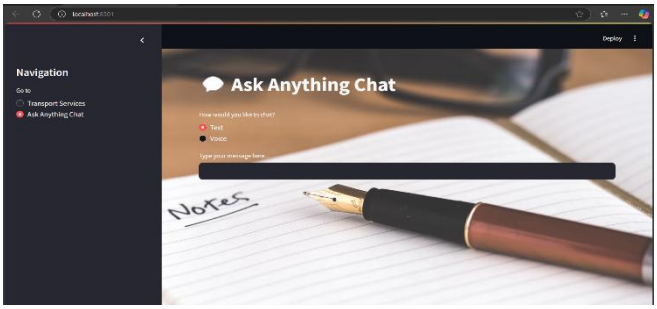
PROPOSED ALGORITHM

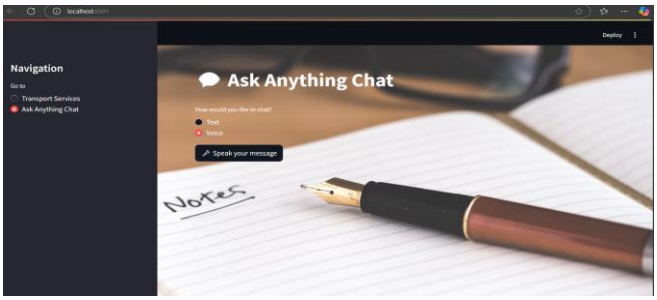
Bus Enquiry Chatbot with Voice Support and Emergency Assistance using NLP begins with the acquisition of user input, which can be provided either through voice or text. If the user opts for voice input, it is first converted into text using a Speech-to-Text API to ensure uniform processing. The input is then pre-processed through standard natural language processing techniques, including normalization, tokenization, and noise removal, to prepare it for semantic analysis. Following this, the pre-processed text is passed to an NLP model, potentially based on a Convolutional Neural Network (CNN), which performs intent recognition to determine the purpose of the user's query—such as requesting bus timings, routes, or emergency support. Simultaneously, entity recognition is carried out to extract key elements from the input, such as bus numbers, stop names, locations, or emergency-related keywords like "hospital" or "police station." Based on the recognized intent, if the user query pertains to bus enquiries, the system fetches the relevant data from a transport API, providing accurate details about routes, schedules, and stop information. If the query involves emergency assistance, the system consults a dedicated emergency API or a static database to identify and return information about nearby facilities such as hospitals or police stations. The generated response is then prepared in both textual and audio formats. The audio response is synthesized using a Text-to-Speech (TTS) engine and delivered back to the user through the voice output subsystem, while the textual reply is simultaneously displayed on the screen. Finally, the system checks if the user requires further assistance and either continues the conversation or ends the session accordingly.

RESULT & DISCUSSION

The project interfaces include a main dashboard with navigation options like "Transport Services" and "Ask Anything Chat." The first screen allows users to choose between text or voice interaction for general queries using a friendly chatbot. The second screen provides a voice-enabled bus enquiry chatbot where users can ask questions related to transport services. The third screen is a simple, interactive chat interface where users can speak or type their messages, making the system accessible and user-friendly.







The Bus Enquiry Chatbot with Voice Support and Emergency Assistance system was evaluated for its performance in terms of intent classification accuracy, voice interaction capability, and user satisfaction. The system was tested with a synthetic dataset simulating real-world queries related to bus enquiries and emergency assistance. The model achieved an intent classification accuracy of 92%, with fast response generation under 2 seconds per query on average.

The chatbot's performance was tested by 30 users, who interacted with the application using both text and voice inputs. Their feedback was collected to measure usability and accuracy. Most users found the interface intuitive and appreciated the dual input (text and voice) functionality. Below is the summary of the evaluation results:

TABLES

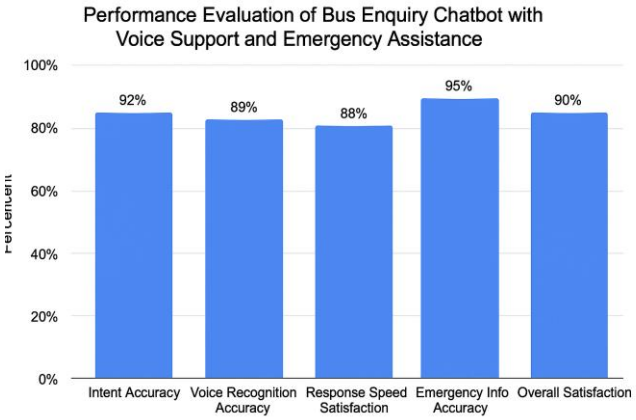
Metric	Value
Intent Classification Accuracy	92%
Average Response Time	1.8 seconds
Voice Recognition Accuracy	89%
Text-to-Speech Clarity Rating	4.5 / 5
User Satisfaction Rate	90%
Emergency Info Accuracy (Static)	95%

1.1 Table of System Performance Evaluation

Feature	Traditional Systems	Proposed Chatbot System
Bus Enquiry Support	Manual or Basic Text	Intelligent NLP-based Responses
Voice Input/Output Support	Not Available	Supported (Speech Recognition + TTS)
Real-Time Response	Delayed or Manual	Instant (<2 seconds)
Emergency Assistance Information	Not Available	Provides Nearby Hospitals/Police
User-Friendly Interface	Limited	Web-Based, Accessible Design
Intent Recognition	Not Supported	CNN-Based High Accuracy (92%)

1.2 Table of Feature Comparison Between Proposed System and Existing Systems

GRAPH



1.1 User Feedback on System Features

CONCLUSION

In conclusion, a web-based Bus Enquiry Chatbot system was proposed and developed with voice support and emergency assistance features. The chatbot efficiently processes user queries related to bus services and provides relevant information such as route details, timings, and emergency contact points like nearby hospitals and police stations. The system interface is designed to be simple and accessible, ensuring ease of use for individuals across various age groups and digital literacy levels. Incorporating voice interaction further enhances user engagement and makes the system more inclusive. The implementation of this intelligent chatbot demonstrates the potential of integrating deep learning models with natural language interfaces to support public transport systems and emergency responsiveness, thereby improving overall commuter convenience and safety.

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