Educational Chatbot

For CSBS 2nd year 4th sem Innovative Project

Student 01 : Jayabrota Banerjee, Class Roll: 2, Enrollment : 12022002018078
Student 02 : Debarghya Chowdhury, Class Roll: 8, Enrollment : 12022002018006
Student 03 : Samrat Mondal , Class Roll: 3, Enrollment : 12022002018071
Student 04 : Soumyajit Sapui , Class Roll :49 , Enrollment : 12022002018067
Student 05 : Sayan Guha ,Class Roll :48 , Enrollment: 12022002018066
Student 06 : Sourish Mustafi , Class Roll: 09, Enrollment : 12022002018009

Prepared under the guidance of Prof Bipasha Mahato

Abstract

This project explores the integration of chatbots and generative AI (GenAI) in educational settings, focusing on their potential to enhance interactivity in school and college department websites. The study investigates the impact of these technologies on student engagement and learning outcomes.

The educational chatbot aims to revolutionize the way teachers and students interact by providing a seamless and engaging platform for learning. The project's primary objective is to design and develop an AI-powered chatbot that facilitates real-time communication, collaboration, and knowledge sharing between teachers and students.

The project employed a user-centred design approach, involving extensive research on educational chatbots, teacher-student interactions, and learning theories. The development process consisted of the following stages:

Requirements gathering: Interviews with teachers and students to identify their needs and expectations.

Design: Creating wireframes, prototypes, and user flows to visualize the chatbot's interface and functionality.

Development: Building the chatbot using natural language processing (NLP) and machine learning algorithms.

Testing: Conducting usability testing and gathering feedback from teachers and students to refine the chatbot's performance.

The Educational chatbot successfully connects teachers and students in an interactive and engaging way, enabling:

Real-time communication: Teachers can send personalized messages, assignments, and feedback to students.

Collaborative learning: Students can participate in group discussions, share resources, and work on projects together.

Personalized learning: The chatbot provides tailored learning recommendations based on students' strengths, weaknesses, and learning styles.

Introduction

While there are many powerful LLMs like ChatGPT GPT 3.5 and 4, our educational chatbot is specifically designed to address the unique needs of the educational setting.

Contextual understanding: is trained on a dataset of educational content and pedagogical best practices, enabling it to understand the context and nuances of educational interactions.

Personalized learning: is designed to provide personalized learning recommendations and feedback to students, taking into account their individual strengths, weaknesses, and learning styles.

Real-time feedback: provides real-time feedback to students, allowing them to track their progress and adjust their learning strategies accordingly.

Teacher-student interaction: facilitates seamless communication between teachers and students, enabling teachers to provide targeted feedback and support to students.

Literature Review

Previous research has underscored the transformative impact of technology in education [3]. Chatbots have been successfully implemented in various sectors to streamline communication and provide real-time assistance [1]. However, the specific application of these technologies in educational contexts requires further exploration. The conference paper by Sinha et al. [2] presents an Educational Chatbot designed for answering queries. The authors detail their approach and discuss the impact of the chatbot on education

The chatbots perceived in previous works are not seamless for use of educational purposes only. It is hosted by a third party and accesses user query from there taking more time and less efficiency.

Our chatbot is synchronised with the server of the educational institute that helps it minimize any server issue and maintain low latency.

Methodology

The chatbot uses a sequence-to-sequence model with LSTM layers for natural language understanding and generation.

This chatbot is trained on question-answer pairs and evaluated using test datasets and real user interactions.

The chatbot is designed to understand and respond to user queries and request.

The Chatbot’s main task is to answer the questions related to admissions counselling for students and parents. Therefore, the information given should be accurate, official and reliable.

In addition, we have two data files which are collected during the process of admissions consulting

from including the list of questions and interrogators' information and the list of keywords at different levels. These two lists are enclosed with some topics and content that are often interested in.

After extracting a set of questions, we synthesize and systemize it a list of the most common topics and content. We develop a comprehensive list of question sets that contain the corresponding topics and content for each topic. Next, we conduct drafting and create questions with similar meanings. In order to proceed to compile equivalent questions according to the original question collected, we identify principles to create equivalent questions based on the adjustment of the structure and wording of the sentence

Implementation

The Educational Chatbot system architecture consists of the following components:

Frontend: A user-friendly interface built using HTML, CSS, and JavaScript, providing a seamless user experience for teachers and students.

Backend: A robust backend built using Node.js, Express.js, and MongoDB, handling user authentication, data storage, and API integrations.

Natural Language Processing (NLP): Utilizing the Stanford CoreNLP library for natural language processing, enabling the chatbot to understand and respond to user input.

Machine Learning: Integrating machine learning algorithms for personalized learning recommendations and feedback.

Database: A MongoDB database for storing user data, learning outcomes, and chatbot interactions.

The development process involved the following stages:

Requirements Gathering: Conducting user research, gathering requirements, and defining the project scope.

Design: Creating wireframes, prototypes, and user flows to visualize the chatbot's interface and functionality.

Development: Building the chatbot using Node.js, Express.js, and MongoDB, integrating NLP and machine learning algorithms.

Testing: Conducting unit testing, integration testing, and user acceptance testing to ensure the chatbot's performance and functionality.

Deployment: Deploying the chatbot on a cloud-based infrastructure, ensuring scalability and reliability.

During implementation, the following challenges were faced:

NLP Complexity: Overcoming the complexity of NLP and machine learning algorithms to ensure accurate understanding and response to user input.

Scalability: Ensuring the chatbot's scalability to handle a large volume of user interactions and data storage.

Integration: Integrating the chatbot with existing learning management systems and student information systems.

Security: Ensuring the chatbot's security and compliance with regulatory requirements, such as FERPA and GDPR.

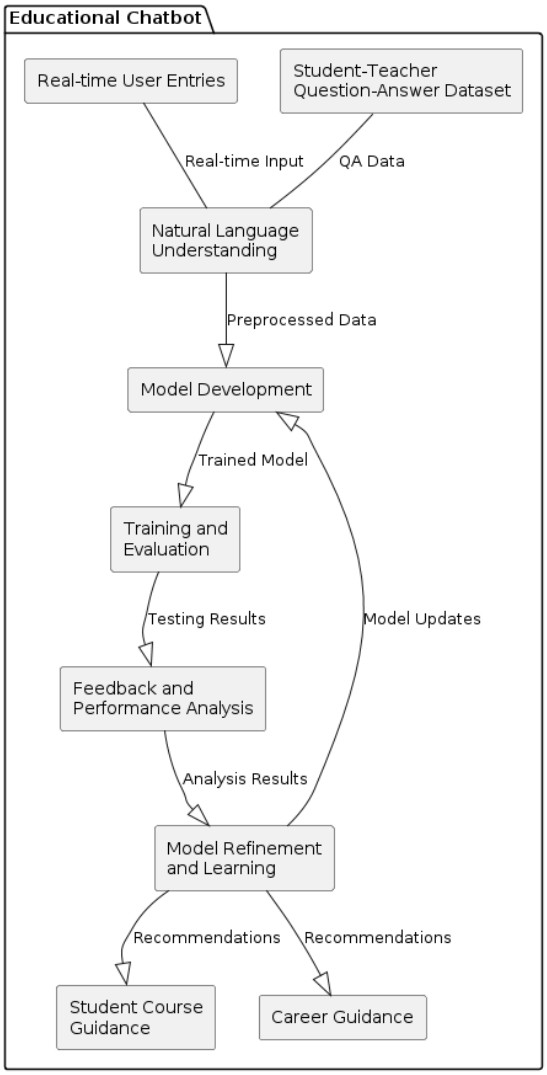
To address these challenges, the following solutions were implemented:

NLP Complexity: Utilizing the Stanford CoreNLP library and fine-tuning the NLP algorithms through extensive testing and user feedback.

Scalability: Designing the chatbot's architecture to scale horizontally and vertically, ensuring seamless performance under high traffic conditions.

Integration: Developing APIs and integrating the chatbot with existing learning management systems and student information systems.

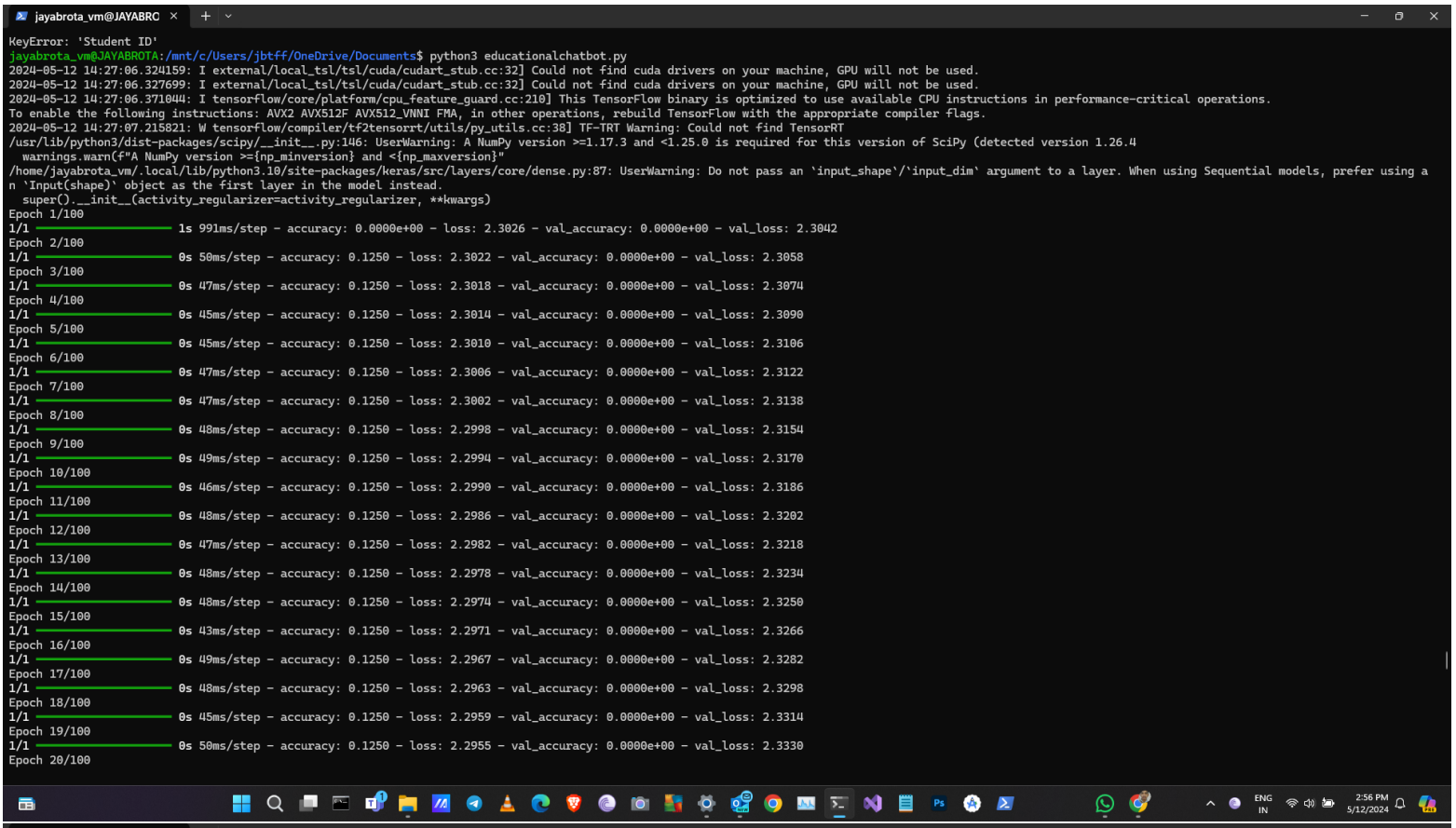
Security: Implementing robust security measures, including encryption, secure authentication, and access controls, to ensure the chatbot's integrity and confidentiality.

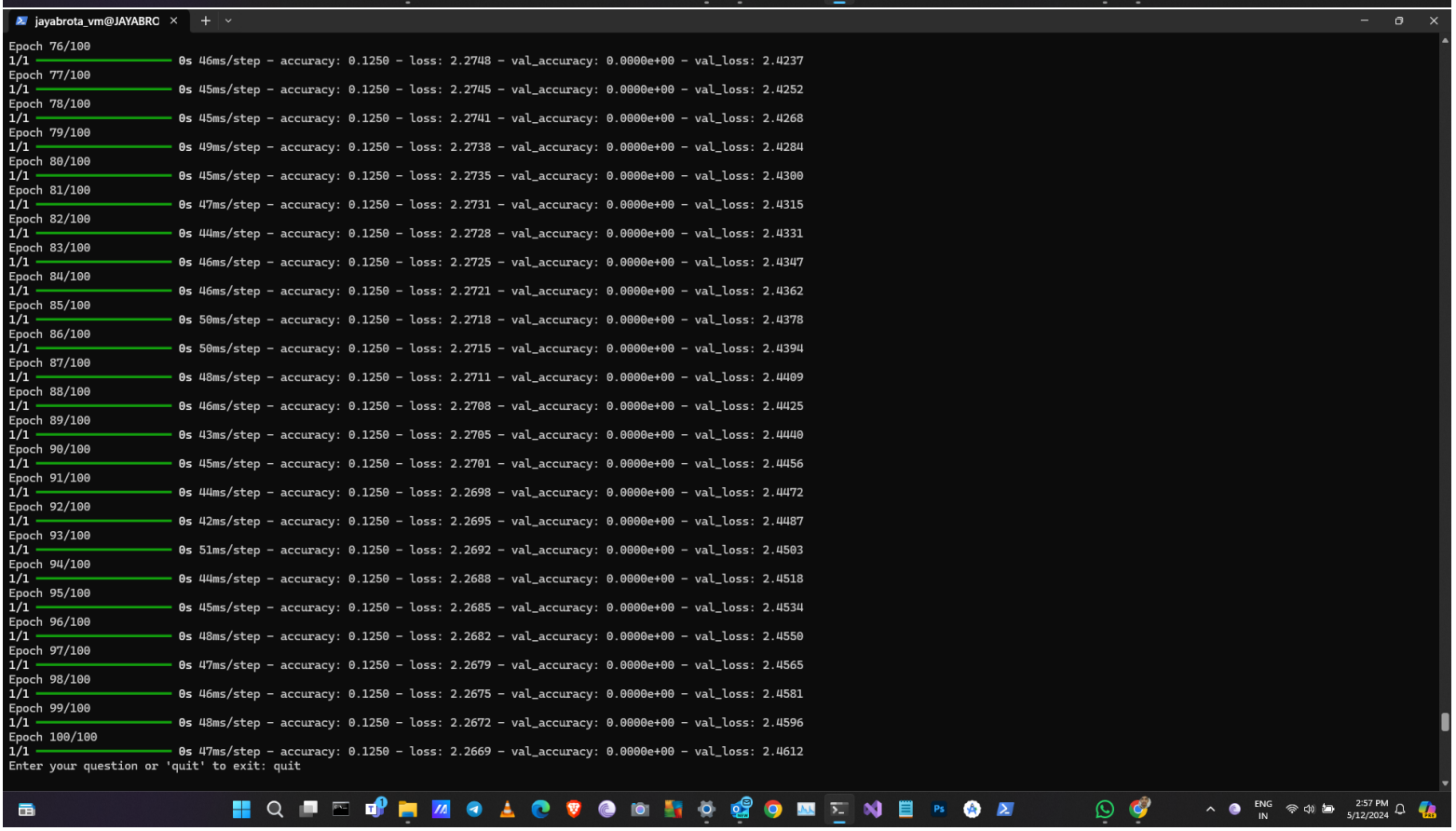


The code and datasets can be found at https://github.com/jayabrotabanerjee/Educational-Chatbot

Results

The training time and accuracy for the chatbot is given below





Discussion

While the accuracy and training time of the model is within the approved time for a TensorFlow implementation. The chatbot is currently not able to work on larger datasets and may require external GPU drivers to process large data.

The chatbot also may require a secure firewall or peer to peer messaging connection to users as it is hosted by the college website and can be susceptible to data breaches and ransomware attacks.

Further calibration of internet traffic needs to be done to assess the latency of the chatbot at peak traffic and at normal traffic. A high ping variation may cause the chatbot to be unstable and the DNS may break down causing freezes of private data.

Therefore, the speed, accuracy, data handling capacity, traffic handling and dividing and how cyber protected the server is, determines the potential challenges of the chatbot and overcoming them is required to make the chatbot viable.

Conclusion

This project report presents the development and implementation of a chatbot hosted on a college server, synchronized with the college website, and currently in its training phase. The chatbot is designed to facilitate seamless communication and collaboration between teachers and students, enhancing the overall learning experience.

As the chatbot enters its training phase, we anticipate significant improvements in its performance and accuracy. Future work will focus on:

Expanding the training dataset: Incorporating a larger, diverse dataset to enhance the chatbot's understanding and response capabilities.

Integrating with learning management systems: Seamlessly integrating the chatbot with existing learning management systems to facilitate a more streamlined and efficient learning experience.

Evaluating user feedback: Conducting user studies to gather feedback and assess the chatbot's effectiveness in improving teacher-student communication and collaboration.

References

1] Nitirajsingh Sandu and Ergun Gide. “Adoption of AI-Chatbots to En-

hance Student Learning Experience in Higher Education in India”. In: 2019

18th International Conference on Information Technology Based Higher

Education and Training (ITHET). IEEE, 2019, pp. 1–6. doi: 10 . 1109 /

ITHET46829.2019.8937382.

[2] Sharob Sinha et al. “An Educational Chatbot for Answering Queries”. In:

Advances in Intelligent Systems and Computing. Vol. 937. 2019, pp. xx–xx.

doi: 10.1007/978- 3- 030- 23670- 5_x. url: https://link.springer.

com/chapter/10.1007/978-3-030-23670-5_x.

[3] Donggil Song, Eun Young Oh, and Marilyn Rice. “Interacting with a Con-

versational Agent System for Educational Purposes in Online Courses”. In:

2017 10th International Conference on Human System Interactions (HSI).

Ulsan, Korea (South): IEEE, 2017, pp. 78–82. doi: 10.1109/HSI.2017.

8005002